HOUSEHOLDS

GOOD PRACTICE NOTE 3

Analyzing the Incidence of Consumer Price Subsidies and the Impact of Reform on Households — Quantitative Analysis

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ESMAP

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ACRONYMS AND ABBREVIATIONS

CNG	compressed natural gas
CPI	Consumer Price Index
DH	Moroccan dirham
ECA	Eastern Europe and Central Asia
EST	energy subsidy reform
GDP	gross domestic product
HUS	Housing and Utilities Subsidies
kg	kilogram
kWh	kilowatt-hour
LPG	liquefied petroleum gas
m3	cubic meter
MW	megawatt
OECD	Organisation for Economic Co-operation and Development
tcm	thousand cubic meters
VAT	value added tax
VDT	volume-differentiated tariff

1. INTRODUCTION

This note aims to provide guidance on how to assess the distributional implications of energy subsidy reform (ESR) using quantitative methods.[1] It is intended for use by those familiar with the basics of welfare measurement, ideally part of a multi-disciplinary team. Ideally this assessment would therefore be complemented by insights from qualitative analysis (see Good Practice Note 4) and by an analysis of the effectiveness of feasible compensatory measures (see Good Practice Note 5).

The note focuses on how to assess the distributional implications of household level impacts of ESR (as opposed to firm level, discussed in Good Practice Note 6). Its scope is confined to cases where ESRs lead to higher prices paid by energy consumers. As Good Practice Note 1 outlines, ESRs do not necessarily lead to higher prices, and could even decrease prices actually paid, such as when producer subsidies in the form of price support paid for by consumers are eliminated, or when consumer price subsidies lead to illegal diversion and out-smuggling, acute fuel shortages, and prices that are even higher than official prices on the black markets. The latter is particularly important, because a lack of data often forces the distributional analysis of ESRs to take observed expenditures on subsidized energy and scale them in proportion to the calculated price gaps—the gap between the unsubsidized price and the official price—to estimate the incidence of subsidies, whereas in practice consumers may be paying much higher prices than the official prices. Further, this note is not confined only to ESRs in that the distributional effects of higher prices of fuels used as feedstocks—such as natural gas used in fertilizer manufacturer—are also captured.

In the above context, this note considers only the impact of price increases. Other impacts, such as on service quality, access, or accountability, are therefore not explicitly considered.[2] In addition, while this note tries to present a general approach, practical pointers are provided that are relevant for the analysis of different types of energy, the prices of which are rising, and which are used either directly or in the production of goods and services widely in the economy. Overall, therefore, the note discusses the analysis of liquid fuels, gas, electricity and district heating (a source of heating used primarily in Eastern Europe). The word *prices* applies to all forms of energy, while *tariffs* applies to schedules of regulated prices that are applicable to regulated electricity, gas, or district heating.

The central issue that motivates this note is that while energy subsidies are generally inefficient as a measure to redistribute income to the poor (whatever the rhetoric on their implementation),[3] their removal is likely to affect lower-income households negatively. The hardship that rising energy prices may impose on lower-income households in most cases would appear to have a relatively limited effect on the incidence of poverty.[4] The impacts on the depth and severity of poverty, however, might be much pronounced. And given the difficulties poor people already face in meeting their basic needs, cutting further into their budgets can have serious negative consequences. If not compensated for, higher energy prices affect livelihoods, particularly of the poor, through their impact on general inflation, and through direct effects on households and businesses, especially energy-intensive industries.[5]

For households—the focus of this paper—two main channels of impacts can be identified, relating respectively to consumption patterns and income streams. Both consumption and income can be affected directly by higher prices for energy, or indirectly through other price changes triggered by the changes in energy prices (most notably through higher transport costs caused by rises in gasoline and diesel prices). These indirect effects, though harder to quantify than direct effects, can be significant for petroleum products. For example, Coady, Flamini, and Sears (2015) estimate that indirect effects would account for about 55% of the potential impact of the rise in fuel prices, with significant differences by region depending on the energy intensity of household consumption.[6] Other indirect effects which go beyond the focus of this paper but have important implication for the recommendations one can make in terms of compensation strategies, include increased exposure to fuel price volatility and the health and environmental impacts linked to a shift back to biomass.[7]

Table 1 summarizes the relative vulnerability of different groups of people to the various effects of removing energy subsidies. The table is no more than illustrative, as it makes some important simplifying assumptions. In each country, actual impacts will depend on consumption patterns, the extent to which consumers can adjust their consumption when prices change,[8] and the distribution and type of income-generating activities, particularly those in which the poor tend to engage.[9][10] There can be significant differences between rural and urban areas, especially in low-income countries, as rural areas are not only typically poorer, but also less likely to be connected to grid electricity. Table 1 also assumes that consumers pay official unsubsidized prices before the subsidy removal. In fact, it is not uncommon for consumer price subsidies for liquid fuels to result in acute fuel shortages and for households to pay higher prices on the black markets.[11]

TABLE 1: Direct and Indirect Effects on Households of Increases in the Price of a Previously Subsidized Energy Source

Direct effects	Indirect effects
Direct effects impact users of the previously subsidized energy source, which costs more following reform.	**Indirect effects touch all households in the economy through (a) increases in costs of goods and services that depend on the energy source for which the price rises, and (b) increases in the costs of other energy sources through substitution and generalized inflation.**
Consumption All households with access to the energy source will be affected. Impacts will vary depending on the share of household resources spent on the energy source and the price elasticity of demand (which in turn depends partly on the potential for substitution, other price elasticities, the degree of nonessential consumption, and so on). *In the case of liquid fuels:* • Rural households, in particular the rural poor, would be affected by kerosene price increases, as kerosene is often used for lighting and cooking. • Urban households that have cars would be affected by higher gasoline and diesel prices. This effect may be especially relevant for poor families in higher-income countries, especially those with weak public transportation systems. *In the case of networked utilities (electricity, gas, district heating):* • In better-off countries, consumption of energy by the poor tends to be inelastic with respect to price. • The urban poor typically pay for fuels and are also more likely to be connected to electricity than their rural counterparts, making them more vulnerable. • Natural gas is generally not available in rural areas. In low- and lower-middle-income countries, rural households are also less likely to be connected to electricity, or to consume LPG as the primary fuel for cooking and heating.	**Consumption** Strong indirect effects are to be expected for higher prices of *transport fuels*, particularly diesel (used by trucks). Effects will vary depending on the consumption baskets of poor households, on the price elasticity of demand for different goods, and on the distance between production and consumption centers. In principle, one would expect the urban poor, who are most dependent for their basic needs on goods transported from somewhere else and on public transportation for personal transport to be most vulnerable to these effects, but this cannot be ascertained *a priori*. There is evidence, for example, that oil prices significantly affect food prices (maize) in subnational markets. Indirect effects are likely to be minor for LPG, which is subsidized largely for use by households (although illegal diversion to commercial establishments is common), and for kerosene (jet fuel, which is its main use, is typically not subsidized, while about two-thirds of the rest is estimated to be used by households).

Direct effects	Indirect effects
Income	**Income**
All households that use the energy source for income-generating activities will be affected. For those engaged in commercial activities, the extent of the impact depends critically on how much of the additional input cost they can pass through to final consumers.	All households involved in productive activities are likely to be affected by increases in input costs stemming from rising energy prices (such as higher costs to transport inputs, higher costs of energy-intensive inputs).
Groups that have been found to be particularly vulnerable include fisherfolk (who depend on diesel fuel), farmers (who use diesel or electric pumps for irrigation), and small and medium enterprises.	In some sectors, indirect effects can be particularly strong. For example, agricultural households are likely to be more affected by rising fertilizer costs linked to the increase of specific feedstocks, such as natural gas. Poorer farmers who are less likely to adopt modern technology may still be affected by substitution effects between energy sources. For example, owing to higher prices of fossil fuels, the biomass that is used for fertilizer in traditional agriculture and as an energy source may become scarcer and more expensive.
	Other
	Higher fuel prices can result in broader impacts on the livelihoods of poor people and their communities.
	Examples include the health, environmental, and social impacts of greater reliance on traditional biomass (often with a strong gender dimension in the burden of collecting it), including exposure to significantly high levels of unhealthy pollutants.

Source: Adapted from Ruggeri Laderchi (2015).

Broadly speaking one can distinguish three types of analyses: (a) general equilibrium analyses, incorporating both the direct and the indirect welfare effects of the reforms; (b) limited general equilibrium, incorporating only a subset of the indirect effects; and (c) partial equilibrium approaches focusing only on the direct effect of reforms on prices and household real incomes. The latter two are commonly considered as the short-run impact of reforms prior to household and producer responses. They are also considered an upper bound on longer-term adverse impacts, since household responses (for example, switching consumption away from goods that underwent a price increase or toward subsidized goods) tend to decrease adverse welfare impacts and increase beneficial welfare impacts, although they require time to materialize. This would typically be through some efficiency measure cutting demand (for example, in the case of heating insulation, higher efficiency stove or heaters) or switching to alternative energy sources (for example, investing in different fuel type heating equipment, or switching to public transport to minimize expenses on fuel for transportation).

Given this general context, this note is structured as follows: Section 2 provides an overview of the different issues that a quantitative assessment of the distributional impacts of price and tariff increases would seek to address. Sample TORs for conducting a partial equilibrium assessment of distributional impacts are included in Annex A. Section 3 provides a quick summary of the main methodologies for estimating the welfare impacts of price increases. Section 4 provides an overview of practical issues related to

performing this type of analysis, focusing in particular on data issues. Suggestions for questions to be included in a household survey (where such possibility might arise) are included in Annex B. Section 5 concludes.

2. THE PROCESS OF CONDUCTING DISTRIBUTIONAL ANALYSIS

Before looking at the technical aspects of the distributional analysis of the impacts of ESR, it is worth pointing out that while a number of solid technical tools have been developed, expert judgment relying on different areas of expertise might be required to address shortfalls in the information available. In addition, the nature of the process is such that several of the steps, if not most of the analysis, might need to be conducted iteratively. In practice, therefore, while the note tries to describe an organized sequence of activities, the analysis might be less straightforward than it appears.

Examples of the complications which require expert judgment include the data limitations of standard household surveys when covering energy issues, and the realities of energy provision in low-income context where access or metering might be limited, fuels might be sold in different parts of a country with different prices, multiple connections and reselling of power might be practiced, and rationing and smuggling might be rife.

As far as the process is concerned, providing advice on how to conduct these reforms requires collaboration across different areas of expertise, often through repeated iterations. An understanding of the policy contexts and of the way different aspects of the reform interact is therefore essential. A poverty economist working in this area might start with the simple brief of assessing the distributional impact of existing subsidies and of how "market parity" or "cost recovery" prices for one or more energy sources would affect the population. This, however, might already entail familiarizing oneself with a number of sectoral technical details. For example, the unsubsidized price of energy might depend on choices made by energy sector analysts on the time horizon that is relevant (and therefore whether investment plans should be factored in or not), and estimates on which would be considered reasonable levels of efficiency in that market. And these details matter much beyond personal knowledge— from the equity point of view, for example, understanding whether existing estimates would saddle consumers with the burden of making energy sector's providers' budgets square despite their various inefficiencies (for example, high distribution losses) is more than a technical detail.

In addition, as the dialogue of a multisectoral team progresses, the initial brief of the poverty economist might expand. Different reform options—for example different pathways of price increases, or different combinations of changes to the price structure (for example, the introduction or refinement of lifeline tariff levels and structures for networked utilities) and price increases—might have to be considered. Qualitative analysis (discussed in Good Practice Note 4) may

point to specific—for example, seasonal—patterns of household energy spending, different types of energy use, and nature of household coping mechanisms that may reveal higher vulnerabilities for specific groups. In addition, technical inputs on the analysis of existing safety nets conducted by the Social Protection specialist might be easily produced when household surveys include the required information (as discussed in Good Practice Note 5, this might not be the case and different data sources might be required to conduct this type of analysis, in addition to the program readiness and institutional assessments). And when compensation options are being discussed the poverty economist might need to collaborate closely with the rest of the team to identify pros and cons of different alternatives (such as compensation through a new targeted social protection program;

compensation through a combination of existing social protection programs; compensation through a combination of cuts in out-of-pocket expenditures on health, education, and food) by evaluating the distributional implications of each. Experience shows that different teams find different ways in practice of managing the complementarities and potential overlap between the tasks of the poverty economist and the other team members, such as by relying on the same research assistant, or working sequentially on different parts while sharing program files, or even by working independently and collaborating in the packaging of the outputs for a common audience. It is important, however, to be aware of the complementarities between these different tasks and how they might evolve during the assessment process.

3. A QUANTITATIVE ASSESSMENT OF DISTRIBUTIONAL IMPACTS: KEY QUESTIONS AND HOW TO APPROACH THEM

A microeconomic analyst working in a team supporting energy subsidy reform is typically asked to help answering three interrelated policy questions:

- How large are energy subsidies and who is benefiting from them?

- Who is going to be affected by the removal of energy subsidies and—more specifically—would poverty increase significantly?

- How much would it cost to compensate vulnerable groups?

Answering these apparently simple questions requires pulling together a lot of different

sectoral expertise, and analyzing very different kinds of data. In the context of the three questions above, for example, a poverty economist would be mostly focusing on the second question, by looking at who is going to be affected by energy subsidy reform (ESR), how large the subsidies are relative to household income and expenditures, and what the estimated impacts of the removal itself would be. However, he or she would also have to provide an analysis of who benefits from the energy subsidies,[12] as well as the incidence of the benefit, and might also be called on to provide some insight from the household survey to triangulate other sources when estimating the absolute size of the

subsidy (something that is typically done by an energy or macro specialist). Finally, the poverty economist will also need to work very closely with whoever is trying to assess the costs of compensation, and might be involved in modeling different compensatory measures and their targeting performance. In addition, tailoring the answers to the local realities requires a close engagement with the policy dialogue so that only relevant options are analyzed.

This section provides a quick overview of the role of the analysis of household survey data in providing answers to the three key questions highlighted above, where complementary information and analysis is needed, and where the distributional analysis, which is the main focus of this note, would fit in.

How Large Are Energy Subsidies and Who Is Benefiting from Them?

With respect to the first issue—how large are energy subsidies and who is benefiting from them—the analysis of a household survey can mostly contribute to the second part of the question: **provide an estimate of how different forms of subsidies that reduce household expenditures on energy benefit different households.**[13] While such an analysis is limited, given that households often benefit directly only from a small proportion of overall subsidies, it can prove very helpful in policy analysis, since subsidies are often justified on the grounds that they make specific energy sources affordable to poorer groups in society. Such an analysis, for example, can highlight the poor's consumption of very limited quantities of the energy sources subsidized and, as a result, are very minor beneficiaries of the subsidies. At the same time, caution should be used in interpreting the results. While focusing only on households, subsidies may appear

relatively progressive (more progressively distributed than income). Even such a benign assessment might prove incorrect once consumption of subsidized energy sources across the entire economy is considered. The case was powerfully illustrated in the case of the kerosene subsidy in India (World Bank 2003), where an assessment was reversed (from not regressive to highly regressive) once the finding that nearly half of subsidized kerosene had been diverted, most likely to the automotive diesel sector, was taken into consideration.

Classifying subsidies may be done in a number of ways. For example, Good Practice Note 1 discusses different mechanisms through which subsidies are distributed. For the purpose of this note, as we are focusing on households, we adopt a simple distinction based on how these subsidies reach households. The first is consumer price subsidies, whereby consumers pay less than in the absence of the subsidy. The second is cash transfers or discounts, which reduce the net expenditures on energy by consumers.

While the analysis of the latter can rely on well-established tools for the analysis of social protection programs,[14] the analysis of consumer price subsidies presents some additional complications. Households benefit from price subsidies in proportion to their consumption of the subsidized energy. Since information on quantities consumed by households is seldom, if ever, available from household expenditure surveys or any other surveys, quantities consumed must be imputed. A common approach is to divide the expenditures by an average price to arrive at the quantity, and multiply by the difference between the estimated unsubsidized price and the average price to arrive at the incremental cost of subsidy removal for each household.

The total amount of subsidy captured by the households computed in this way can be calculated and plotted with standard tools.

Where specific programs provide transfers to various groups to help consume energy, estimating the distribution of these benefits is akin to estimating the distribution of any other social protection program. The analyst can therefore rely on such tools as a concentration curve, which plots the share of the overall expenditures spent on subsidies that reaches the bottom *x*% of the distribution. Concentration curves can be plotted alongside Lorenz curves in order to assess the extent to which they are progressive or regressive in relative and absolute terms. Indicators such as concentration coefficients and Kakwani indices can be computed, as well as standard indicators of program performance, such as the following:

- **Coverage:** Percentage of households where at least one member receives subsidies

- **Targeting or concentration shares:** The share of total transfers going to each group (typically welfare quintile)

- **Generosity or relative incidence:** The percentage of total household income and expenditure constituted by the subsidy[15] and, if there is a shared understanding on whom the program should reach (for example, the poor or the bottom 20%)

- **Leakage:** The proportion of those who benefit from the subsidy who are not part of the group they are meant to reach

Since subsidies are proportional to consumption, they tend to be captured by the better off, making them regressive (although they may be relatively progressive if they are more equally distributed than income).

However, their removal may harm the poor disproportionately if they are able to purchase subsidized energy and subsidies comprise a large share of their household income and expenditure. A household survey can be used to analyze whether subsidies captured by households are regressive by comparing the concentration coefficient of the subsidy with the Gini. If the concentration coefficient is negative, the subsidy is progressive and pro-poor. If it is positive, but lower than the Gini, it is relatively progressive. If the concentration coefficient is higher than the Gini, subsidies are regressive both in absolute and relative terms. It is important to note that this comparison does not allow drawing conclusions about the overall progressiveness of the price subsidy for that energy source. To assess the overall progressiveness, data for all purchasers of the subsidized energy source are needed, and such data are never available in cases where fuels are smuggled out of the country. One exception is where the subsidy targets only households. In such cases, a comparison of the total amount allocated by the government and the total amount consumed by households will tell how much has been diverted, provided that quantities consumed by households can be reasonably estimated (see section 4 on the difficulties of doing so). A rare example of this is India's household expenditure survey, which explicitly asks how much subsidized kerosene and unsubsidized kerosene the household consumes.

Who Is Going to Be Affected by the Removal of Energy Subsidies and—More Specifically—Would Poverty Increase Significantly?

This is the central question that an analysis of the distributional implications of ESR should address. The frequently encountered lack of information on the actual quantities consumed

poses a significant challenge to estimating the impact on poverty, underscoring the importance of highlighting the limitations in discussing the findings.

Bearing the foregoing limitations in mind, even in cases where policy attention is on one single number (say, the poverty impact), a comprehensive analysis of this issue would entail the following steps:

1 | **Understanding consumption patterns and how they change by rural/urban location, region, access to different sources of energy, season when relevant, and any other relevant characteristics (for example, welfare group)**.[16] Analysis of access,[17] consumption and spending patterns, and use of energy (for example, which source is used for cooking, heating, lighting) allows identification of categories of households vulnerable to specific energy price increases, since households' vulnerability to price increases crucially depends on their demand for that energy source and the availability of substitutes. If multiple data points are available, analysis at different points in time can help correlate past price changes with changes in consumption patterns, whether directly on energy or on other items of interest (such as changes in education or health spending resulting from past price hikes). Beyond the main indicators on consumption and spending on different sources (as relevant to the analysis), indicators of affordability—such as energy expenditure shares, or others that might be collected where relevant, such as information on payment delays, arrears on utilities, or the self-reported ability to heat adequately—can also prove very informative in this initial descriptive step. Qualitative tools can also be used to assess households' level of access to

different types of energy sources, and the purpose of their use, seasonality of spending patterns, and differences in consumption patterns by urban or rural location (see Good Practice Note 4).

2 | **Measuring the impact of the price increase on household welfare**. This is the core of a distributional assessment, and its main output is a simulated welfare distribution. Additional variables, such as simulated quantities consumed and simulated energy shares, can also be produced. Once household level effects have been computed, they can be summarized and graphed by income group, poor or non-poor, and for other relevant categories (for example, social assistance recipients, pensioners, or other groups considered "vulnerable").

A crucial distinction in this analysis is the extent to which the indirect welfare effects that result once households and firms respond by changing their demand for and supply of goods and services and factors of production following the price increase are incorporated into the analysis.

3 | **Summarizing the impacts of some key indicators according to the focus of the study.** The real income or expenditure distribution after energy price increases can be employed to calculate poverty incidence or other poverty indicators (using commonly used national or international poverty lines), such as depth, severity, or the number of new poor. Where energy shares of household expenditures are high and affordability is a critical issue, measures of affordability, such as the energy share, the rates of energy poverty, or poverty itself are useful indicators (See annex C for more information on measuring energy poverty). Estimates of

the numbers of those who would qualify for some important means tested program might also be obtained, if relevant to the policy dialogue. As mentioned above, this is often the part of the analysis that attracts most policy attention, although ultimately it is just a way of summarizing information produced in the previous stage.

How Much Would It Cost to Compensate Vulnerable Groups?

Based on the estimates of how much households have been affected described above, one can simulate how existing or potential social assistance programs could help mitigating the adverse effects of reforms on poor households or specific vulnerable categories of the population. Good Practice Note 5 offers a comprehensive view of how compensations options through social assistance should be assessed, and Good Practice Note 7, by providing a macro-perspective, highlights how a plurality of compensation options might be considered beyond compensation through a social protection program. Yet, depending on the country dialogue, there might be scope for producing highly stylized estimates of compensation costs to give a sense of the overall magnitudes being involved. For example. it might be useful to compare the amount of resources absorbed by subsidies with the amount that would be absorbed if it were possible to compensate the poorest x% of the population for the price increase, quite irrespective of whether it is possible to put in place a program that perfectly compensates the bottom *x*% of the population.

With this understanding in mind, and as an input to the broader (iterative) discussion on compensation options mentioned in section 2, different types of simulations can be conducted, such as the following:

- **Simulations conducted assuming perfect targeting** capture the mitigation budget required if there were no administrative costs and perfect information. While both assumptions are unrealistic, this highly stylized measure can be useful in the policy dialogue to compare the budgetary costs of different mitigation strategies (for example, compensating all the poor or compensating only the poor who would become eligible for some targeted program) or different price increase scenarios (for example, a big bang scenario versus a scenario of more gradual increases).

- **Simulations trying to replicate the eligibility criteria for different programs** in contrast offer the advantage of showing how well different program designs would protect effectively different groups of interest, although such simulations might be limited if the household survey does not cover all the indicators used to determine program eligibility.

An important caveat to keep in mind is that for the comparison between different program designs to be meaningful, if at least one of the programs is already in place, eligibility in the baseline should also be simulated. This is to make sure that the comparison between scenarios is not biased by such issues as low take up or administrative error (which would be captured by the real data on transfer receipt), as well as by the limited replicability of real life eligibility criteria with the household survey information.[18]

4. DIFFERENT METHODS TO ESTIMATE HOUSEHOLD-LEVEL WELFARE IMPACTS OF ENERGY SUBSIDY REFORM

PARTIAL EQUILIBRIUM ANALYSIS

Most analyses rely, at least as an intermediate step, on the estimate of partial equilibrium effects. Such direct impacts are estimated following one of two approaches. The first focuses on the purchasing power loss the household experiences following the price increase. Therefore, it measures the impact in terms of real incomes and expenditures. Intuitively this is proportional to the share spent on the item in the household expenditure (figure 1). For example, if a household spends 2% of its expenditure on a given energy source, whose price is going to double (increase by 100%), and it makes no adjustment in the amounts it consumes, its purchasing power loss will be 2%. This can be thought of as the real income or expenditure of the household contracting by 2%.[19] Note that this approach

lends itself very naturally to estimating (partial equilibrium) poverty impacts incorporating the purchasing power loss that every household experiences into the welfare indicator of interest (for example, household per capita income or consumption).

A second approach is to measure the impact on households in terms of their welfare. Following Hicks (1942), the welfare impact of price change on households in the case of a purchased good is commonly understood as the additional expenditures required to reach the same level of utility following a price increase than with the initial price, a measure called the Compensating Variation.[20] Such a measure requires prior knowledge of the preferences and various methodologies have been presented in the theoretical and empirical literature to approximate this

FIGURE 1: First Order Impact Based on the Share of Energy Expenditures
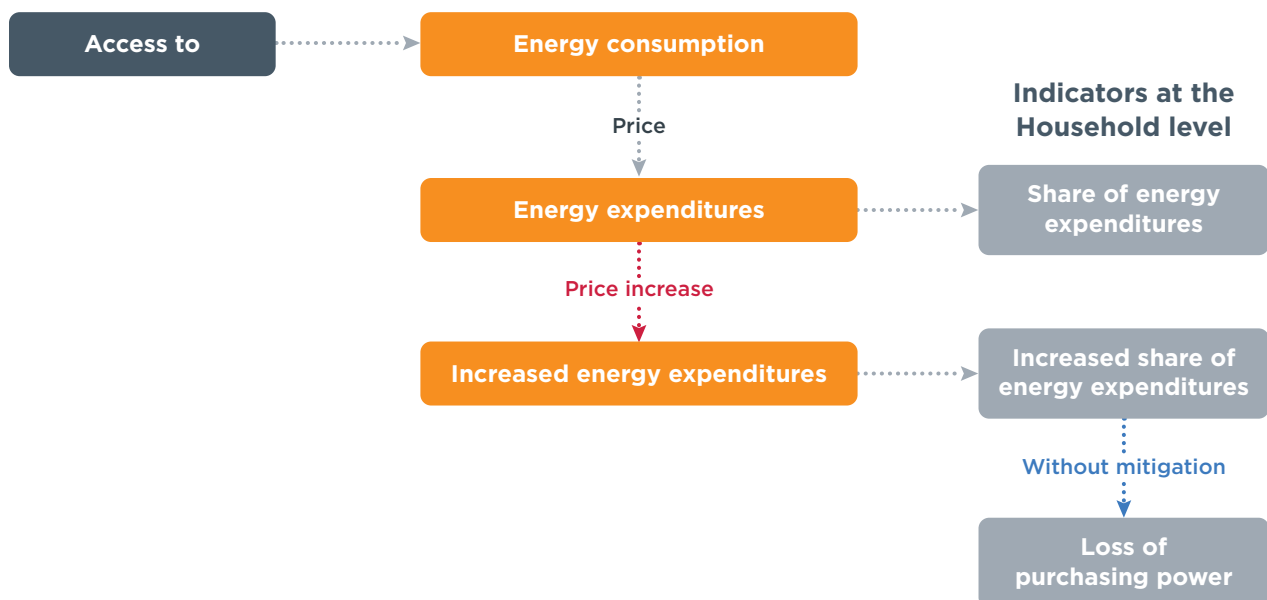
welfare measure with limited assumptions. The simplest approximation of the welfare measure is the Laspeyres Variation, the change in income required to purchase the original quantities of the good after the price has changed. This measure would be an upper bound of the actual welfare change in the absence of energy shortages before the price increase. If energy rationing was 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.

Another widely used measure is the loss of Consumer Surplus, which requires information on the demand function, but not on preferences. For non-negligible price elasticity,[21] as Consumer Surplus does not assume a constant utility, this measure underestimates the true welfare effect and is smaller than the Compensating Variation measure. The Laspeyres Variation and Consumer Surplus loss can be used as the lower and upper bound of the true value of the real welfare change for an energy price increase. The lower the price elasticity are and the closer these measures and the Laspeyres Variation are is a good measure of the Compensating Variation when price elasticity is close to zero (see Cory and others [1981], as well as Araar and Verme [2016] for an updated review of these measures).

GENERAL EQUILIBRIUM EFFECTS

Estimates of the indirect welfare effects of higher energy prices would ideally be captured through the use of an input-output matrix incorporating the energy intensity (disaggregated by source) of each sector. Making some simple assumptions on how an increase in energy will increase the prices in each sector, and knowing how much each energy source under consideration contributes to the value of production of the goods and services produced by each sector one obtains an estimate of the first-round effects of the increase in one energy price on the prices of all other goods and services produced in the economy. Of course, increases in the prices of the goods produced in each sector will feed through to other sectors, so that the process of identifying how much the overall price increase will be has to be performed iteratively. The indirect real-income effect is then calculated by multiplying the expenditure shares of the various goods and services by the estimated percentage price increases in these sectors. Note that the precision of this simple method depends heavily on the possibility that households have to switch their consumption away from fuels and goods and services with relatively high price increases toward those with relatively low increases.[22]

Depending on the energy source under consideration (increases in the price of petroleum products typically have indirect effects in many sectors if not all through transport costs, while increases in prices that affect only households, such as district heating, which is typically provided to apartment buildings, can be expected to have negligible indirect effects) and the availability of an I/O matrix, one can use a simpler approach to incorporate only some indirect effects which, a priori, one can consider most relevant. This approach, which can be defined as one of "limited general equilibrium," would involve identifying and quantifying based on expert judgment of which channels are likely to matter the most in a given context. For example in an agricultural economy there might be important repercussions of changing natural gas prices through their indirect effects on the cost of fertilizer if

fertilizer manufacturers are benefiting from subsidized natural gas, which is used as a feedstock for fertilizer production, while the impacts on other sectors outside of agriculture may be less. Depending on the coverage of

variables related to farm production in the household survey, this important element could be modeled and included to the analysis of the direct distributional impacts of the gas price increase.

5. DOING DISTRIBUTIONAL ANALYSIS IN PRACTICE

This section discusses first the logic, then some of the common issues faced when having to apply the approaches described above in practice. Those mostly refer to shortfalls in the data and pragmatic ways in which they can be addressed.

SETTING UP THE ANALYSIS AND COMPLEMENTARY DATA NEEDS

To assess distributional impacts in practice one might rely either on pre-packaged options or on one's own programming. Either way it is helpful to understand the logic of what is being done, both to understand how the results can be interpreted and to choose the tool that might be most appropriate.

ASSESSING THE DISTRIBUTIONAL IMPACT OF THE DIRECT EFFECTS OF ENERGY SUBSIDY REFORM

Figure 2 provides a summary of the two main steps involved assessing the distributional impact of the direct effects of energy subsidy reform (ESR), namely constructing a simulated baseline and simulating the impact. One typically needs to simulate the baseline if the household survey is not recent (as a rule of thumb if the survey is more than two years old) or if growth and inflation have been significant between the time the survey was run and the time when the energy reform has taken place or is being considered.[23] Once the counterfactual scenario is constructed (usually under the simplifying assumption that economic growth has resulted in a distributionally neutral shift, that is, that all incomes have been growing at the same rate),

FIGURE 2: Overview of the Simulation Steps

ENERGY PRICE INCREASE

ENERGY SHARES for Survey Year	ADJUSTED ENERGY SHARES for Reference Year	INCREASED ENERGY SHARES
Latest Household Budget Survey	**Constructed Baseline**	**Simulation**

▸ Increase in the share of expenditures, by quintiles
▸ Change in real income
▸ Poverty headcount using the (adjusted) poverty line
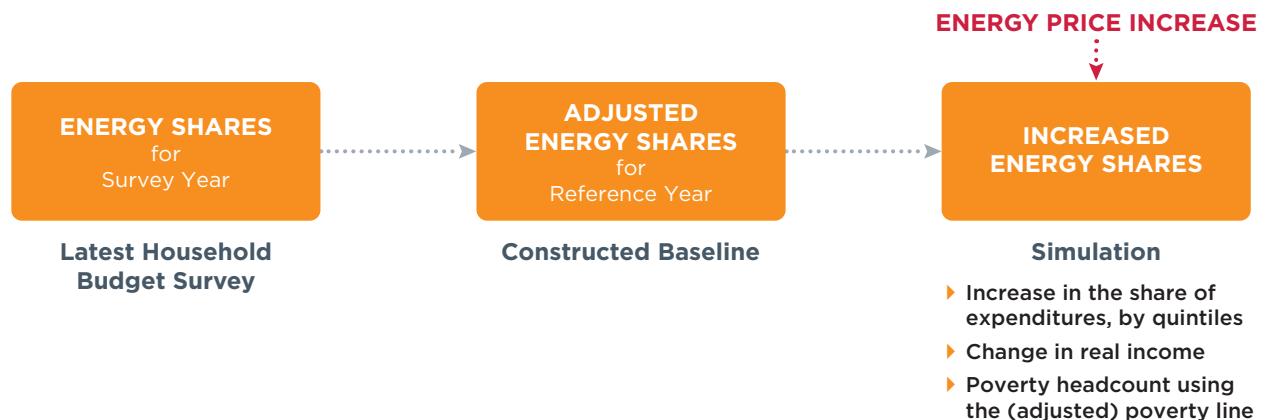
the simulated energy expenditures shares and the real income after the energy price increase (actual increase or expected increase) can be compared with the forecasted energy expenditures shares under the constant price scenario of the baseline. Note that if poverty impacts are to be calculated, the poverty line also needs to be updated to make sure that it retains the same constant purchasing power as in the base year.

As a first step, the total nominal expenditures (prior to any adjustment) is required in order to calculate the share of energy expenditures as a share of the total nominal expenditure. It is usually different from the welfare indicator, which is already adjusted for the different cost of living across the sample. In computing energy expenditure shares, the following issues need to be considered:

- **What is included in total expenditures varies from country to country:** For poverty analysis, most countries exclude the purchase of large durables that can cause a one-off inflation of the total expenditures of the affected households. Some countries also exclude large expenditures on rare events, such as weddings. It is important to understand what is excluded especially when making cross-country comparisons.

- **Not all expenditures are in cash:** Energy price increases are relevant for energy products for which households have to pay. Total expenditures, by contrast, often include items for which households did not pay. For the poor, the largest of such "expenditures" is food that was given to or grown by household members. Among energy items, biomass collected by household members (such as wood and agricultural residues) is a common example, particularly in rural areas and in low- and

lower-middle-income countries. These items may or may not assigned imputed values, typically market values in the vicinity of the household in question. For the purpose of poverty analysis, total expenditures inclusive of such imputed values are important. To understand the impact of higher energy prices on the poor, however, it would be useful to examine energy expenditures shares of cash-only expenditures (excluding imputed values of all items for which the household did not pay), as well as total expenditures used in poverty analysis.

Depending on the type of analysis conducted, and whether an actual reform is mimicked, or potential scenarios are simulated, different sets of variables are required, such as the following:

- **Distribution of the subsidies:** To estimate the distribution of energy price subsidies before and after the reform, unsubsidized prices need to be estimated. Good Practice Note 1 reviews the data requirements and methodologies for different types of energy. However, it is worth repeating the points made earlier that household expenditures on energy may not be correlated with their actual consumption—because households are not individually and accurately metered, or payment arrears are common, or prices paid differ from the official prices (utility staff extracting unofficial payments, fuel shortages pushing up prices on the black markets). In the case of network energy, it should be possible in theory to compare the aggregated imputed consumption from the household data with utility data on total consumption for such users to assess if the extrapolations of quantities from expenditure data are broadly reasonable. A general sense of whether such extrapolations on average results in an over- or underestimation of

one type of energy consumption, while helping qualify the results, however, does not necessarily help in the distributional analysis.

- **Distributional impact of a uniform price increase:** Simulating the direct impact of a uniform price increase requires limited data at the household level, as only the share of expenditures for energy, the total expenditures and the price increase are required. These simulations can be conducted by software. such as SUBSIM,[24] or with International Monetary Fund (IMF) Stata do-files[25] described below, if quantities can be reasonably accurately estimated from the price data available. Yet even in this relatively straightforward setup, challenges might arise.

  - If prices are regulated, but black market activity means that households are paying higher (and possibly very different in terms of location) prices, simulations based on the official price are going to represent an upper bound of the welfare loss.

  - If rationing is present, it is impossible to predict future consumption based on pre-reform consumption levels.[26] In the case of electricity, for example, which is rationed in most countries in Sub-Saharan Africa, if price increases translate into improved service, consumption could increase. In this case, the increase in spending would capture an increase in welfare as opposed to a negative impact. A sense of distributional impact, however, could be obtained by simulating how the value of a basic amount of, say, electricity, would change and analyzing whether such basic amount would be affordable by different groups (for example, answering

the question "Could the bottom quintile afford to cover its minimum consumption needs considering the basic electrical appliances they need?").

- **Distributional impact of non-uniform price increases:** A more common reform approach is to differentiate price increases by energy type. For fuels, this could mean increasing the prices of higher-grade gasoline (higher octane) and diesel (lower sulfur) much more than lower-quality fuels, or LPG sold in large cylinders (LPG sold in 15-kilogram cylinders more than that sold in 5-kg cylinders). In the case of network energy, uniform price increases are virtually unheard of. With a few exceptions, such as Liberia, virtually all countries have tariff schedules unique to residential consumers, and within residential consumers, many have two or more schedules. Where there are two or more schedules, without knowledge of which schedule each household subscribes to, only an approximation of the increase using a uniform (average) increase can be conducted if the household survey does not include the information needed to differentiate different types of customers. Where the tariff schedule applicable to each household is known, knowledge of the actual tariff structure allows simulation of the price increase applicable to each household. The analysis requires the variables to identify the categories targeted by each specific tariff (for example, in Belarus and Ukraine, the tariff varies according to the type of heating appliances used by the household), in addition to the tariff structure. In the case of differentiated tariff increases in multiple-block tariff structure— for example, the tariff for the first block is unchanged while the upper block tariffs are increased—the information must be even more accurate, since the consumption level

must be estimated prior to the simulation of the price change.[27] When tariff differs by season, the survey should cover the different quarters. Information on the taxes and other fees applied is essential, but gathering that information is not necessarily easy because tariffs are often reported by the utilities excluding taxes and fees not retained by them, while household expenditures include all charges.

ASSESSING THE DISTRIBUTIONAL IMPACT OF THE INDIRECT EFFECTS OF ENERGY SUBSIDY REFORM

As already discussed, several studies have underlined the magnitude of raising the prices of some petroleum products, such as through indirect effects caused by higher costs of transport for distributing goods and services to households, and higher costs incurred in agriculture from higher irrigation and fertilizer costs. This evidence suggests that although direct effects display a strong distributive pattern in average, indirect effects of fuel price increase appear distributionally neutral. Atamanov, Jellema, and Serajuddin (2015) show different effects in Jordan depending on the fuel considered. The removal of diesel subsidies would mainly impact households through large indirect effects (households hardly use any diesel directly), while the removal of gasoline subsidies would mainly affect households directly, with a greater effect on the wealthiest. The same paper, when analyzing electricity subsidy reforms, shows a greater impact on wealthier households, through direct as well as indirect effects because richer households consume more non-food goods and services, whose production is electricity-intensive. In magnitude, electricity reform indirect effects may amount to 40% of total effect, depending on the reform scenario considered.

Analysis of the indirect effects of a price increase, such as in Coady, Flamini, and Sears (2015) study, are based on a "price shifting" model, which describes and quantifies the magnitude of sectoral changes in producer and retail prices resulting from an exogenous price shock. It uses information on the current structure of an economy, at current levels of production, reflected by an Input/output Matrix, thus is a static model (see also Good Practice Note 7 for limitations of such fixed coefficients models compared to more comprehensive Computable General Equilibrium models able to estimate longer term effects).

The model assumes that exogenously generated price changes are either "pushed forward" to output prices or "pushed backwards" onto factor payments when output prices are fixed (determined by world prices or controlled by the government). The model also assumes constant returns to scale in production, perfect competition, and reproducible fixed factors of production economywide. These assumptions allow the analyst to use the input-output matrix—which describes the input shares (of all sectors) in the output of all sectors at a point in time and given prevailing prices—to generate producer price changes assuming production technologies and production input shares remain fixed. Results generated are considered as an upper-bound estimate of the impact of any change in government-administered price policy on household welfare.

Under the specific assumption that all sectors are either Cost-Push or Controlled,[28] the change in Cost-Push retail prices separates the direct effect of the shock from the indirect effects arising from changes in producer prices in the Cost-Push and Controlled sectors. In order to solve the price-shifting model using

one of the software alternatives and to use results to trace the impact of price policy on household welfare, the following steps should be completed.[29]

1 | *Prepare the Input-Output (I/O) matrix*. The analyst should choose an I/O year closest to the year of the primary household survey. Both the OECD (http://www.oecd.org/trade/input-outputtables.htm) and the World Input-Output Database (www.wiod.org) maintain I/O databases that are regularly updated. I/O matrices are usually stated in flows: each row will describe the value of that sector's output by destination (that is, did the sector's output go to other sectors for use as production inputs or to households for consumption?), and each column will contain a complete list of the value of production inputs (from each sector). To figure out the weight of each input in each output, one must calculate the technical coefficients. This is done from the flows in the I/O matrix by dividing each cell in column j with the row sum (that is, total output) from the final row (where i=j). Technical coefficients express the value of inputs (in a sector) as a share of the value of total output from that same sector.

2 | *Map household consumption expenditures to I/O table sectors.* The analyst will need to use his or her judgment in mapping each household questionnaire item to the relevant I/O sector. In cases where an item consumed by the household could plausibly come from more than one sector, it is reasonable to split each household's total consumption of that item between all plausible sectors according to sectoral share in total output (according to the I/O table).

3 | *Calculate the subsidy as a percentage of the market price/reference price and map the subsidy schedule to I/O table sectors*

4 | *Determine which (if any) I/O sectors would continue to have regulated/non-market prices if the price policy under consideration were revised.* For example, in the case of fuel subsidies, the relevant counterfactual may more likely be one where the government still controls the price of fuel even after eliminating the current subsidy. In such a counterfactual, fuel would be sold at a higher price, but the price at which it sold would not necessarily be freely determined by market supply and demand.

5 | *Read in the I/O matrix* with the software.

6 | *Enter exogenous price shocks and designate sectors with fixed prices.*

7 | *Solve the model.*

USING PREPACKAGED SIMULATION MODELS

Various prepackaged simulation models exist, with SUBSIM and the so-called "IMF files"[30] being popular. However, they are useful primarily if quantities can be back-calculated with reasonable accuracy based on available price information. Unfortunately, as explained in detail elsewhere, this is not the case in many countries. Where the requisite information is not available to estimate quantities consumed, more tailored albeit often less ambitious approaches based on whatever information is available are called for.

SUBSIM is a World Bank tool designed to facilitate and standardize rapid distributional analyses of subsidies and simulations of subsidies reforms (Araar and Verme 2012),

especially when indirect effects are expected to be significant. The model estimates the impact of subsidies 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 welfare effect on household of the price increase, assuming that the loss in welfare is approximated by the total expenditures required to maintain the same level of consumption than before the price increase (**thus the Laspeyres Variation**) or a **lower** bound (**the Equivalent Variation**) using them as a reference for the welfare level after the price increase, with an assumption on preferences based on a Cobb-Douglas utility function, as well as a price-elasticity. There are two versions of the model to estimate direct and indirect effects using household expenditure survey data and input-output matrixes. Note that the analysis with an I/O table, by requiring that expenditure items from the household survey are matched with those covered in the I/O table, requires aggregating items and considering their average prices. Depending on the detailed nature of the I/O table, it might require aggregating all petroleum products in one category, or almost certainly considering only one type of "gasoline" without reference to the quality (such as the octane level).

For the estimation of the indirect effects, the SUBSIM software creates automatically 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 (in the short-term option, the increased prices in the non-shocked sectors do not become higher input prices for all sectors).

Although the model has been developed for the Middle East and North Africa region,

with a focus on oil prices such as in Jordan (Atamanov, Jellema, and Serajuddin 2015) and Libya (Araar, Choueiri, and Verme 2015), it can also be applied to energy, food, or water subsidies and accommodates linear and nonlinear pricing for the direct effects, assuming some simplifying assumptions.

The IMF has also developed a set of publicly accessible Stata do-files that estimate the direct and indirect effects of indirect tax or subsidies, using the price shifting model described previously.[31] Both tools provide a rapid analysis, including the indirect effect of price increases on household welfare.

While these ready-made tools are already available, the needs of the country engagement might be such as to require and justify the expense of time and effort to conduct a finer modeling of the impacts through custom-made programs. This is especially the case for networked utilities with multiple tariff schedules for residential customers. In these circumstances, ready-made products, which lend themselves to rapid analysis, might disregard some of the specificities of the tariffs that apply to the most vulnerable households and provide a poor approximation of the impacts that would matter the most for the analyst. Regarding the modeling of behavioral responses, a strong distributional pattern of consumption may exist as evidenced by Zhang (2011) in Turkey where price elasticities for electricity consumption are much lower for lower-income households than for wealthier ones. As in Zhang (2011), most of the tailored analyses rely on the estimation of the loss of consumer surplus, or provide the upper bound (Laspeyres Variation) and lower bound (Compensated Variation) of the welfare impact, with constant consumption for the upper bound and post-increase consumption

with a price-elasticity assumption for the lower bond (see a selection of studies in Annex B).

Note also that, depending on the social assistance programs available in the country and the dialogue on whether and how they can be adapted to cope with the impacts of reforms, the existing social assistance schemes might require tailored modeling (as they might require tailored modeling for possible modifications of the existing schemes). In coordination with the Social Protection specialist working on those issues, it might be agreed that creating customized files for both the poverty impacts and the social protection response might be the most efficient way of organizing the work.

MEASUREMENT CHALLENGES

The application of the methods discussed in this note is crucially dependent on the quality, reliability, and comprehensiveness of the information contained in the household surveys. This section summarizes some of the most common difficulties when deriving the key variables needed for the analysis of ESR, and points briefly to additional data sources that might help in addressing some of these challenges.

LIMITATIONS IN THE ENERGY SPENDING VARIABLES

The distributional analysis discussed in this note typically relies on household expenditure surveys or other surveys that collect disaggregated expenditure information (such as a Living Standard Measurement Survey with an expenditure module). This implies that information on household-level spending on energy will be available,[32] although not necessarily with the required level of detail. It might not be possible, for example, to obtain disaggregated information on a given energy source, such as when fuels expenditure are presented as an aggregate, or residential energy spending is aggregated with other housing expenditures.[33]

Similarly, the lack of information or ambiguity regarding the time reference period for different energy expenditures might make it difficult to extrapolate the expenditure to an annual amount (or averaging to a monthly one) to make it consistent with the total expenditure variables used. It is not uncommon for questionnaires to adopt vague reference periods such as "winter and summer" or "heating period" (the questions would then ask for typical expenditures over such periods).

Finally, the seasonality of expenditures might be critical where heating and cooling needs are significant.[34] Even surveys that are run over the entire year might not be released with details of inter-year variation, so that even if average values adequately capture yearly averages, it might be hard to estimate correctly some key variables that depend on monthly consumption. This is most evident in the case of utilities when block tariffs are in place and there is strong seasonality. In such a case, average monthly consumption might fall in a tariff block that differs from either the tariff block of the peak consumption season (for example, gas for space heating in winter, electricity for cooling purposes for the summer) and of the low consumption season, or both.

These challenges are compounded when seeking to compare across countries if survey questionnaires differ.

Addressing such challenges requires some creativity. It might require relying on complementary sources to triangulate and

possibly impute variables (for example, when ratios of consumptions in different periods of the year are derived from administrative data and used as a basis for imputation) or reducing the ambition of the analysis. For example, for the purposes of assessing energy affordability when the required expenditure data is not available, but some information (even if aggregate by quintile) on overall expenditure exists, one can at least calculate the expenditure share of a "minimum energy bundle" defined as covering essential needs (for example, in electricity sector reform focusing on the costs of using several light bulbs, a fan, and a fridge) to have a sense of affordability. In the case of liquid fuels, for example, the estimate of the basic bundle can be informed by assumptions or information on the amount of kerosene needed for lighting or LPG used in cooking (where use of LPG is widespread even among the poor). It is also important to look at total expenditures on energy, and not just expenditures on the subsidized forms of energy, to assess whether meeting basic energy needs is affordable. In addition to helping in approximating an assessment of affordability, the costs of a minimum energy bundle can be an input in approximating a rough distribution of the household-level direct benefits of the subsidies. Finally, depending on resources, the time available and the characteristics of the survey (so that data quality is not affected), one could consider collecting more data by adding ad hoc energy modules to existing household surveys.

CHALLENGES IN EXTRAPOLATING ENERGY QUANTITIES CONSUMED FROM ENERGY SPENDING DATA

As discussed above, since household surveys typically do not include information on the

quantities of energy consumed, those need to be extrapolated from energy expenditure data. Special care should be taken in ensuring that the extrapolation is based on nominal expenditures, rather than on expenditures that have been adjusted for differences in cost of living across regions.

The reliance on energy expenditures implies that all possible concerns for the way energy expenditures are reported, as described above, will affect such an extrapolation. In addition, additional challenges might arise, such as the following:

- Official prices may be lower or much lower than the actual prices paid due to fuel shortages. Absent a price survey at the same time as household expenditure data are being collected, it is not possible to back-calculate quantities from expenditures. If fuel shortages are driving higher prices, the actual prices paid can be location- and time-specific, with large variations from purchase to purchase, making it virtually impossible to track quantities based on expenditure data.

- Prices may be location-specific, and for certain energy types also dependent on the volume purchased. For example, LPG purchased in large quantities (such as large-cylinder refills) typically has lower unit prices, but the lumpiness of each purchase makes it unaffordable for the poor.

- Even if the prices paid are precisely known, if fuels with different prices are lumped together in the household expenditure survey—for example, different grades of gasoline lumped into a single category called gasoline, gasoline and diesel lumped into a single category called automotive fuels, and natural gas and LPG lumped into

a single category called gas—again it is not possible to calculate quantities consumed.

- If an energy source is paid for less frequently than the recall period in the household expenditure survey, a large number of households would record zero expenditures. A classic example is a recall period of a month when LPG sold in large cylinders is refilled less frequently than every month. This has resulted in a large number of households citing LPG as their primary cooking fuel in Mexico reporting zero expenditures on LPG (Kojima, Bacon, and Zhou 2011).

- Quantities consumed may be curtailed by energy shortages, which in turn may be caused partially or even solely by energy subsidies (see Good Practice Note 1). If subsidy removal can largely eliminate energy shortages—which is possible with liquid fuels—actual consumption may rise, even among the poor, to meet their basic needs (say for lighting with kerosene) and especially among the better-off. Depending on which energy shortages are being addressed, consumption of other forms of energy may fall. For example, if electricity was previously rationed because tariff levels were too low to enable the utility to purchase adequate fuels for generation, and higher tariffs after the subsidy reform enable the utility to purchase more fuels and eliminate rationing, those households previously purchasing diesel for backup generators may switch back to grid electricity, substantially increasing electricity consumption and correspondingly decreasing diesel consumption.

- Network energy presents additional challenges:
  - If there are multiple schedules of regulated tariffs for households, it would not be possible to back-calculate

consumption, unless the household expenditure survey asks which schedule the household subscribes to, which household surveys almost never do. For example, Mali has a total of 27 schedules for residential consumers depending on the level of service (Kojima and others 2016), whereas the household expenditure survey provides no information on the household's tariff schedule, making it impossible to back-calculate quantities consumed. As an example of differentiated utility tariffs, Ukrainian gas tariffs are differentiated by categories defined on the basis of the appliances used by the household and by consumption levels; electricity tariffs are differentiated between rural and urban areas as well as consumption; and district heating tariffs differ by location, being a function of the local provider.

- Unlike liquid fuels, for which payments are made at the time of purchase, utilities issue bills at fixed time intervals, and late payments are allowed or tolerated to varying degrees. As a result, payments made at one point in time may be a poor reflection of the quantity consumed: expenditures may be low on account of underpayment, or high on account of making up for payment arrears. The 2012 National Survey of Household Income and Expenditures in Mexico asked a series of questions to understand arrears, including when the last payment for electricity had been made, while the 2005 Integrated Sample Household Budget and Labor Survey in the Kyrgyz Republic asked for the quantity of electricity consumed, the amount billed, and the amount paid for three successive months as well as the amount of subsidy received. Most

household surveys, however, simply ask how much the household paid during the recall period. Asking just one question about how much the household paid over a fixed period of time could under- or overestimate (the latter if past debts are being repaid to utilities) monthly expenditures. Cross-checking household survey data against data from the utilities could indicate the magnitude of these problems and ways of adjusting data for a more accurate picture. Lampietti and Junge (2006) combined billing and payment records from the utility and merged them with household survey data to address recall errors, under- and over-reporting, and the presence of arrears, which enabled more accurate estimation of current and historical electricity consumption as a function of household income and other characteristics. However, such an approach would entail considerably more work, as well as data gathering challenges.

- The converse of the above is prepaid metering, which is increasingly popular in Sub-Saharan Africa. With prepaid metering, households pay in advance for energy they plan to consume in the future. Depending on how little or how much they pay, the expenditures may bear little resemblance to the quantity consumed during the recall period. Further, few household surveys, if any, ask if the household has a prepayment plan, making it impossible to tell what the expenditures represent.

- Each household may not be individually metered and in a timely manner. If several households are connected to a single meter, or if households are billed according to estimation (as in

a number of countries in Sub-Saharan Africa), expenditures are not correlated well with the charges calculated from tariff schedules, and in some cases expenditures and theoretical bills based on tariff schedules are virtually delinked.

- Some or all of the utility bills may be covered in rent or by employment benefits. In such cases, information on neither expenditures or consumption may be available.

- If every household is accurately and individually metered, utilities can provide the requisite data. However, utility data have no information on total household expenditures, and matching utility data with household expenditure data by household identity is virtually impossible. Moreover, if there are multiple different utilities covering different regions of the country (as in Namibia and South Africa), consolidating the information from different utilities alone would require considerable work, even if every utility is willing to provide the data.

In the absence of requisite data, vastly simplifying assumptions have to be made to estimate the amount of price subsidies each household receives.

METHODOLOGICAL CHOICES IN CONSTRUCTING KEY VARIABLES OTHER THAN ENERGY CONSUMPTION

While the findings are extremely sensitive to the way energy consumption is measured, the construction of other variables needs also careful thought.

Selection of a Welfare Indicator. Identifying an appropriate welfare indicator is essential

for the distributional analysis, independently from the type of reform to be simulated. The welfare indicator is used to rank households according to their living standards. When using a nationally representative household expenditure survey, the indicator already exists and is usually the one used for poverty analysis—this might be total expenditures for consumption per capita or per adult equivalent, regionally and temporally adjusted or total income, similarly adjusted.

Creation of the Energy Shares Indicator. As mentioned above, when examining energy expenditures, it is important to ensure that those are taken in nominal terms, rather than being adjusted for spatial differences in costs of living. Similar concerns affect the calculation of energy shares for affordability purposes. If an unadjusted expenditure aggregate is not already available in the survey, the analyst might need to reconstruct it using all expenditures.

In addition, where it is possible to separate out imputed values, computing shares out of cash-only household expenditures, as well as out of an all-inclusive household expenditures, would be useful to provide a full picture of the welfare impacts of higher prices. In the case of low-income pensioners who fully own their homes, for example, an affordability assessment might reach different conclusions if considering expenditure shares based on cash expenditures only or on a full expenditure measure.

Other Data Needs. Finally, it is worth mentioning some of the other data sources that can help fill gaps in the household survey information available; triangulate some indicators, especially for access, service quality, and payments pattern; and identify seasonal effects or for further simulating indirect effects. Table 2 contains a list of various data sources that teams can use depending on their reliability, accuracy, and relevance.

TABLE 2: List of Additional Data Sources

Utility data	Detailed information on payment and expenditures for formal consumers, data on tariff structure, costs, quality, payment recovery, and consumption. As such, utility data is extremely relevant to assess the impacts of an increase in the cost of fuel or energy services.
	However, utility data do not give any information on the household socioeconomic context and are available only for formal consumers. Utility data is therefore irrelevant for households drawing electricity from officially connected households or for households with illegal connections.
National statistics	Administrative sources, such as utility data from the Ministry of Energy or data on social assistance recipients, poverty, and socioeconomic development from the ministry in charge of social policy, can help provide context and crosscheck findings from the survey.
International statistics	Some specialized databases, such as the tariff database of the Energy Regulator Regional Association for Europe (https://erranet.org/knowledge-base/tariff-database/) can offer some simple cross-country comparisons (based on average tariffs in this case).
Qualitative assessment	Complements quantitative data by illustrating impacts beyond monetary ones. Can informing the design of new survey modules. For more info, see Good Practice Note 4.
Census	Data on energy access and housing characteristics can help provide general context for the analysis.

ANNEX A: SAMPLE OUTLINE FOR A REPORT ON THE DISTRIBUTIONAL ASSESSMENT OF ENERGY PRICE INCREASES

BACKGROUND

1 | **General background on poverty and severe poverty**

1.1.1 | Table: Incidence of, by region, urban or rural, etc.

1.1.2 | Table: Profile of special groups of interest (if discussed in policy dialogue, for example, unemployed or pensioners)

Info needed:

- *National poverty lines and details on local consumption aggregate*
- *Special group of interest—particularly if emerging in social assistance dialogue*

2 | **Background on the energy sector**—note that the information on prices and structure is needed for subsequent steps of the analysis, but might have been collected under other "modules" of the work; other items listed that might provide useful complementary information to the analysis of the distributional impact on residential customers clearly do not apply to all energy sources and will be omitted depending on the scope of the work.

2.1 | Background on reforms in the sector and how it affected prices over time—details on energy price-setting mechanisms

2.2 | Current prices for major sources of energy

2.3 | Details on the type of subsidies available, eligibility criteria, amounts permitted per eligible beneficiary, and delivery mechanism on paper

2.4 | Subsidy delivery mechanism in practice and associated consequences

2.5 | Cross-subsidies between consumers (industrial/residential) and among energy sources; information on non-collection of network energy bills; taxes and other fees where they are not captured in the schedules of regulated tariffs

2.6 | Costs of connection and metering (needed if access is not universal or if each household is not individually metered)

CORE ELEMENTS

3 | Patterns of energy use

3.1 | Use of different sources (by poverty status, quintile, for selected groups)

3.2 | Access

3.3 | Details on use of different types of energy-consuming assets or appliances by different groups.[35]

3.4 | Evidence on seasonality if available from either the household survey or administrative sources

> *Info needed*:
> - *Evidence from household surveys*
> - *Complementary evidence from qualitative analysis, particularly on seasonality if not covered by quantitative data*

4 | Energy expenditures (possibly evolution over time if multiple data points)

4.1 | Table: Share of energy expenditures in total HH expenditures (by poverty status, quintile, for selected groups)

4.2 | Table: Share of energy expenditures in monetary HH expenditures (by poverty status, quintile, for selected groups)

4.3 | Table: Composition of energy expenditures by source (by poverty status, quintile, for selected groups)

5 | Quantities consumed

5.1 | Average quantities consumed (by poverty status, quintile, for selected groups)

5.2 | Quantities consumed in different seasons if relevant (say for networked energy if there are significant cooling and heating needs, depending on the season).

6 | Performance of current policy measures.

6.1 | Distribution of the price subsidy

6.2 | Additional information to what is listed above under patterns of energy use and which can help understand such findings. In the case of utilities, for example, details on the block tariffs: distribution of households by block, share of households that consume within blocks that are priced below average (by region, quintile, poverty status, rural/urban—if cross-subsidization between residential consumers). Where subsidized fuels are rationed, comparison of the official expenditure on the rationed fuel—for example,

if a household is entitled to 5 liters a month of subsidized kerosene at a discounted price—with actual expenditures reported by eligible households would be another example.

6.3 | Breakdown of subsidy received by energy source, by quintile and group of interest

7 | Distributional impact of tariff increases

7.1 | Table: Changes in energy expenditure share (by quintile and for groups of interest)—this can be by energy source if looking at multiple increases, or overall. If calculating both direct and indirect effects, they might be presented in different tables.

7.1.2 | As background for calculating the indirect effects: Share of spending on energy intensive items (for example, food, which, is very sensitive to transport costs; passenger transport) by quintile and group of interest

7.3 | Table: Poverty impact (overall, and for groups of interest)

7.4 | Incidence of the poverty increase

7.5 | Energy poverty impact (where relevant or where there is information to compute the effect)

7.6 | Evidence from focus groups on coping mechanisms and behaviors, if available

Info needed:

- *Evidence from qualitative analysis*
- *Elasticity estimates if available—evidence from focus groups can help triangulate*

POSSIBLE EXTENSIONS, DEPENDING ON NEEDS OF THE DIALOGUE AND DIVISION OF LABOR WITHIN THE TEAM

8 | Energy affordability—affordability is one of the criteria adopted by the Multi Tier Framework (MTF) to evaluate "usable" access to energy.[36] While in the MTF, it does not lend itself to a simple binary classification, it is worth noting that in the framework, affordability is defined in the case of electricity as the basic service not costing more than 5% of income, while in the case of cooking, it requires that the levelized cost of the cooking solution absorb less than 5% of income. Such estimates can form the basis of a summary affordability indicator (analogous to the concept of energy poverty adopted by countries in the European Union). As an alternative energy shares can be analyzed without resorting to the creation of a binary variable capturing whether energy is not affordable.

8.1 | Affordability—share of energy expenditures in total HH expenditures: incidence of "unaffordable energy" or energy poverty across groups, its correlation with consumption poverty, sensitivity of estimates to the adoption of a different threshold to defined energy "not affordable"

8.2 | Profile of those with high energy shares or without access to affordable energy as identified before, by user, defined by "main type of energy source"

8.3 | Complementary info from qualitative analysis

> *Info needed*:
>
> - *Evidence from household surveys*
> - *Local definition of energy poverty if one or several have been adopted or are under consideration*
> - *Complementary evidence from qualitative analysis on other concerns that households have: debt arrears, lack of metering and unfairness of bills, quality of service*

9 | Analysis of current programs and descriptives to inform the overall discussion on compensation options. As discussed in the text these additional tabulations, data permitting, can be an input in a full assessment of existing social protection measures and in the discussion of which compensation options might be pursued.

9.1 | Table: Distribution of direct subsidies or energy-related transfers and social programs if they exist by quintile, poverty status, and energy poverty—coverage, distribution of beneficiaries, distribution of benefits, generosity.

9.2 | Table: Distribution of other major social assistance programs by quintile poverty status, energy poverty—coverage, distribution of beneficiaries, distribution of benefits, generosity

9.3 | Table: Share of household expenditure spent on other items under discussion as part of the design of broader compensation options—for example, food or other basic items for which a value added tax (VAT) reduction might be considered, out-of-pocket expenditures in health or education if (targeted) measures to decrease those are being considered.

> *Info needed:*
>
> - *Information on safety nets, earmarked energy subsidies (possibly to be collected by a local consultant if not available)*
> - *Information on eligibility criteria for social assistance (if transfers are known to exist, but are not captured by the surveys)*
> - *Information of cost recovery tariff*

9 | 10. Stylized policy simulations on compensation costs for various tariff increase scenarios and/or highlighting impacts on groups of interest (for example, the poor, the bottom 40 percent of the population and those defined as "vulnerable" in the relevant legislation)—as discussed above these stylized simulations can be a useful input in the overall dialogue, for example, helping provide an order of magnitude for the fiscal costs of different price increase scenarios and of course highlighting their distributional implications.

N.B. All simulations to be evaluated for their impact on poverty, incidence, concentration of benefits, energy share spent by different quintiles.

Base case: Distributional impact of a given set of increases.

Simulation 1—reallocating resources through social assistance (least cost solution): Consolidating energy-related transfers into one budget (or another discretional or appropriate budget) and distribute it uniformly per household to

    a. the bottom x% of the distribution

    b. those who are receiving major social assistance programs (independently of the quintile, poverty etc.)

Further simulations could focus on ballpark estimates of mitigating impacts through energy efficiency measures or other measures discussed in the policy dialogue.

ANNEX B: SELECTED STUDIES FROM THE WORLD BANK AND THEIR MAIN METHODOLOGICAL ISSUES

A number of resources documents the welfare impact of energy sector reforms in countries around the world, including Coady, Flamini and Sears (2015), and the Asian Development Bank and Global Subsidies Initiative assessments of subsidy reform in Asia (https://www.iisd.org/gsi/fossil-fuel-subsidies/modelling-impacts-fossil-fuel-subsidy-reform-asia).

This annex does not seek to provide a comprehensive guide to the evidence, but rather to examine a few examples of country studies, which might provide a picture of the type of analytical challenges encountered and how they have been addressed.

ENERGY SUBSIDY REFORM IN ARMENIA. SEE KOCHNAKYAN AND OTHERS (2013).

In order to bring the prices to cost recovery, electricity and gas prices have been increased in steps from 2009 to 2013—electricity price by 17% and 28% and gas price by 37% and 18% (see figure B1). In parallel, in order to mitigate the adverse impact on vulnerable household, a discounted gas price has been applied since 2011 to Family Benefit recipients for a total gas consumption up to 300 m3/year (increased to 450 m3/year in 2013). As new investments are planned for the supply of electricity,

FIGURE B1: Evolution of the Average Prices for Gas and Electricity for Residential Customers Armenia
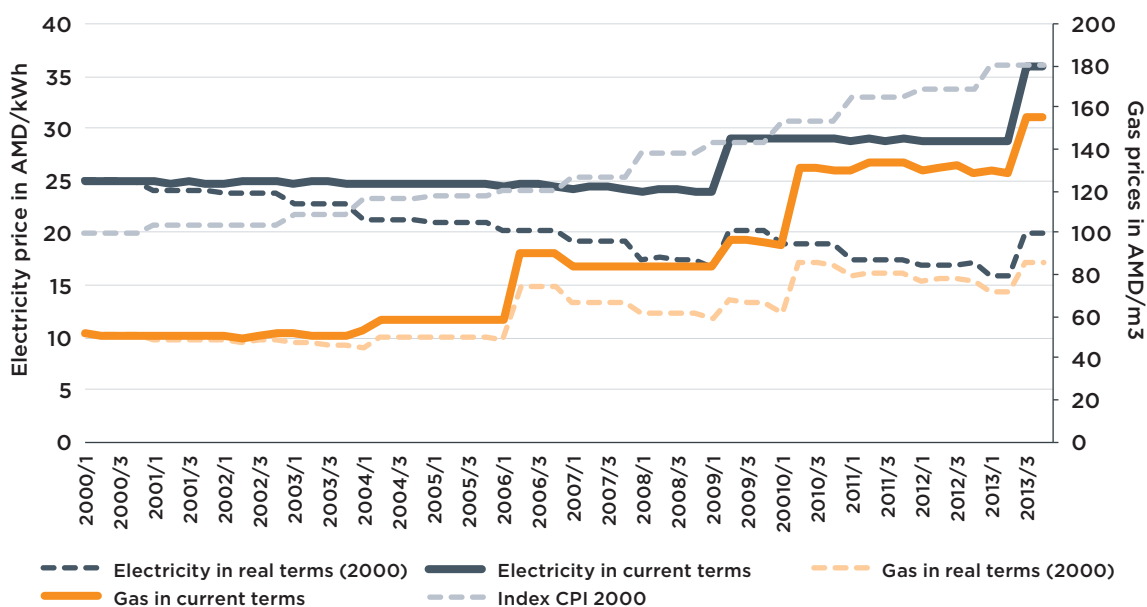
Source: ERRA database and author calculations.

significant electricity tariff increase will occur in the coming years (from 40% to 240% depending on the generation and the financing scenario).

Heating Source and Energy Expenditures

Gas is the main heating source for half of Armenian households; 44% of the poorest quintile and 57% of the wealthiest relied on gas for heating in 2012 (80% of the population has access to gas and 72% of the Family Benefit recipients). Wood is also an important source of heating (30% of all households and 36% of the poorest) along with electricity (15% in average). Energy expenditure as a share of total expenditures reaches 9% in average (gas represents 4.6% and electricity 4%), with a slight distributive pattern (8.7% for the wealthiest quintile and 9.9% for the poorest).

Distribution of the Subsidies

Prior to the gas price increase, the gas subsidy (when the tariff was assumed to be 30% below the cost recovery) was highly regressive as 39.2% of the subsidy was supplied to the wealthiest quintile and only 9% to the poorest. The new gas subsidy (the discounted tariff is 100 AMD/m3 instead of 156 for Family Benefit beneficiaries) is quite progressive as an estimated 43% of the transfer is supplied to the poorest quintile. However only 28% of the poorest quintile and 18% of the poor are covered by such scheme. For reference, the current Family Benefit program, while limited in coverage (only 36% of the poorest quintile is covered by the program in 2012), is more progressive as 52% of the transfer goes to the poorest quintile.

Impact of the Reform

Using the household survey for 2012 the combined increase in gas and electricity tariffs in 2013 is estimated to increase the share of the population living in poverty by about 2.8%, and would reach 3.5% without a gas discounted price offered to Family Benefit families.

Data and Methodological Issues Arising from the Armenian Context

Because of the gas price discount offered to a specific category of the population (Family Benefit recipients) for whom the tariff applied depends of the annual consumption, the actual tariff applied to these users is not precisely known. Using the regular tariff structure underestimates the subsidies provided to the Family Benefit recipients.

Wood cost is not correctly reported in the household survey, since only 1% of those using wood to heat their homes report wood expenditures. This prevents the highlighting of any substitution behavior in favor of wood use following the gas and electricity price increases.

The simulation of direct energy subsidy supply relies on current coverage, which was still very limited in 2012, and cannot model an extension of the program (only perfect coverage of the poorest is modelized, thus without inclusion and exclusion errors).

ENERGY SUBSIDY REFORM IN MOLDOVA. BERHOLET (2015).

Since the 2012 energy price adjustment, costs have risen continuously and energy tariffs have fallen short of cost recovery (especially for the gas bought in U.S. dollars). The implementation of the 2015 tariff adjustment decided by ANRE (Agenția Națională pentru Reglementare în Energetică), the regulatory agency for gas and electricity, has been suspended. Based on parameters influencing the end-user tariffs, the cumulative electricity tariff increase required is estimated to range between 42–61% from 2014 to 2016 and 73–113% from 2014 to 2020. The range of cumulative heat tariff increase is estimated to be 21–80% by 2016 and 30–78% by 2020. The consumer gas tariff increase is assumed to be 25% by 2016, based on the 2015 tariff adjustment decided, and the cumulative increase should reach 50% by 2020.

Energy Expenditures and Energy Mix

The Household Survey Data (2013) indicates that 80% of Moldova's population spend more than 10% of their expenditures on energy bills. On average, energy expenditure is 17% of the total, which is high compared to other countries in the region (and 21% among the poorest quintile and even 22% among isolated women). The spending pattern for energy or "energy mix" is very heterogeneous, with urban households spending 15% on utilities (central heating, gas, and electricity) while rural households spend more on solid fuel (wood and coal). Central heating is only available in the Capital City Chisinau and one secondary city (Balti) and is the main heating source in both cities. Where central heating is not available, gas use for heating increases with wealth. Energy consumption is highly seasonal with central heating and gas expenditures twice the annual average during the first quarter. However, the share of household resources spent on electricity remains rather constant across the year, since few households rely on electricity for heating. Wood is often purchased ahead of the heating season, during the third quarter.

Impact of the Reform

The estimated range of energy tariff increases would increase the average share of energy costs in total expenditures to 18–20% in 2016 and with projected economic growth, the share would decrease to 17–18% in 2020. Within the estimated range of energy tariff increases, the poverty rate is expected to increase by 1.1–1.9 percentage points in 2016 compared to a baseline and in 2020 by 1–1.5 percentage points. Wood users are vulnerable to electricity tariff increase, since they are poorer and thus more vulnerable to poverty due to a price increase.

Subsidies and Social Assistance

A heating allowance program complements the social assistance cash transfer (remaining modest with 7% of the population covered in 2014—136,000 beneficiary households—and only 12% of the poorest quintile.). It complements the Ajutor Social program to compensate the poor for increased cost of living during 5 months of heating season (flat monthly benefit of MDL 250 offered to all recipients of Ajutor Social and to those households whose income is below 1.6 times the Guaranteed Minimum Income).

Data and Methodological Issues Arising from the Moldovan Context

Seasonality is well managed in the household budget survey as for all energy items, and current month's expenditure is reported, but also the 12-month estimate (except for electricity where only current expenditure is reported). The consumption expenditure aggregate as per the Statistical Office procedure includes annual average for energy items except for the electricity (current month). Inconsistencies or missing are corrected using the current expenditures and the median reference period.

Regarding the mitigation through the Social Program, a perfect take-up could cover 446,000 households. This is not easy to simulate using the household budget survey because of all the eligibility criteria. Thus estimation is based on current coverage or perfect coverage of the poorest. Also Municipal Heating benefits in Chisinau and Balti are not reported in the survey (in Chisinau 33,000 households covered from 189,000 households targeted): The average monthly benefit paid during five months in Chisinau to gas, wood, and coal users is MDL 450 and for central heating users MDL 285, thus higher than the national Heating allowance. Average monthly benefit in Balti during five months is MDL 200.

ENERGY SUBSIDY REFORM IN UKRAINE. BASED ON UNPUBLISHED NOTES. SEE ALSO WORLD BANK (2013).

The Government of Ukraine (GoU) implemented substantial natural gas and heating tariff increases under the IMF's Extended Fund Facility (EFF) arrangements, resulting in a substantial decrease in implicit subsidies for residential users. The implicit subsidies in the form of low end-user tariffs disproportionately benefited richer households, hindered investments in the energy sector and, ultimately, proved to be extremely costly for the national budget. As part of a three-year transition to cost recovery, gas and district heating prices increased in 2014 (by 56% and 40%, respectively), and in 2015 a major gas price increase has been applied (+450% with a lifeline for households heating with gas, and consequently an increase in a district heating tariff of 70%). The devaluation of the hryvnia has eroded the impact of the tariff increase on gas, restoring a de facto universal subsidy on the 50% of yearly gas consumption that does not fall into the lifeline. In May 2016, the transitional lifeline

tariff for consumers heating with gas has been abolished and the tariff switch to a uniform tariff. In parallel, electricity tariff (increasing block) have increased twice a year since 2015. As a consequence, the average increase between 2014 and 2016 reached 470% for gas, 155% for electricity, and 190% for district heating, while the inflation reached about 70% during the same period.

Energy Expenditures

In 2013, poorer households spend a higher share of their resources on energy (almost 8% for the 30% poorest versus less than 6% for the upper 70%). 27% of the poorest quintile in large cities, and 22% of the poorest quintile in small cities and rural areas spend more than 10 % on energy (the national average is 14%). Expenditure patterns reflect the sources to which households in different locations have access: households in large cities mostly rely on district heating and gas, while in smaller cities and rural areas—mostly on gas.

Subsidies and Impact of the 2015 Reform

Existing subsidies (subsidies from the tariffs) prior to the price increase are regressive: in 2013, only 15% of the direct and quasi-fiscal subsidies are provided to the poorest quintile while 24% of the wealthiest are covered. Post energy increase, had the devaluation not occurred, the distribution of the gas subsidy would have been more progressive (17.4% to the poorest and 17.5% to the wealthiest, instead of 16.8% and 18.4% respectively with the devaluation). The lifeline per se cannot guarantee a progressive distribution of the benefits, since there are many large users of gas also among the poor. Those are poor households living in individual houses in rural areas, with very inefficient heating systems (limiting the possibility to adapt their consumption level). As a consequence, the gas implicit subsidy in 2015 is quasi-neutral. In addition, the most regressive subsidies are the ones supplied through the district heating tariff; they are still in place in 2015 (less than 11% of the district heating implicit subsidy goes to the poorest quintile while 35% goes to the wealthiest). As a consequence, the combined gas and district heating subsidies remain regressive even after the 2015 reform.

In contrast, social assistance programs, which are the main tool to address the distributional impact of the tariff increase, have become already much more progressive than they were (only 12% of the Housing and Utilities Subsidies (HUS) are supplied to the poorest quintile in 2014—where the coverage was very limited- and it would reach 36% in 2015 already if the HUS program could be extended to all eligible households). The formula for HUS calculation is based on the ratio of the cost of a normative consumption bundle to income (the total cost for a normative consumption should not exceed 15% of disposable income for a household earning the equivalent of 2 Minimum Salary per capita; it decreases for lower income levels according to a sliding scale). When energy price increases, more households become eligible for

the HUS as their consumption (normative as well than actual) increases and exceeds the threshold. Thanks to the sliding scale, about 92% of the bottom decile is eligible against 14% in the top decile. In parallel with the extension of the coverage, the generosity also increases. The updated administrative data in 2016 shows that 44% of the households were actually covered (from 4% in 2014). In order to accompany the program extension, the norms have been reduced in 2016 and 2017. Recent simulations conducted in 2017 allow the estimation of the fiscal needs for different scenarios of changes in the eligibility criteria, the distributional impact of different alternatives and the poverty impact of reducing transfers under those scenarios.

Data and Methodological Issues Arising from the Ukrainian Context

The Housing and Utility Subsidies (HUS) are based on the normative consumption, depending on the surface area of the housing and the number of persons. For each household eligible, a proportion of this normative consumption is covered, not the actual consumption. Heating being the main source of energy consumption, norms vary for heating and nonheating purposes, thus across users and across the year. Although available data are annual averages, subsidies at the household level must be calculated separately for heating and nonheating seasons then aggregated. Also because the energy price increases are significant and because they are partly compensated by HUS, no elasticity assumption can be made. All simulations are conducted holding constant consumption levels and considering total expenditures before HUS. Finally, the analysis does not include the possible effects of nonpayment, which might increase with further restrictions on HUS eligibility.

ENERGY SUBSIDY REFORM IN BELARUS. ZHANG AND HANKINSON 2015.

Despite nominal increases, residential gas, electricity, and district heating tariffs have not kept pace with rising production costs. District heating production costs in particular have risen sharply since 2005, driven by the cost of imported natural gas and depreciation of the Belarussian ruble against the U.S. dollar. Residential tariffs are currently at 11–25% of cost-recovery levels, depending on the provider and technologies used. Belarus still benefits from preferential tariff for gas imported from Russia (the US$263/tcm applied in 2011 was even reduced to US$163/tcm in 2012), but in case of an import gas price hike, financial losses in the district heating sector would more than double. The fiscal costs borne by the government reached 2.5% of GDP in 2012 and benefit disproportionately to wealthier households and the cross-subsidies imposed on nonresidential customers increase the cost of energy in all other sectors and indirectly to households.

Energy Expenditures

In 2012, since most households are connected to district heating (almost all of them in urban areas and more than half of them in rural areas), district heating and electricity each account for 40–50% of the total expenditures on energy. Energy as a share of total expenditures accounts for less than 5% of the total expenditures in 2012 and decreases with wealth (from 4.9% for the poorest quintile to 1.6% for the wealthiest).

Impact of Higher Tariffs

Study conducted using Household Survey from 2012 shows that higher tariffs will have the most impact on the poorest households—and households in rural areas. Urban customers in the poorest quintile can be expected to spend, on average, 21% of their incomes on district heating services if tariffs are set at full cost-recovery under a uniform cost-recovery price scenario. If the tariff is differentiated based on each provider cost-recovery, rural customers in the poorest quintile would spend 23% of their income on district heating services for such scenario.

Social Protection

The fiscal savings could be used to fund social protection mechanisms with better coverage and targeting. Options include expanding or topping-up the existing Public Targeted Social Assistance Program (GASP) and/or refining the Housing and Utilities (H&U) subsidies program discontinued in 2009.

Data and Methodological Issues Arising from the Belarussian Context

Since the tariff is calculated according to information on metered and unmetered customers, as well as ownership of equipment, such as water heaters and gas stoves, these variables are required to identify the tariff applied. The differentiated tariff per category of customers and per season would affect the distribution of the implicit subsidy and the distributional impact of the price increase to cost-recovery.

Remark: In Belarus household surveys, district heating expenditure was included in the "sum of payment for the use of living quarters, the maintenance and the public services," which regroup district heating, water, waste collection, and other building items. This item is further disaggregated using the ratios for typical households with the normative consumptions.

ENERGY SUBSIDY REFORM IN JORDAN. ATAMANOV, JELLEMA, AND SERAJUDDIN 2015.

The simulation of petroleum and electricity removal uses the SUBSIM tool and assesses the direct and indirect impacts of the reforms conducted in 2013, adjusting

for economic growth (GDP per capita nominal), inflation (CPI), and for population size changes, using 2010 Household Expenditure and Income Survey.

Impact of the Subsidy Removal

The study simulates the full removal of petroleum and LPG subsidies and assesses the direct impact of two scenario on the per capita consumption of households per quintile: full subsidy removal with no government mitigation measure, and full removal combined with a cash transfer program that accompanied the petroleum price increase. Both scenarios are conducted using the historical data on butane and propane from the utility Saudi Aramco contract price to calculate the efficient LPG price. Poverty would be expected to increase by 1.6 percentage points. Indirect impacts of petroleum product price increase are estimated using a Jordanian Input/Output table (I/O - 2010) with HIES data and used the disaggregated production figures of the state-owned refinery as a proxy of the industry-wide petroleum—production mix since the Jordanian I/O does not have disaggregated-by-type petroleum products statistics.

The study also simulates the removal of electricity subsidy along three scenarios (tariff increases as planned for 2015, full removal of electricity price subsidies, progressive removal of the subsidy for all consumer categories but for the first two quintiles). Full elimination of electricity subsidies is expected to increase the poverty rate by 2.4 percentage points.

ENERGY SUBSIDY REFORM IN MOROCCO. VERME AND EL MASSNAOUI. 2015. SEE ALSO KOJIMA 2016.

Food and Fuel Subsidy Reform

Morocco's subsidy system had been in place since the 1930s, with the aim of stabilizing prices for consumers, in part to protect vulnerable population groups, and to promote domestic industries. By 2007 or 2008 the rising fiscal pressure was out of the government's control. Food and fuel subsidies reached 6.6% of GDP by 2012, with the bulk (70%) going to energy products. The subsidy system was no longer achieving its objectives, as much as 75% of energy subsidies were going to the richest 20% of the population.

Launched in June 2012, the reform process was introduced in phases over three years until full price liberalization. In 2013, the government introduced a partial fuel price indexation mechanism for diesel, gasoline, and industrial fuel oil. Indexation was based on a moving average of the previous two months and entailed automatic adjustment of domestic prices when the difference between the market reference price and the domestic retail price exceeded 2.5%. In 2014, the Government of Morocco first removed subsidies for gasoline and industrial fuel oil, then the fuel subsidy for power

generation. It introduced quarterly price increases to reduce the unit subsidy for diesel and entirely eliminated diesel subsidies by the end of the year. In December 2014, the Government of Morocco signed an agreement with petroleum product suppliers. This paved the way for a transitional period between January and November 2015, during which prices would be announced by the government twice a month. LPG remains excluded from the price deregulation though, and annual subsidies have averaged DH 13–14 billion (US$1.5–1.7 billion). In addition, an agreement signed between the government and the national office for electricity and water provides for gradual retail price increases of electricity over three years to match production prices to the sale prices, which entails operational cost savings in addition to price rises of about 3.5% annually. Only the price of the first consumption bracket is maintained unchanged for low-consumption households (less than 100 kWh per month).

In parallel, the government expanded existing targeted social protection programs (support to school-age children and medical assistance for the poor), introduced new social protection programs in support of low-income widows and the physically disabled, and provided support for the public transport to compensate for the cost of higher fuel prices and limit fare increases (see figure C1).

The government implemented the policy as agreed, and deregulated prices at the end of 2015.

The compensation fund budget decreased from 72% between 2012 and 2016.

FIGURE B2: Evolution of the Total Compensation Budget
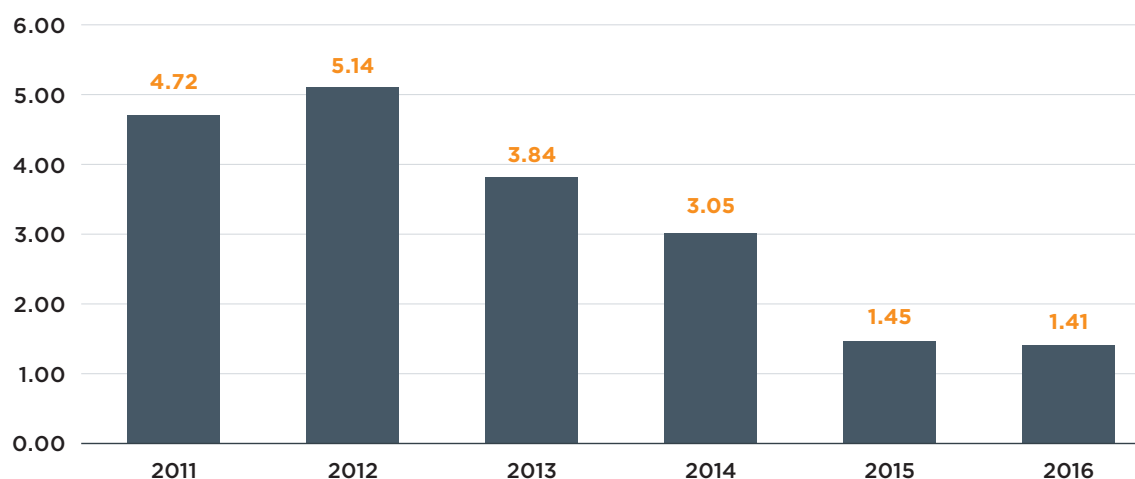
Source: Hassan Bousselmame, Réforme du système de subvention au Maroc. Communication June 2017.

Simulation of the Welfare Effect of the Reforms Implemented between January and October 2014

Direct effects (using household expenditure data)

The elimination of subsidies reduces welfare by about 1% on average with the impact being larger for the poorest quintile (-0.61%) as compared to the richest quintile (-1.07%). The transformation of the upper three blocks in volume-differentiated tariffs (VDTs) has been much more significant for water than for electricity, despite the fact that the water sector had no subsidies and that tariffs per block have not changed. Hence, the change in tariffs structure toward a VDT system can have an even greater impact on welfare than the simple increase in prices.

TABLE B1: Welfare Effects of the 2014 Reform, Direct Effects, million Moroccan dirhams

	Electricity	Water	Gasoline	Diesel	Total	Total (% of expend.)
Quintile 1	-118.0	-94.5	-0.3	-1.1	-213.9	-0.61
Quintile 2	-241.4	-263.7	-1.4	-4.5	-511.1	-0.87
Quintile 3	-366.5	-462.5	-6.3	-20.6	-855.9	-1.04
Quintile 4	-490.8	-677.8	-17.6	-57.1	-1,243.2	-1.05
Quintile 5	-1,182.0	-1,221.2	-154.1	-502.7	-3,060.0	-1.07
Total	**-2,398.7**	**-2,719.8**	**-179.7**	**-586.0**	**-5,884.1**	**-1.01**

Source: Verme and El Massnaoui (2015).

Indirect Effects Using I/O Data Combined with Household Data

With I/O tables, it is not possible to simulate price increases by product or by tariff block, given that the I/O tables are aggregated by sector. Therefore, averages prices are used across products belonging to the same sector or across tariffs blocks.

The shock to the petroleum sector is a price increase of 11.15%, which is an average of the price shocks applied to diesel and gasoline. The assumption here is that gasoline and diesel have a similar weight in the I/O oil refining sector and that they represent the almost totality of the sector. The price shocks applied to electricity is 2.1%, which is an average price increase across tariffs blocks weighted by the number of households in each block.

Results of the simulations show that the relation between direct and indirect effects varies significantly across products and across quintiles. When simulated independently, indirect effects are 88% of the total for petroleum products and 37% for electricity (see table B2). The relative weight of indirect effects is also different

across quintiles. Indirect effects on petroleum products are the quasi-totality of effects for the first (poorest) quintile while they become 81.33% for the upper quintile. This is understandable because the poor consume very little gasoline and diesel. Instead, for electricity, indirect effects represent 30.1% of total effects for the first quintile, and this share increases to 42.17% for the fifth quintile. That is because the coverage of electricity is very large in Morocco, and many if not most of the poor consume electricity.

TABLE B2: Indirect Effects of 2014 Reform (% of total effects)

	Petroleum	Electricity
Quintile 1	99.55	30.10
Quintile 2	98.87	30.31
Quintile 3	96.48	30.52
Quintile 4	93.43	33.89
Quintile 5	81.33	42.17
Total	**87.79**	**36.55**

Source: Verme and El Massnaoui (2015).

ANNEX C: THE MEASUREMENT OF ENERGY POVERTY

Energy poverty, a measure of deprivation that seeks to capture affordability problems as they relate to energy, is an indicator mostly used in Europe and Central Asia, where energy bills can represent very high shares of total household income due to heating expenses. The concept is enshrined in Third Energy Package of legislative proposals for common rules for the internal electricity and gas markets of the European Union (EU), adopted and entered into force in 2009, though not explicitly defined. While only one-third of EU Member States (EU MS) have defined it, the Third Energy Package also requires EU MS to formulate national energy action plans to provide benefits through the social assistance system or to improve energy efficiency for the energy poor.

The concept is generally approximated through a dichotomous variable that captures those who spend more on energy than a given share of their household budget, typically 10%. The 10% threshold was originally defined in the United Kingdom to measure "fuel poverty," with reference to twice the median consumption of low-income households, but has since been used rather mechanically as opposed to in reference to a specific context. This measure of energy poverty is often contested as a basis for targeting support to ensure energy affordability, since it includes an element of preference. In this respect, a major contribution has been made by the Hills report in the United Kingdom (Hills 2012), which suggests identifying households that have both low income and high energy needs as those affected by energy poverty. The report also emphasizes how energy (fuel) poverty per se is not just a facet of income poverty, but a specific challenge requiring a dedicated policy strategy.

Another approach to measuring energy affordability is to focus on the share of domestic energy expenditure in final consumption expenditure for the lowest quintile—the share of energy-related expenditure in total household expenditure for the poorest 20% of the population. Such a share can be examined either by how it is affected by tariff increases, or in reference to the share for another type of basic consumption item (such as food, health, or education) to give a sense of the competing priorities on limited budgets such low-income households might face.

The revised definition of *fuel poverty* in the United Kingdom states that a household is said to be in fuel poverty if they have required fuel costs that are above average (the national median level) and, were they to spend that amount, they would be left with a residual income below the official poverty line.

ENDNOTES

1   The note draws extensively on an earlier methodological piece focused on the analysis of ESRs in the Eastern Europe and Central Asia region of the World Bank (Olivier 2016).

2   Note that some of these effects might be implicitly part of the reform—for example, if ESR is accompanied by measures to increase access or improve accountability of local utilities—or might be part of its "side effects," such as by making local utilities solvent and therefore capable of improving quality, or if they result in the elimination of energy shortages.

3   Proponents of energy subsidies typically argue that energy subsidies help make energy affordable for lower-income groups; facilitate access to improved household energy sources (as opposed to traditional biomass), particularly in rural areas where unsubsidized prices can become prohibitively high; facilitate the shift from more-polluting to less-polluting fuels, such as from solid fuels or kerosene burned in wick stoves to LPG (liquefied petroleum gas) or natural gas; or help shield the economy as a whole from volatile energy prices. All of these points are hotly contested, since critics focus on energy subsidies' ability to achieve these objectives, as well as on their side effects.

4   For example, in Indonesia, it has been estimated that the population that would enter poverty following a reduction in fuel subsidies would increase by 0.4 percentage points based on official price increases (Dartanto 2013). Impacts of about 5 percentage points have been estimated for Egypt (World Bank 2005; Soheir, El-Laithy, and Kheir-El-Din 2009), but arguably these represent the very top of the distribution of effects, since fuel subsidies there were both very high and pervasive. While estimates vary significantly with the methodology used, the studies quoted appear to cover the spectrum of poverty impacts typically found in empirical analyses.

5   For example, using a computable general equilibrium model, Burniaux and Chateau (2011) show that a coordinated subsidy removal could reduce the competitiveness of energy-intensive industries in certain economies (especially in Indonesia, Nigeria, Venezuela, and the Middle East), which in turn would reduce employment in that sector to the extent that labor is not a good substitute for energy inputs. Note, however, that this drop in competitiveness would be accompanied by higher incomes resulting from increased fossil fuel exports. In addition, EU experience suggests that reliable energy supply and a productive labor force, wider access to markets, and so on, are significant drivers of industrial competitiveness—so that an emphasis on fuel prices might only prove reductive.

6   Some transitional measures (cash transfers) can exacerbate the inflationary impact of ESR (see, for example, Clements and others 2013). Note that the finding on the magnitude of indirect effects is likely to be significantly overstated due to 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 as short-term effects or upper bounds of the long-term effects (see also Good Practice Note 7 for more details on these assumptions).

7   Recent evidence on the shift from fuels to biomass has been provided, for example, by the recent policy pilots in India, involving switching from in-kind to cash benefits for LPG and kerosene. Because of the specific design of those measures, household facing poor banking facilities and other barriers to accessing the benefit dramatically reduced their consumption of fuels (Lang and Wooders 2012).

8   Available estimates of the price elasticity of demand vary substantially by type of fuel and with the level of income per capita in a country. A recent review (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. The income elasticity of demand for fuels is much larger in magnitude than the price elasticity. Vagliasindi (2013) reports that long-run elasticities are significantly higher than short-run elasticities. Zhang (2011) estimates the price elasticity of demand for electricity by different groups and finds that demand from poorer households is significantly more inelastic than that from richer households.

9   In addition, the table does not capture complexities, such as policies that may lower the price of LPG relative to kerosene for the very poor.

10 Consumption patterns in Eastern Europe and the former Soviet Union depart markedly from those in most other regions, because of the essential need for heating in winter, limiting the extent to which consumption of energy for space heating can be curtailed. Another distinguishing feature of Eastern Europe and the former Soviet Union is that natural gas and district heating networks may be extended to rural areas in some countries, whereas natural gas pipeline networks in rural areas are virtually unheard of in other regions of the world.

11 Similarly, in the case of networked utilities, subsidies often result in insufficient investment in the sector by the utility, which over time loses the ability to provide services of appropriate quality. Improvements in service quality (for example, reductions in blackouts) following removal of subsidies are not captured in the table.

12 Note that the two questions of "who benefits from the subsidies" and "who is going to be mostly affected by their removal" are very different—it is commonly found, indeed, that those that benefit the most are the better off, since they consume more, while poorer groups are the most affected, since their consumption of subsidized goods represents a larger share of their budgets.

13 In addition, the analysis of household survey data can also help quantify the resources absorbed by the subsidies, that is, the size of the overall subsidy. Such an assessment is partial, however, since it would cover only the household sector. A full quantification of the size of subsidies in the energy sector is discussed in Good Practice Note 1. In addition, while household survey data should provide an accurate estimate of the resources distributed to households through energy subsidy programs, such estimates should at best be considered an approximation, since at the very least they do not include the cost of administration of the program.

14 The ADePT Social Protection module, for example, offers an easy way of calculating key performance indicators of social protection measures and can be downloaded at http://go.worldbank.org/1HHHLLELG0.

15 In the incidence literature, generosity is typically measured as a share of pretax and pretransfer income (that is, at market income). It can also be done at post-transfer income or post-consumption.

16 In certain countries, policy makers are interested in specific categories that are predetermined as "vulnerable," such as pensioners, the unemployed, and single parents.

17 Access should ideally be defined in terms of "the ability to avail energy that is adequate, available when needed, reliable, of good quality, convenient, affordable, legal, healthy and safe for all required energy services" (https://www.esmap.org/node/55526). This definition, which is at the basis of the Multi Tier Monitoring Framework for the SGD 7 involves focusing on the energy services available to the household, independently of the technology that provides it and recognizing that energy access refers to a spectrum of service levels (http://www.se4all.org/sites/default/files/Beyond-Connections-Introducing-Multi-Tier-Framework-for-Tracking-Energy-Access.pdf). While new tools (such as new household surveys and modules that can be integrated into existing surveys) are being deployed, however, existing surveys might allow the measurement only of more simplistic binary measures of access.

18 An example might clarify. When trying to compare whether an existing targeted program (Program A, targeted based on 3 indicators combined as a proxy for low income) should be used to provide compensation, or whether a new program with better targeting (Program B, at the moment only discussed in policy circles, targeted based on a proxy constructed with 5 indicators) should be used, using data on real life recipients of Program A versus data on those who would theoretically be recipients of Program B biases the outcome in favor of Program B, as it implicitly assumes that Program B would have perfect take up.

19 This loss of purchasing power, assuming a 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 their initial level of consumption.

20 We do not retain here the notions of Equivalent Variation or Paasche Variation, since 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 of the consumption. These two measures are commonly used in the fiscal literature where the reference period is the one after the change in price.

21 Note that estimates of the relevant elasticities are hard to come by. Zhang (2011) used the consumer surplus change to approximate the welfare impact of an electricity price increase in Turkey in 2008 after estimating the demand function, allowing the elasticity to vary with income. She estimates an electricity own price elasticity of -0.08 for the poorest quintile and -0.5 for the wealthiest. These results confirm the finding highlighted by the qualitative literature on Eastern Europe that poorer households have a lower price elasticity, since they are closer to a subsistence level. 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 elasticity is likely to be significant. Finally, note that in cases of acute shortages, the price elasticity may even be positive.

22 Longer-term effects taking into account these adjustments would require the use of a more sophisticated Computable General Equilibrium Model, also relying on an I/O table, yet allow the behavior of firms and consumers to be fully flexible, as detailed in Good Practice Note 7.

23 If energy prices have been frozen at a time of high inflation, as is often the case with utilities, this step is all the more necessary.

24 SUBSIM, as described below, allows also the tariff to be nonlinear, with increasing block or volume-differentiated design.

25 Those can be downloaded from http://www.imf.org/external/np/fad/subsidies/index. htm, under "tools."

26 Local knowledge, either through exploring the local press (including through such resources as Factiva) or by relying on local experts, can provide evidence of rationing. Such evidence might be particularly hard to identify if shortages are very localized.

27 The considerations made above on the difficulties of accounting for rationing or spatial disparities in prices would therefore be relevant also in this context.

28 When analyzing a price change resulting from government policies, the proportion of Traded/Non Cost-Push sectors in the sectoral outputs can be ignored and the framework can be reduced to a Cost Push and Controlled sectors (price change either fully pushed onto output /retail prices or controlled by the government).

29 See Inchauste and Jellema (2016) for more detailed steps.

30 See endnote 26.

31 These do-files can be downloaded from http://www.imf.org/external/np/fad/subsidies/ index.htm, under "tools."

32 In the analysis of residential utilities, the survey might collect information on different variables, including actual cash expenditure for utility consumption, cash transfers for energy consumption, and arrears and fines. If the focus of the analysis is on the financial burden on households, the actual expenditure for consumption should be used excluding cash transfers targeting energy consumption (whose impact should be analyzed separately) and potential arrears or fines. Similar adjustments should be conducted on the aggregate expenditure variables for consistency.

33 For example, in Eastern European surveys often district heating and hot water are grouped under a single expenditure item.

34 Cooling needs might not be very relevant to the analysis of low-income countries if the use of air conditioning is limited to few better-off households.

35 See endnote 17.

36 See, for example, http://www.se4all.org/sites/default/files/Beyond-Connections-Introducing-Multi-Tier-Framework-for-Tracking-Energy-Access.pdf.

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Energy Subsidy Reform Assessment Framework

LIST OF GOOD PRACTICE NOTES

NOTE 1   Identifying and Quantifying Energy Subsidies

NOTE 2   Assessing the Fiscal Cost of Subsidies and Fiscal Impact of Reform

NOTE 3   Analyzing the Incidence of Consumer Price Subsidies and the Impact of Reform on Households — Quantitative Analysis

NOTE 4   Incidence of Price Subsidies on Households, and Distributional Impact of Reform — Qualitative Methods

NOTE 5   Assessing the readiness of Social Safety Nets to Mitigate the Impact of Reform

NOTE 6   Identifying the Impacts of Higher Energy Prices on Firms and Industrial Competitiveness

NOTE 7   Modeling Macroeconomic Impacts and Global externalities

NOTE 8   Local Environmental Externalities due to Energy Price Subsidies: A Focus on Air Pollution and Health

NOTE 9   Assessing the Political Economy of Energy Subsidies to Support Policy Reform Operations

NOTE 10   Designing Communications Campaigns for Energy Subsidy Reform

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