INTERNATIONAL MONETARY FUND

Surging Energy Prices in Europe in the Aftermath of the War: How to Support the Vulnerable and Speed up the Transition Away from Fossil Fuels

Anil Ari, Nicolas Arregui, Simon Black, Oya Celasun, Dora Iakova, Aiko Mineshima, Victor Mylonas, Ian Parry, Iulia Teodoru, and Karlygash Zhunussova

WP/22/152

2022
JUL

WORKING PAPER

 WP/22/152

IMF Working Paper
European and Fiscal Affairs Departments

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Authorized for distribution by Oya Celasun and Dora Iakova
July 2022

ABSTRACT: We estimate that the recent surge in international fossil fuel prices will raise European households' cost of living in 2022 by close to 7 percent of consumption on average. Household burdens vary significantly across and within countries, but in most cases they are regressive. Policymakers have mostly responded to the shock with broad-based price-suppressing measures, including subsidies, tax reductions, and price controls. Going forward, the policy emphasis should shift rapidly towards allowing price signals to operate more freely and providing income relief to the vulnerable. The surge in energy prices will encourage energy conservation and investments in renewable energy, but the manyfold rise in natural gas prices could lead to a persistent switch towards coal. To ensure steady progress towards carbon emissions reduction goals, authorities could use the opportunity to strengthen carbon pricing when global fossil fuel prices decline in the future. Non-price incentives for investments in energy efficiency and renewable energy should also be enhanced, as envisaged in the RePowerEU plan.

RECOMMENDED CITATION: Ari, A., Arregui, N., Black, S., Celasun, O., Iakova, D., Mineshima, A., Mylonas, V., Parry, I., Teodoru, I., & Zhunussova, K. (2022). Surging Energy Prices in Europe in the Aftermath of the War: How to Support the Vulnerable and Speed up the Transition Away from Fossil Fuels. *IMF Working Papers, 2022/152*

JEL Classification Numbers:	H22, H23, N50, O13, Q41, Q48, Q51, Q54, Q56, Q58
Keywords:	energy prices, price pass-through, household incidence, distributional analysis, social programs, carbon pricing, climate mitigation

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WORKING PAPERS

Surging Energy Prices in Europe in the Aftermath of the War: How to Support the Vulnerable and Speed up the Transition Away from Fossil Fuels[1]

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[1] Wei Zhao provided excellent research assistance and Marizielle Evio provided expert editorial assistance. The authors thank Laura Papi, Romain Duval, and James Roaf for helpful suggestions.

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I. Introduction

1. Global fossil fuel prices started to recover in 2021 and soared in early 2022 upon Russia's invasion of Ukraine, creating a challenging environment for policymakers. Combined with a rise in food prices due to the war and other non-energy goods' prices amidst pandemic-driven supply bottlenecks, the boom in the price of imported fuels contributed to a sharp increase in overall consumer prices, with inflation rates reaching double digits in many European countries. Governments have responded with a broad range of temporary relief measures to ease the burden of higher energy costs on households and firms. With part of the rise in energy prices expected to be persistent and the fiscal burden of support growing in the context of lower overall national incomes due to the negative terms-of-trade shock, designing support policies in a cost-effective manner remains a key challenge for policymakers. Another open question is what the surge in energy prices means for European countries' policies for reducing fossil fuel emissions.

2. This paper aims to answer the following questions:

- How much of the rise in international energy commodity prices been passed on to retail energy prices so far? What explains the variation in pass-through across European countries?
- What is the distributional impact of the increase in retail energy prices across households? How much would it cost for governments to compensate the more economically vulnerable households for some of the increase in energy prices?
- What is the appropriate design of support measures for households and firms? How do the actual measures taken by European governments so far measure up?
- What are the implications of the rise in energy prices for climate policies?

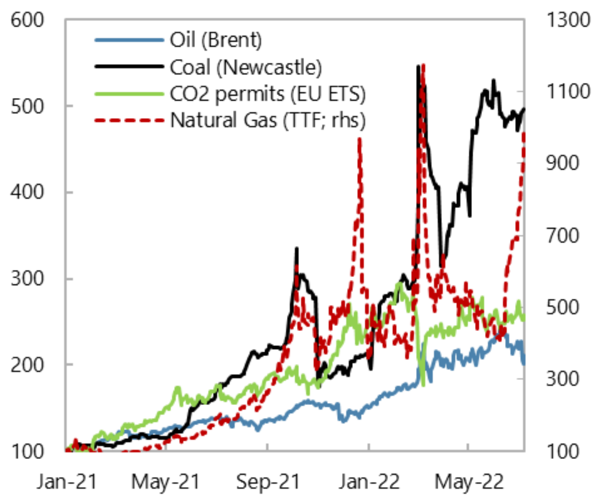
3. The paper is organized as follows. The next section documents the pass-through of international energy commodity to retail prices. The significant variation in pass-through across commodities and countries reflects differences in the structure of energy markets, regulations, and tax policies. The third section presents model-based estimates of the impact of higher energy prices on household budgets at different points of the consumption distribution. The estimated impact of higher energy prices is regressive in many countries, but not in all. The fourth section presents a set of principles that should guide policy responses and summarizes the actual measures taken by European governments to cushion the impact of the energy price surge so far. The fifth section discusses climate policy implications of high fossil fuel prices and the drive for energy security, followed by the final section with a summary and conclusion.

II. Recent Energy Price Developments in Europe

4. Global fossil fuel prices have surged over the past eighteen months. Prices started increasing in 2021 as global demand recovered after the pandemic, while supply remained tight following years of subdued investment in the energy sector (IMF, 2022a). Upon Russia's invasion of Ukraine in early 2022, prices soared to historically high levels, especially for natural gas, given the risk of disruptions to trade in energy commodities and concerns over future supply (Figure 1-a). Russia has a large footprint in global natural gas, crude oil, and coal markets, accounting for about 20, 10, and 5 percent of global exports of those commodities, respectively, and is deeply integrated into Europe's markets and distribution networks (in 2020, it supplied 35, 25, and 45 percent of the natural gas, crude oil, and coal imports of the EU and the U.K. combined).[2] By the end of the first quarter of 2022, crude oil prices had doubled, coal prices tripled, and natural gas prices increased more than five-fold relative to early 2021. Futures prices suggest that these increases have a significant permanent component. Relative to prices expected in early 2021, about half of the increase in crude oil and coal prices is expected to last through 2026, while for natural gas, about a quarter of the increase is expected to persist through 2026 (Figure 1-b). Meanwhile, the price of carbon allowances in the EU cap-and-trade system more than doubled, to about €75 per metric ton of CO_2 over the same period, driven by the adoption of more ambitious emissions reduction goals by the EU.[3]

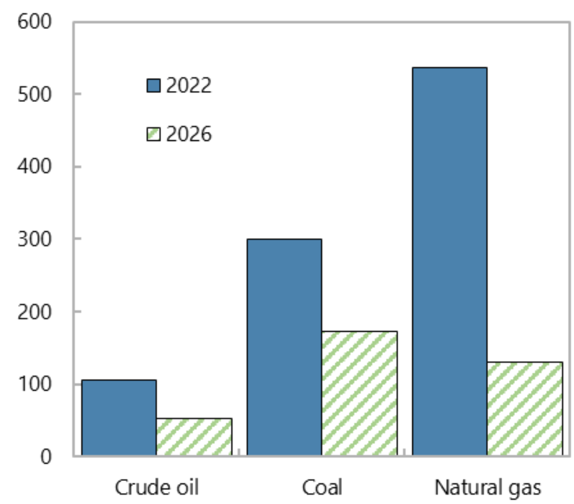
Figure 1. International Fossil Fuel Prices

1-a. Primary Energy Commodity Prices (Index 01/01/2021=100)



Sources: Bloomberg Finance L.P., and IMF staff calculations. Data as of July 7, 2022.

1-b. Difference in Prices Projected for 2022 and 2026 in June 2022 vs. January 2021 (Percent)



Sources: Bloomberg Finance L.P.; and IMF staff calculations. Notes: Oil prices correspond to the Brent Crude Oil index, coal prices to the simple average of the Newcastle and Richard Bay indexes, and natural gas prices to the Netherlands TTF index. The calculations are based on annual averages of futures prices as of June 20-24, 2022.

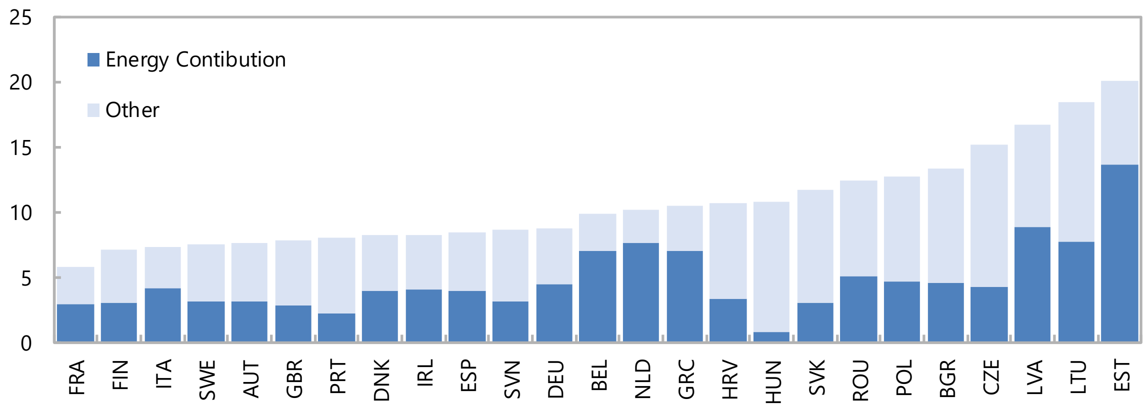
5. The rise in energy prices added substantially to headline inflation in Europe. The weight of energy goods and services in the consumer price indices (CPI) varies between 5 and 15 percent in most of Europe. Despite these modest shares, given the fast rise in prices, energy items directly accounted for about half of the annual CPI inflation rates in May 2022. The contribution to CPI inflation exceeded 3 percentage points (pp) in most countries, and was greater than 5 pp in Belgium, Estonia, Greece, Latvia, Lithuania, the Netherlands, and Romania (Figure 2).

[2] Several European countries (including Austria, Czechia, Germany, Hungary, and the Slovak Republic) receive an important share of their natural gas supplies through pipelines from Russia, and lack domestic LNG terminals or sufficient pipeline connections to other countries that would allow them to fully replace Russian supplies in the short term.

[3] The price of EU ETS permits dropped significantly at the onset of the war in Ukraine but has since partially recovered. At around €88 per metric ton of CO_2 by mid-May 2022, it remained significantly above early 2021 levels of just above €30 per metric ton of CO_2.

Figure 2. Contribution of Energy Prices to Consumer Price Inflation, May 2022

(YOY, in percent)



Sources: Haver Analytics, and IMF staff calculations

6. Differences in wholesale markets, regulations, policy measures, and contracting practices can help explain the cross-country variation in retail energy price inflation. While wholesale prices for gasoline and natural gas are relatively uniform across countries in continental Europe, wholesale prices for electricity can differ significantly depending on the fuel mix used in power generation. The pass-through from international energy commodity to retail prices tends to be faster for transport fuels (gasoline and diesel) than for natural gas and electricity. The frequency and magnitude of adjustments in retail electricity and natural gas prices are determined by regulations, contracting practices, and government interventions, which vary significantly across countries. Eventually, however, suppliers are likely to pass cost increases on to consumers.

Wholesale Markets for Energy

7. Wholesale spot prices for natural gas have increased to record high levels uniformly across European continental markets.[4] Prices in Europe have moved broadly in tandem with prices in the Asian market (which includes the largest net importers of natural gas other than the EU) but have diverged from those in the United States. Price convergence across European continental wholesale hubs (shown in the gray shaded area in Figure 3-a) has remained strong so far, given only partial disruptions to fossil fuel imports and still-available fuel storage supplies.[5] However, some market segmentation could emerge within Europe in case of a full shut-off of natural gas flows from Russia, given the diversity in access to LNG imports at present.[6]

[4] Spot prices in the U.K. hub, measured by the National Balancing Point (NBP)—index, have typically moved together with spot prices in continental European hubs. Nonetheless, starting in April 2022, high import volumes of liquefied natural gas (LNG) and limited capacity to pipe gas on to Europe have driven UK wholesale prices down, reaching a record discount relative to the Title Transfer Facility (TTF).

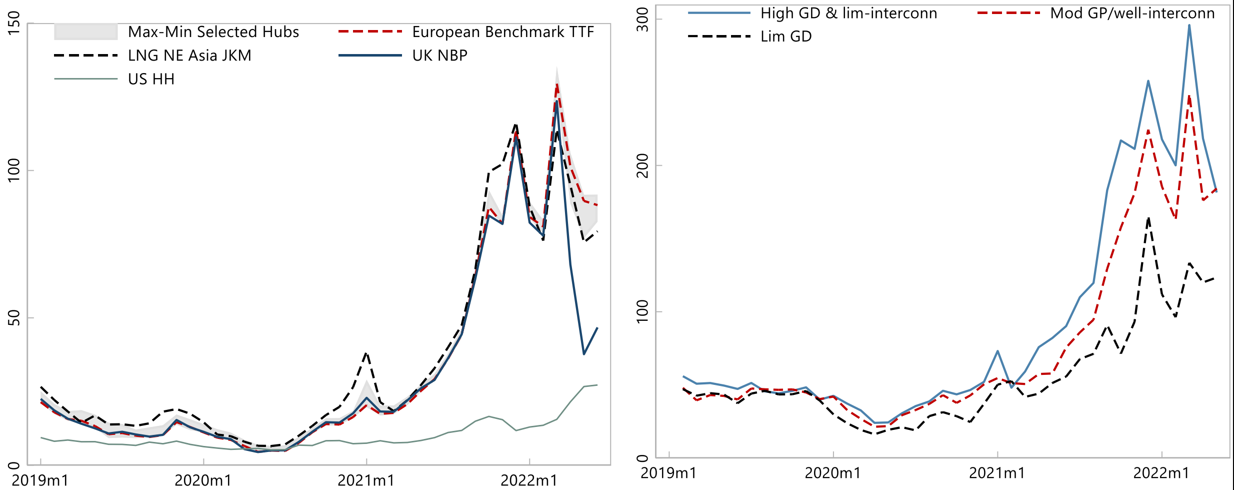
[5] High price levels usually magnify differences between differentially priced gas import-contracts (ACER 2022). Hub-based contracts are linked to spot prices, moving in tandem with them. Other types of contracts may instead, for instance, be linked to oil prices or forward natural gas price contracts. It might, then, take some time for spot prices to filter into import contract pricing. Information on long-term contracts is limited, and the latest available proxies are for 2021Q4 (EC 2022).

[6] For an analysis of potentially more severe disruptions, see Di Bella et al. (2022) and Lan et al (2022)..

Figure 3. European Wholesale Natural Gas and Electricity Prices

3-a. Wholesale Natural Gas Prices (€ per MWh)

3-b. Wholesale Electricity Prices (€ per MWh)



Note: European gas hubs include NLD, DEU, AUT, FRA, POL, ESP, ITA.

Note: GD=Gas dependency. Country grouping, based on ACER (2021), reflects the degree of gas dependency in electricity generation (high/moderate/limited) and grid interconnectedness (limited/well).

Sources: Bloomberg Finance L.P., European Association for The Cooperation of Transmission System Operators for Electricity (ENTSOE), and IMF staff calculations.

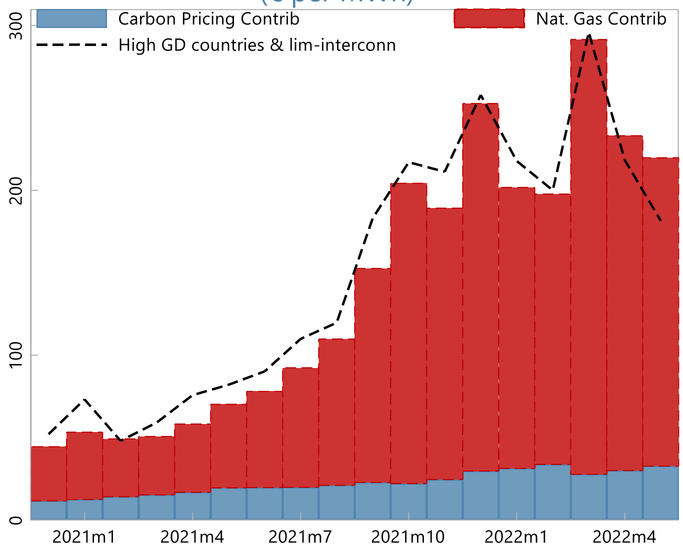
8. European wholesale electricity prices have increased significantly as well, but with differences across countries (Figure 3-b). A decomposition exercise (Figure 4) suggests that the rise in natural gas prices accounts for about 90 percent of the increase in wholesale electricity prices since 2021Q1,[7] with higher carbon prices in the EU Emissions Trading System (ETS) accounting for about 10 percent.[8] The reason for the tight relationship between natural gas and electricity prices is that wholesale electricity markets in the EU follow a "marginal" pricing system, in which the bid with the highest price (among all accepted bids to meet consumer demand) sets the overall price. In hours of high electricity demand, this is usually a fossil fuel plant (typically, a natural gas plant).

[7] The decomposition considers the variable costs (including CO_2 emissions costs) of a theoretical, combined-cycle gas turbine plant with a thermal efficiency of fifty percent based on natural gas prices in line with the estimations in ACER (2021) and BdE (2021).

[8] In wholesale electricity markets, producers (power plants) sell electricity to retailers (utilities), who deliver it to their clients.

Figure 4. Wholesale Electricity Price Decomposition

(€ per MWh)



Sources: Bloomberg Finance L.P., ENTSOE, and IMF staff calculations.

Note: GD=Gas dependency. Methodology follows BoS (2021), ACER (2021). The dotted line shows the simple average for countries with high dependency on natural gas in electricity production and limited grid interconnections, per the ACER (2021) classification. This includes ESP, IRL, ITA, PRT and GBR.

9. Wholesale electricity price variation across countries reflects varying shares of natural gas in the electricity generation mix and the extent of electricity market interconnectedness with neighboring countries. Price increases have been more prominent in countries with high natural gas dependency and relatively more limited electricity interconnections (e.g., Ireland, Italy, Portugal, Spain, and the U.K.). A higher dependency on natural gas implies that it is more frequently the marginal price setter, and limited interconnectedness constrains the extent to which electricity can be imported from areas with lower prices. Conversely, price increases have been more subdued in countries with very limited fossil fuel reliance in their electricity generation mix, where most electricity is produced using renewables, including hydro (e.g., the Nordic countries).

Retail Markets and Consumer Prices of Energy

10. The pass-through of higher wholesale prices to retail energy prices has varied significantly across products and countries. The retail pass-through is affected by a variety of factors.[9] First, the ratio of wholesale prices to final retail prices varies across countries, reflecting tax/levy structures and network fees which do not necessarily move in tandem with wholesale prices. For instance, fuel duties are typically levied on a per-liter basis. As such, a one-percent increase in wholesale prices typically results in less than a one-percent increase in retail prices, and the extent of this "dilution" varies across countries based on the level of duties.[10] Moreover, governments have adopted a variety of measures to smooth retail energy prices since Fall 2021, such as a reduced Value-Added Tax (VAT) or excise taxes, which have contributed to differences in observed pass-through

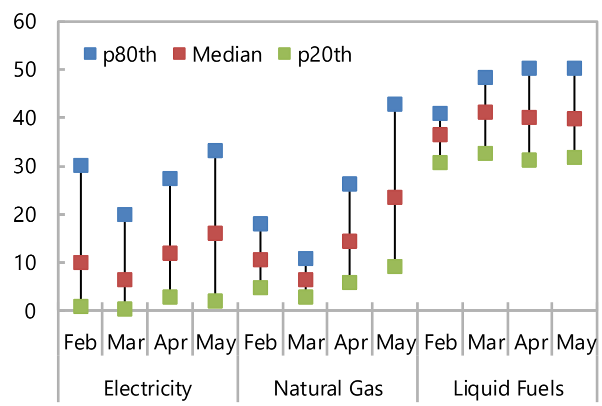
[9] See EC (2022), ECB (2016), ECB (2010), and ECB (2006).

[10] In the EU, taxes other than the VAT and recoverable levies as a share of total prices net of taxes and levies range between 50 and 100 percent for retail gasoline, between -20 (related to a household refund in the Netherlands) and 120 percent for retail electricity, and between 0 and 125 percent for retail natural gas.

across countries. Second, different regulatory frameworks and government interventions influence the frequency or magnitude of price changes by utility companies. For instance, over the period 2017–2021 retail electricity prices have been updated, on average, less than twice a year in Hungary, Croatia, Bulgaria, Lithuania, Slovakia, and Poland, while they were adjusted monthly in Finland, Latvia, Belgium, Estonia, Spain, and Sweden.[11] Third, energy retailers' contracting practices also differ across countries, with a varied reliance on dynamic pricing, for instance.[12] Finally, methodological differences in inflation measurement may also lead cross-country variation in retail energy price inflation. The scope of prices measured is not necessarily the same across countries.[13]

Figure 5. Observed Pass-through, 2022

(In percent)



Source: Bloomberg Finance L.P., ENTSOE, Haver Analytics, and IMF staff calculations.
Note: Pass-through is computed as the ratio (in percentage) of retail to wholesale y-o-y inflation. Wholesale inflation is measured by the TTF Index for natural gas, and by Brent Crude Oil Index for liquid fuels. All underlying variables are in Euros.

11. The observed pass-through of international crude oil prices to transport fuels has been larger than that of coal and natural gas prices to retail electricity and natural gas prices (Figure 5). This reflects a faster speed of adjustment of fuel prices in general (Figure 6) and fewer mitigating measures for transport fuels (than for retail electricity and natural gas) until recently. Retail natural gas and electricity prices are revised less frequently by utility companies, so they take, on average, longer to adjust to a rise in wholesale prices. This suggests retail prices of electricity and natural gas are yet to reflect the commodity price surge in many countries. Importantly, delayed adjustment in retail prices relative to increases in domestic energy commodity prices, translates into cost pressures on utility companies and/or the government. The way in which retail contracts are set also drives different speeds of retail price adjustment across countries. The adjustment is typically fast in countries with a high prevalence of dynamic pricing for retail customers. Only seven EU retail electricity markets have dynamic pricing systems (EC 2019), and coverage of these systems is only high in Estonia, Sweden, and Spain (Boeve et al. 2021).

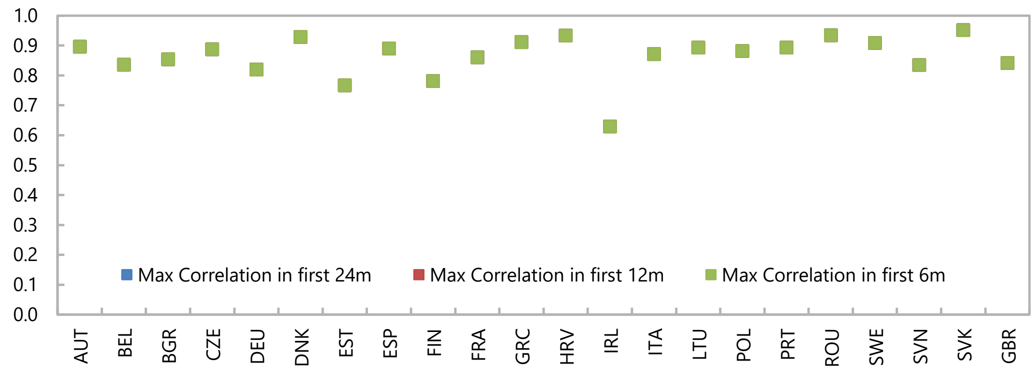
[11] As measured by the electricity Harmonized Index of Consumer Prices (HCPI) subcomponent at a two-digit precision and a monthly frequency.

[12] Dynamic pricing systems are characterized by a high frequency of price updates. For instance, this may be the case if retail prices are stipulated as a function of wholesale prices (plus a given mark-up, taxes, and other fees).

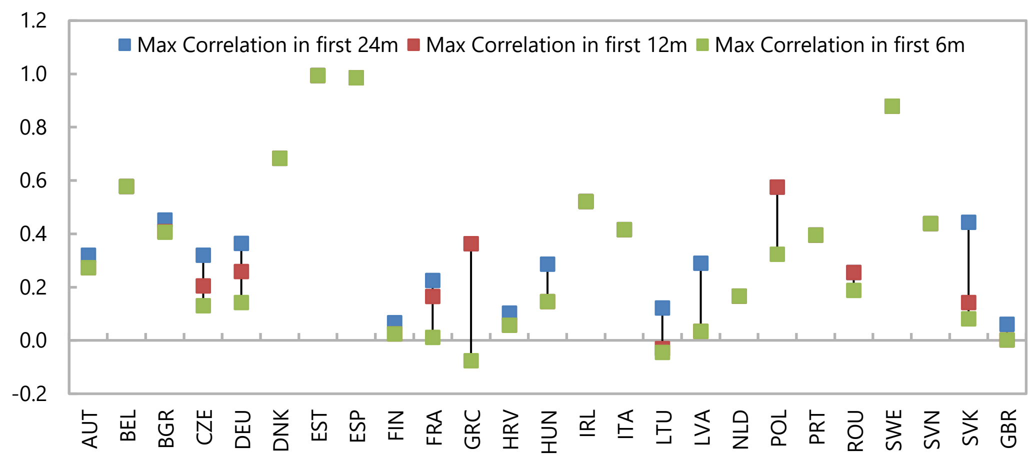
[13] For instance, the HCPI is based on the price of new energy contracts in the Netherlands, while in Spain it is based on the regulated electricity market (which is directly linked to wholesale markets). In Estonia, data on electricity prices are collected centrally from the Nord Pool power exchange and may not fully reflect effective prices paid by households, on account of a significant share of fixed-price contracts. These methodologies imply that measures based on the observed HICP overstate pass-through rates faced by households in some countries.

Figure 6. Correlation in Wholesale and Retail Energy Prices

6-a. Correlation Between Wholesale and Retail Prices of Liquid Fuels (2015–2021H1)



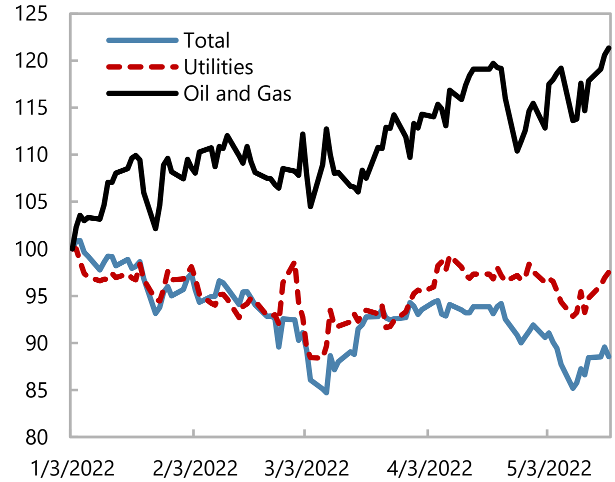
6-b. Correlation Between Wholesale and Retail Electricity Prices (2015–2021H1)



Source: Bloomberg L.P., ENTSOE, Haver Analytics, and IMF staff calculations.
Note: Correlations computed based on monthly data. Wholesale prices are measured by the Brent Crude Oil Index for liquid fuels. Wholesale electricity prices are country-specific. Retail prices are measured by the corresponding HICP subcomponent. All underlying variables are measured in Euros. For some countries, fewer than three squares may appear due to overlap in the Figure.

Figure 7. Stoxx Europe 600 Equity Valuation

(Index Jan. 3 2022=100)



Sources: Datastream, and IMF staff calculations.

12. The fossil fuel price surge has generated windfall gains for some energy producers, while others have registered losses. Surging energy prices may create a gain in producer surplus in some cases, while household (consumer) surplus shrinks. Domestic extractive industries (where present) benefit from strong fossil fuel prices (Figure 7); for instance, the primary production of natural gas, oil, and solid fuels amounts to more than a fifth of gross available energy in Bulgaria, the Czech Republic, Denmark, the Netherlands, Poland, Romania, Norway, and the UK. Meanwhile, the structure of the electricity market can also lead to windfall profits for some electricity producers. As discussed in Paragraph 8, under the "marginalist" system, all electricity producers are paid the same price, set by the marginal unit. This may lead to benefits of considerable magnitude for those technologies that generate electricity at a largely unchanged marginal cost (such as nuclear, wind, and renewables) when the price of the marginal unit (typically set by a fossil fuel power plant) surges.[14] It is important to note, however, that some producers have long-term contracts with clients at a pre-established price and may, therefore, not benefit from higher prices in the spot market. For example, in Germany, natural gas producers have faced financial difficulties as they could not pass surging wholesale prices in spot markets onto customers (who usually have long-term contracts). In response to heightened uncertainty with natural gas supply from Russia, the Energy Security Act was amended in July 2022, to allow for government intervention in stabilizing critical energy sector companies as well as to enable energy producers to pass higher natural gas procurement costs onto consumers.

III. Distributional Implications of High Energy Prices

13. Surging energy prices have a sizable—yet uneven—impact on household budgets. For a given household, the impact of higher energy prices depends on the shares of its spending on energy products (direct effects) and on other products or services whose prices increase when energy prices go up (indirect effects). This section illustrates the impact of energy price increases on households at various points in the consumption

[14] According to IEA (2022), excess profits of up to €200 billion (close to 1.4 percent of EU GDP) could be generated in the EU by electricity producers using gas, coal, nuclear, hydropower, and other renewable energy sources in 2022, assuming gas prices of €22/MMbtu and CO_2 prices of €90/tonne.

distribution using the IMF's Climate Policy Assessment Tool (CPAT; see Annex 1). The exercise estimates the burden that the surge in energy prices is expected to imply for households in 2022.[15]

- **Price scenario.** The scenario is based on the projected energy prices for 2022 derived from international fossil fuel futures prices (as of May 2022), compared with a baseline derived from futures prices as of January 2021.[16] Specifically, average prices for 2022 for crude oil, coal, and natural gas are assumed to be 102, 273, and 450 percent higher than expected in early 2021, respectively. The average EU ETS price in 2022 is assumed to be 126 percent higher than expected in early 2021.

- **Retail prices.** The prices for crude oil, natural gas, coal, and ETS permits are used to project the retail prices of fuels and electricity for each country in 2022. For each energy product, the retail price increase is obtained by scaling the international fossil fuel price increase by a country-specific coefficient based on observed pass-through over the last year (see Annex 1). For transport fuels, since international crude oil prices feed into retail prices relatively quickly, the ratio of year-on-year (y-o-y) change in retail to y-o-y change in wholesale gasoline prices as of February 2022 is taken as the pass-through coefficient. For natural gas and electricity, pass-through from commodity to retail prices typically takes longer, so the highest pass-through coefficient observed over the last year (since May 2021) is used instead.[17]

- **Consumer incidence.** When energy prices increase, households' cost of living changes for two reasons. First, households pay more for the energy and other goods/services they consume. Second, households consume less of the goods/services that become more expensive. The reduction in demand—in response to higher prices—tempers the increase in the cost of living, to some extent. The model estimates the burden on consumer budgets for households in different consumption quintiles. The analysis assumes a uniform price elasticity of demand of 0.5.[18]

- **Caveats.** Results rely on modeling assumptions, including the use of observed pass-through coefficients, which are typically noisy and may understate the pass-through over time (this is presumably more relevant for countries with less frequent price adjustments). The consumer burden estimations depend on a price elasticity of demand, which is assumed to be homogeneous across households and products.[19] Additionally, methodological differences in the measurement of retail energy prices may overstate the actual price increases (and passthrough coefficients) faced by households in some countries (see footnote 13).

14. The average burden across European households is estimated to be close to 7 percent of total household consumption in 2022, with significant variation across countries (Figure 8-a):

- **Budget shares.** On average, European households devote just over ten percent of their total consumption to energy products, mostly to transport fuels, electricity, and natural gas (see Table A1 in Annex 2). Spending shares of energy products are typically lower for higher-income countries, ranging from about 6 percent in Finland to 13–15 percent in Hungary, Slovakia, Croatia, and the Czech Republic (Figure 8-b). The composition of spending on energy also varies. This matters because, if prices of natural gas increased by more than those

[15] Policies that aim to cushion the impact of retail price increases are not modeled explicitly but are captured indirectly in the pass-through assumptions for the projection of energy prices.

[16] The old baseline is based on futures prices for the week of January 4 to 8, 2021. The new baseline is based on futures prices for the week of May 9 to 13, 2022.

[17] In particular, the analysis is based on the maximum pass-through (i.e., the ratio of 12-month retail inflation to 12-month wholesale inflation) over the last year, computed at a monthly frequency. Wholesale inflation is computed using the Netherlands TTF price for gas, Brent oil for oil products, an average between Richards and Newcastle for coal, and the model estimate for combined-cycle plants for electricity.

[18] If, for example, residential electricity prices increased by 10 percent, the quantity of electricity demanded would fall by 5 percent.

[19] Behavioral responses may vary with household income (e.g., the poor may be less responsive than the wealthy to changes in prices, given their already-low consumption levels of goods and services) as well as by product.

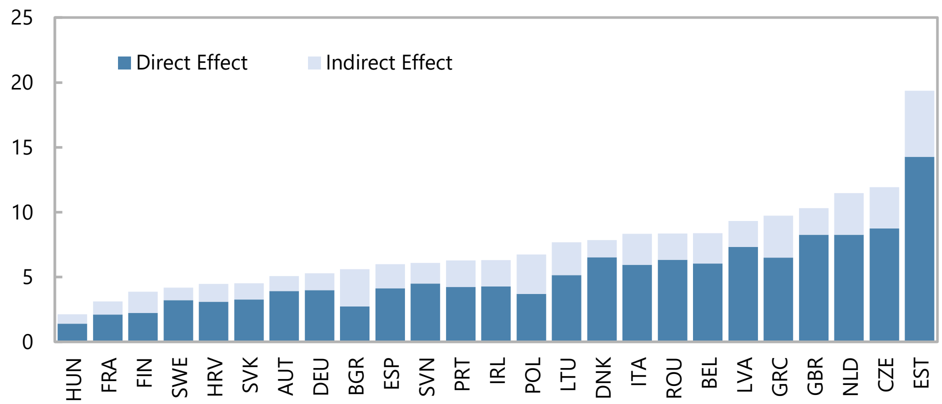
of other energy products, households in countries with larger spending on natural gas (relative to their total consumption) would face a larger burden.

- **Retail price increases.** Increases in the retail prices of electricity, natural gas, and gasoline are estimated to average 73, 122, and 36 percent, respectively, across countries (see Table A2 in Annex 2).[20] Predicted increases for natural gas and, particularly, electricity prices vary significantly across countries, as discussed in section II (Figure 8-c).
- **Indirect effects.** Indirect effects (via the cost-induced increases in prices of non-energy goods/services) typically account for 30 percent of the total impact on household budgets on average (Figure 8-a).

Figure 8. Higher Energy Prices—Direct and Indirect Burdens on Households

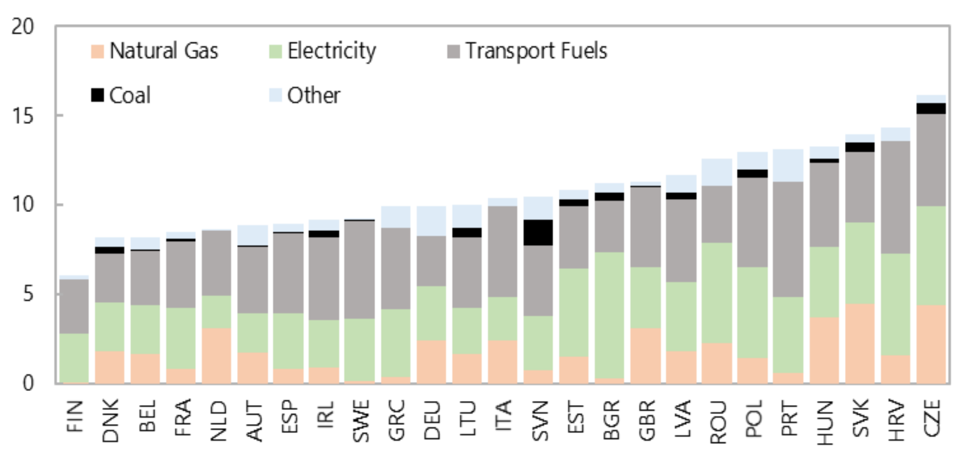
8-a. Direct and Indirect Household Burdens

(Average; in percent of total household consumption)



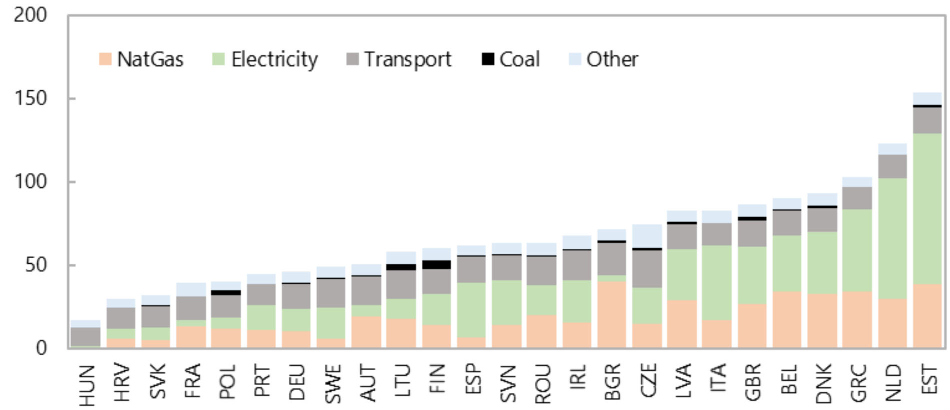
8-b. Direct Spending on Energy Products

(Average; in percent of total household consumption)



[20] This refers to the average for the EU and UK, excluding Cyprus, Luxembourg, and Malta. Price increases are for 2022 and are computed relative to prices estimated using expected international fossil fuel futures and ETS permit prices as of early 2021.

8-c. Energy Price Increase Index
(In percent)

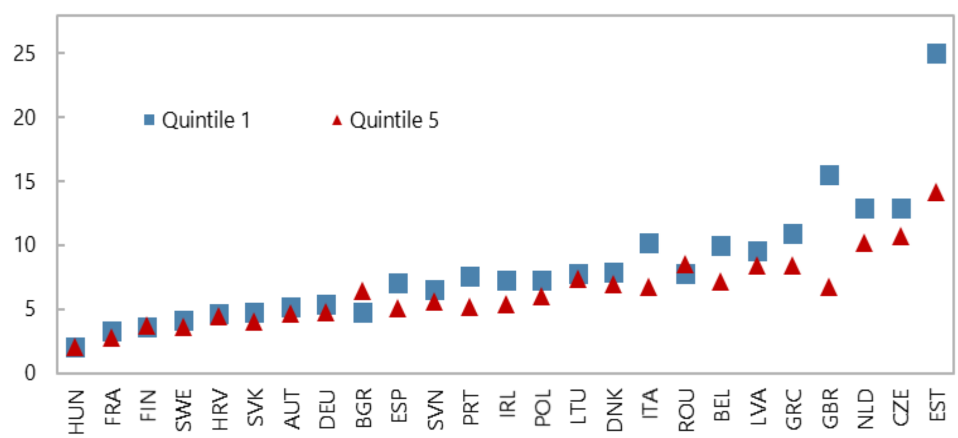


Sources: Bloomberg Finance L.P., Eurostat; and IMF staff estimates using CPAT. See also Annex 1.
Note: Household budget shares by product (Figure 8-b) are computed as simple averages across household consumption deciles for each country. The energy price increase index (Figure 8-c) is weighted by the mean household budget shares for energy products across European countries (i.e., weights are equal for all countries). Price increases compare the current projected 2022 prices based on May 2022 futures prices with those based on January 2021 futures prices. Retail prices are computed based on country-energy product observed pass-through coefficients over the last year. "Transport" refers to gasoline and diesel. "Other" refers to LPG, kerosene, and non-road oil products.

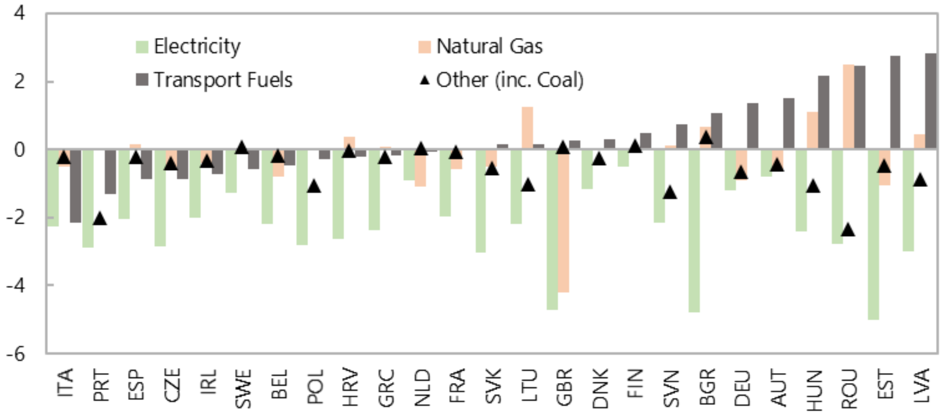
15. Higher energy prices tend to be regressive: they typically hurt poorer households more than richer ones (Figure 9). The distributional impact is determined by the different patterns of consumption of energy products for richer versus poorer households:

Figure 9. Distributional Impact Across Countries

9-a. Household Burden by Quintile
(In percent of total household consumption)



9-b. Cross-Quintile Differences in Shares of Total Consumption
(Top quintile mean versus bottom quintile mean; percentage points)



Source: Bloomberg Finance L.P., Eurostat, and IMF staff estimates using CPAT.
Note: Price increases compare the current projected 2022 prices based on May 2022 futures prices with those based on January 2021 futures prices. For Figure 9-a, underlying calculations are conducted at the decile level, and "quintiles" in the chart refer to the simple average of the corresponding deciles.

- **Electricity and natural gas.** In all European countries, poorer households tend to spend more on electricity as a share of total consumption than richer households (Figure 9-b). Thus, the direct impact of higher electricity prices is regressive. Poorer households also spend, on average, more on natural gas (relative to their total consumption) than richer households in most countries - with a few exceptions such as Bulgaria, Hungary, Lithuania, and Romania.

- **Transport fuels.** Spending on transport fuels as a share of household consumption is relatively flat across consumption quintiles. In several countries, richer households spend more on transport fuels (as a share of total consumption) than poorer households, reflecting the markedly higher car ownership for richer households. However, average expenditures for transport fuels may mask significant within-quintile heterogeneity; for the subset of low-income households that own a car, fuel spending can account for a large share of total consumption. The spatial dimension is also relevant: rural households generally spend a higher share of their consumption on transport fuels, presumably to commute longer distances in areas with limited means of public transport.

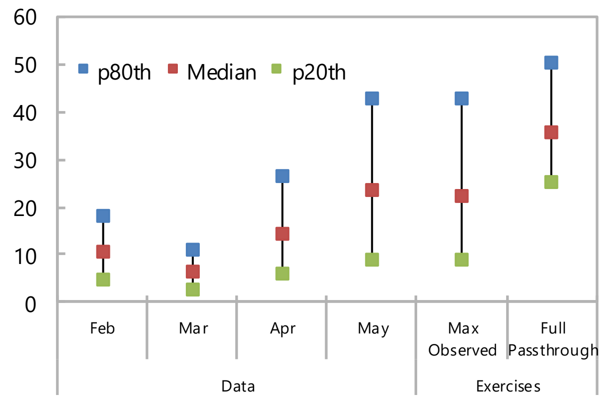
16. Looking ahead, retail prices for energy may continue to increase in many countries. Importantly, in countries where retail price increases have been small so far, adjustments may continue, either as international prices filter into import contracts gradually or as domestic retail prices of energy continue to be adjusted to reflect higher costs. Some of the burden may fall on energy firms and/or the government, but the historically large increase in natural gas prices may make it exceedingly costly for domestic energy providers and/or the government to maintain retail prices below cost-recovery for an extended period. For illustrative purposes, Figure 10-b shows the additional impact on household budgets from a hypothetical, higher pass-through of wholesale natural gas prices to retail prices, assuming that the entire nominal change in wholesale prices is translated into retail prices. While this "hypothetical high pass-through" case is not realistic within a one-year horizon,[21] it is useful to highlight countries most exposed to pass-through dynamics. In this case, total burdens on households

[21] This is because retailers buy natural gas, in part, through long- term contracts and at prices different than contemporaneous wholesale prices. Additionally, retailers may seek to smooth prices for their customers, who may also be on contracts according to which prices update infrequently (for instance, once a year).

are higher by around 1.3 percentage points of consumption, on average across countries. The additional impact is particularly high in countries with a relatively large share of household spending on natural gas and which have experienced a relatively small pass-through to retail natural gas prices to-date (e.g., Croatia, the Czech Republic, Hungary, Romania, and Slovakia).

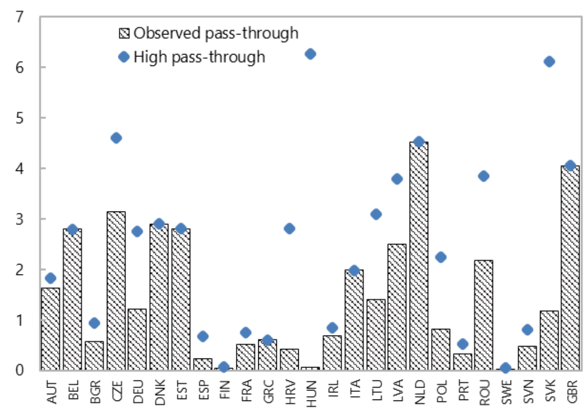
Figure 10. Burden of Increase in Retail Natural Gas Prices—Hypothetical High Versus Observed Pass-through

10-a. Passthrough from Wholesale Prices
(In percent)



Sources: Bloomberg Finance L.P., Haver Analytics, and IMF staff calculations using CPAT.
Note: Pass-through is computed as the ratio (in percent) of retail to wholesale y-o-y inflation. Wholesale inflation is measured by the TTF Index for natural gas. All underlying variables are in Euros. Full pass-through refers to the nominal change in retail prices being equal to the nominal change in wholesale prices. "Max. observed" refers to the maximum pass-through coefficient observed since March 2021 (used in the baseline simulations).

10-b. Direct Burdens for High Versus Observed Pass-through
(Average; in percent of household total consumption)



Source: Bloomberg Finance L.P., Eurostat, and IMF staff estimates using CPAT.
Note: This Figure does not include indirect effects. See main text for details on the "observed" pass-through estimations. "Hypothetical high pass-through" retail price increases are computed as the maximum of those computed under the observed pass-through scenario and $\frac{P_{i1}^{ret}-P_{i0}^{ret}}{P_{i0}^{ret}} = \left[(1+VATrate)\frac{P_{i0}^{INT}}{P_{i0}^{ret}}\right] * \frac{P_{i1}^{INT}-P_{i0}^{INT}}{P_{i0}^{INT}}$.

IV. Policies to Cushion the Impact of Higher Energy Prices

17. The design of support measures needs to balance several objectives. First, given concerns about energy security and the EU's climate goals, relief policies should preserve strong incentives for conserving energy and transitioning away from fossil fuels. Second, relief measures should be cost-effective, which calls for providing time-bound and targeted (rather than broad-based) support. The increase in global fuel prices is a negative terms-of-trade shock for fuel-importing economies. It causes a decline in real income, which economic agents need to adjust to. Governments cannot, and should not, aim to offset the loss of real income. Instead, they should aim to protect the poor and vulnerable households, which tend to spend a greater share of their incomes on energy and have little means to cope with the rapid increase in the cost of living (i.e., they are likely to experience substantial hardship when energy prices spike). When support is extended to firms, the rationale for it and the duration of the measures should be stated clearly (see more detailed discussion below).

18. New policy measures that mute the price signal should be avoided and should be wound down where they have already been introduced. As discussed in the next sub-section, many European governments have taken measures to delay the pass-through of wholesale to retail energy prices through tax reductions or price controls. Temporary measures that suppress price increases could be an acceptable response to a short-lived shock in countries with ample fiscal space. The main benefit of such measures is that they can be implemented quickly and may be the only option when income relief programs (such as targeted or uniform transfers) are difficult to extend within the relevant timeframe. Some targeting could be achieved by differentiating support across fuel types based on their relative weights in the consumption of different household income groups (e.g., in some countries LPG and kerosene are more important for low-income households). However, these measures are an inefficient tool to protect the economically vulnerable, are fiscally costly, and they mute the demand adjustment to the price shock (including energy-conserving behavior and energy efficiency investments).[22] Moreover, price-suppressing measures are politically difficult to withdraw and generate adverse spillovers, since preventing demand adjustments keeps global energy prices high, prolonging the burden on energy-importing, lower-income economies.[23,24] In addition, as more countries take broad measures, others feel pressure to take similar measures, creating another negative externality. Among price-suppressing measures, lifeline tariffs that provide discounts to small users (as a proxy for lower-income households) or infra-marginal amounts of energy usage (e.g., based on past consumption or estimated minimum necessary usage) would be less distortionary and less costly than uniform price controls. In some instances, policymakers may think of temporary price controls as a tool to restrain headline inflation and limit second-round effects on wages and non-energy prices. However, delaying potentially inevitable price adjustments likely trades off lower peak inflation in 2022 for a longer period of elevated inflation in the future. It is not clear that the energy price spike would have smaller second-round effects on prices in a prolonged period of elevated inflation than in a shorter-lived price spike.

19. Governments should increasingly focus their policy effort on providing vulnerable households with income support without distorting the marginal price they pay for energy. The support measures can target households below a certain point of the income distribution and, ideally, would be phased out progressively. Targeting requires good data on the income and composition of households and strong social safety nets (SSNs). Through existing SSNs and guaranteed minimum income (GMI) programs, many European governments can provide a reasonably fast response at a low administrative cost[25] Another option is to provide negative income taxes (rebates) to low-income households through the tax system. When SSNs are fragmented or simply do not reach some households[26] providing uniform lump-sum transfers (which could also take the form of lump-sum vouchers or discounts on energy bills, ideally linked to income and household size) would be preferable to

[22] See, e.g., empirical evidence from Guénette (2020). Suppressing the pass-through of higher energy prices in the current juncture can also magnify the economic cost of potential energy supply disruptions (Di Bella et al., 2022).

[23] Since the supply of some energy goods is inelastic in the short run, measures that impede demand adjustments help maintain the pressure on prices.

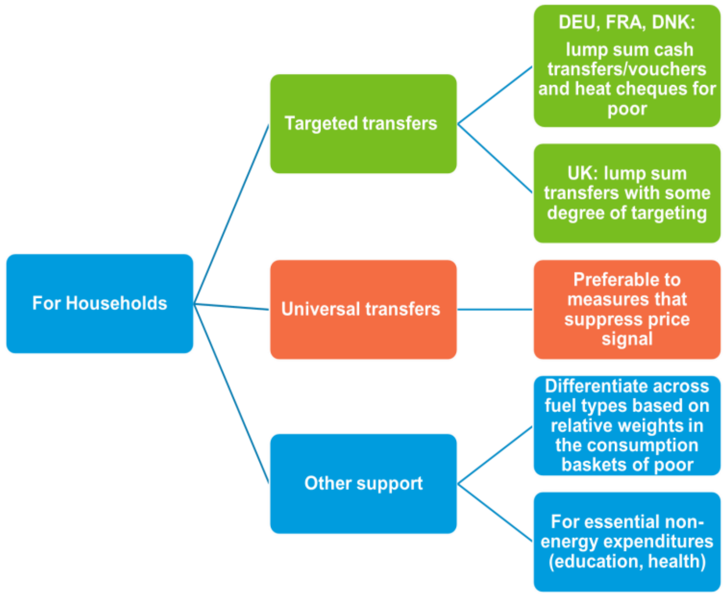
[24] While energy price increases may have raised revenues from *ad valorem* taxes, reducing these taxes or replacing them with specific taxes have all the undesirable effects associated with price-suppressing measures. It would be preferrable to, instead, recycle the extra revenues through more targeted and less distortionary support measures.

[25] For example, the UK and Germany provided cash transfers to households that were already on means-tested benefits. While these transfers were one-off, they have helped bridge household budgets until social benefits are adjusted for the increased costs of living. France and Poland have provided means-tested vouchers to compensate households for rising energy prices. In the case of Poland, voucher support is phased out gradually along the income distribution to avoid cliff effects.

[26] Social protection programs are often fragmented and benefits for different groups are uncoordinated (and not always conditional on income or wealth). That may not allow for good targeting of social support. Moreover, social benefits are often not indexed to inflation, or even if they are indexed, adjustments may take place with a delay, or inadequately address the purchasing power of the poor (as lower-income households' budget share for energy bills is usually larger than that of other households). Existing SSNs might also not reach some of the lowest-income households, especially in remote rural areas, or when informality is prevalent.

measures that suppress price signals. Governments may consider providing additional support to low-income households for essential, non-energy expenditures (education, health, food) that are at risk of being squeezed by higher energy costs (Figure 11). It would also be important to work on defragmenting and strengthening national SSNs, so that they can be used to provide transfers to a higher share of households than those receiving social safety benefits (Amaglobeli et al., 2022; IMF, 2022b).

Figure 11. Income Support Measures for Households



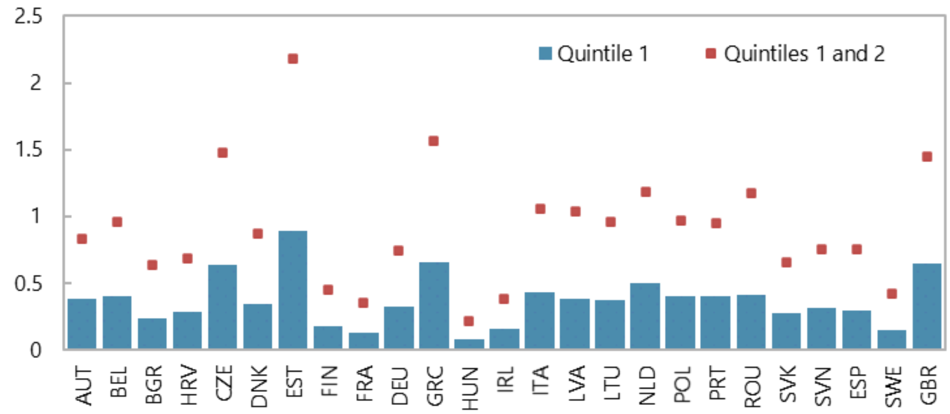
Sources: IMF European Department Desk Survey and Sgaravatti et al. (2021).

20. Targeting government support to those that need it the most helps contain fiscal costs. As an example, fully compensating the bottom 20 percent of households for the 2021–22 price surge is estimated to cost, on average, 0.4 percent of GDP, though with substantial differences across countries (Figure 12). Based on the incidence estimates from section III, fully compensating households in the bottom consumption quintile in the Czech Republic, Estonia, Greece, the Netherlands, and the UK would require revenues of more than 0.5 percent of GDP, while the corresponding figures for Finland, France, Hungary, Ireland, and Sweden is less than 0.2 percent of GDP.[27] Providing support to households in the higher quintiles will raise the cost, even if the amount of support is less generous for households with higher incomes. For example, providing, as a lump sum, half of the compensation for the bottom quintile to the next two quintiles (covering the 20th to 60th percentile of the consumption distribution) would double the average cost to 0.8 percent of GDP. If it is not possible to precisely target lower-income households, a uniform lump-sum transfer that compensates almost fully the households near the bottom of the income distribution (but represents a smaller fraction of the burden faced by higher-income households) is a possible alternative.

[27] Fully compensating the bottom 20 percent of households for the direct and indirect impact of the "hypothetical, high pass-through" of wholesale to retail natural gas prices (as described in Section III) would increase the fiscal cost by 0.05 percent of GDP, on average, across countries. The increase would be about (or more than) 0.1–0.3 percent of GDP in Croatia, the Czech Republic, Germany, Hungary, Poland and Slovakia.

Figure 12. Cumulative Revenues to Fully Compensate Lower-Income Households, 2022

(In percent of GDP)



Source: Bloomberg Finance L.P., Eurostat, and IMF staff estimates using CPAT.
Note: Shows cumulative revenues required to compensate the bottom quintile, and bottom two quintiles, for consumption losses following the 2021-22 international energy commodity price surge.

21. While the case for supporting lower-income households to prevent energy poverty is compelling, the case for supporting firms is less clear. Most European authorities have chosen to help firms cope with spiking energy costs, including through tax relief, energy subsidies, and/or guaranteed loans. The European Commission has launched a temporary state aid framework in March 2022 to provide guidance in this area. The rationale for using taxpayers' money to help firms cope with an energy price shock rests on the argument that a large temporary shock can damage the balance sheets of viable firms, leading to bankruptcies, layoffs, and scarring of productive potential. If viable firms are liquidity constrained and cannot borrow to weather the shock, temporary government support may be justified. However, if the surge in energy prices is persistent, a reallocation of demand and production toward less energy-intensive activities is inevitable, and policies should not postpone the necessary adjustment. With the current spike in energy prices proving to be highly persistent, the case for continued firm support is weakening.

22. Any support to firms should be temporary, targeted to otherwise viable firms, and ideally should include incentives to reduce energy use. Determining which firms are at risk due to the energy price spike but viable in the long run is highly challenging in practice. Most large, energy-intensive firms have access to working capital and can absorb or pass along a temporary cost shock. By contrast, small- and medium-sized enterprises (SMEs) tend to be liquidity constrained or have weaker balance sheets, and are therefore more likely to need support.[28] Ideally, support should take the form of temporary liquidity assistance, and be conditional on hedging energy price exposures going forward and, where feasible, on increasing energy efficiency and lowering GHG emissions. In cases where governments choose to provide grants or subsidies, these should not be proportional to energy usage but should ideally be offered on a lump-sum basis (or linked to past levels of energy usage) to incentivize energy savings. It is critical that support for firms be strictly temporary and extended only in

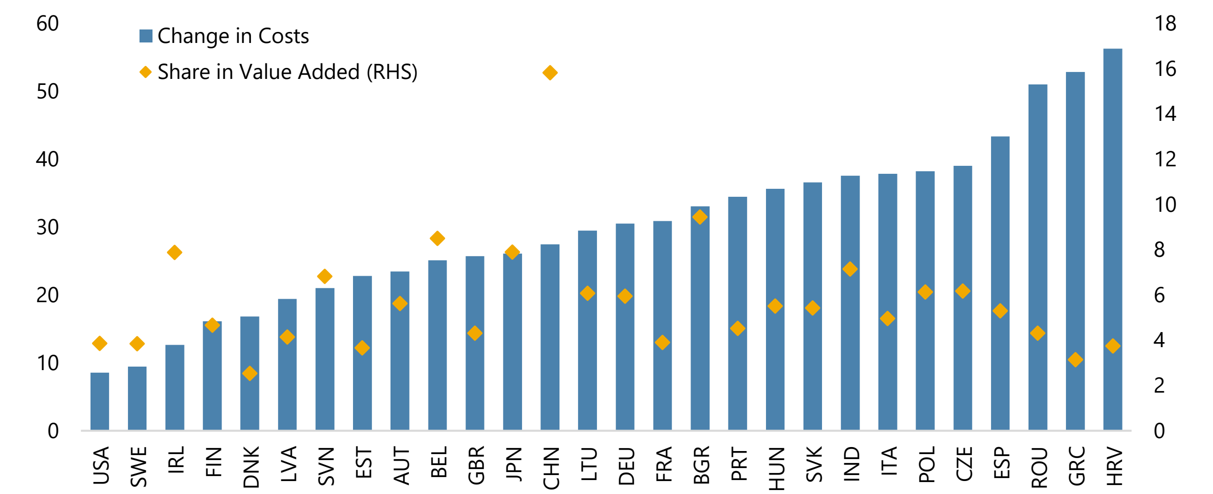
[28] There could also be a case for providing compensation to firms which are unable to pass through higher energy input costs to their customers due to government regulations and price controls introduced during the energy crisis. The case for compensating firms affected by pre-existing regulations and controls is weaker, as such firms, in principle, have had an opportunity to hedge or insure their exposure to volatility in energy prices. The benefits of providing support in such cases should be weighed against the risk of contributing to moral hazard.

exceptional cases, given the practical and political difficulties in targeting the support well, and the unintended side effect of limiting the demand response to high energy prices.

23. Special considerations apply to companies that play a critical role in importing and distributing energy, especially natural gas. The sharp increase in gas prices in recent months are imposing financial strains on companies that purchase gas on wholesale markets and distribute it to customers on fixed-price contracts. To help ensure the solvency of critical energy companies, and avert the possibility of energy shortages that would entail sizable economic losses, governments might need to make sure that energy companies can pass on cost increases to end-users on otherwise fixed-price contracts, complemented with further targeted support for vulnerable households. Energy companies may also need liquidity support (so they can meet their margin calls and continue making purchases on wholesale markets).[29]

24. Evidence is mixed on whether the rise in energy prices following Russia's invasion of Ukraine is putting European manufacturing firms at a sizable competitive disadvantage. On the one hand, natural gas prices for many EU countries (where replacing natural gas imports from Russia will require new infrastructure to be built) stood well above those in the US (by about 73 percent), the UK (by close to 70 percent),[30] and moderately above those for Asia (about 18 percent) in May 2022. But, given cross-country variation in reliance on natural gas (or other energy products), the cost impact of the boom in energy prices on Energy-Intensive, Trade-Exposed (EITE) industries in the EU may not necessarily be larger than in non-EU countries (Figure 13).

Figure 13. Impact of Rising Retail Energy and Carbon Prices on EITE Sector Costs, 2022



Source: IMF staff estimates using CPAT. "EITE" sectors are defined as "energy-intensive and trade-exposed" sectors and here include cement, chemicals, non-ferrous metals, and iron and steel products. Yellow diamonds represent the total share of these sectors in total industry output (based on the GTAP-10 database).

[29] A new legal amendment in Germany gives the government the power to authorize gas suppliers to pass on higher prices to customers that would otherwise be on fixed-price contracts, to ensure the solvency of these suppliers. The German government also has a plan for loans to energy producers to post margins on their hedging contracts (energy companies guarantee their sales prices ahead of time by selling their products through forward contracts. When the spot price rises above their contracted forward price, they have to post a security deposit (margin) that increases with the price difference).

[30] The spread relative to UK prices seems a historical anomaly, due to limited storage capacity in the UK coupled with strong liquefied natural gas inflows.

25. Ultimately, accelerating the green transition is the best way to limit vulnerability to spikes in fossil fuel prices and enhance energy security (see section V). To this end, governments can promote incentives to invest in renewable energy (and many are indeed doing this, as discussed in the next section) and energy efficiency. To incentivize energy efficiency, governments could provide support to households and firms to undertake energy-saving investments (e.g., installation of insulation, heat pumps), or condition other support on such actions.

26. The fiscal costs of support measures are growing. In some countries, the fiscal costs of measures introduced in response to energy price increases since the summer of 2021 are estimated to exceed 1.5 percent of GDP by end-2022, excluding loan guarantees for companies for which the cost is difficult to estimate *ex ante* (Figure 14-b). Most of these costs stem from price controls and subsidies; the annual cost of targeted measures implemented so far, including cash transfers and vouchers, is estimated to be less than 0.5 percent of GDP in most countries. The country survey used for Figure 14-b does not quantify fiscal costs for several countries and for a few other countries complete estimates of the costs were not available; moreover, the cost of loan guarantees is excluded. Thus, the estimates in Figure 14-b represent lower bounds of the costs of support measures across countries. Since a substantial part of the increase in energy costs is likely to persist, governments should phase out costly measures and should identify sustainable revenue sources (e.g., new or increased carbon taxes that can come into effect when international energy commodity prices fall) to finance targeted support. More generally, the benefits of policies to counter the effects of high energy prices will have to be weighed against the economic cost of financing such policies by raising additional revenues or cutting other expenditures.

27. Taxing the windfall profits of some energy producers can be an option in some cases, but careful design is key to avoiding unintended consequences. Some countries have introduced, or are considering, taxes on the windfall profits of extractive industries and/or some other energy suppliers to help offset the costs of relief policies. Ideally, countries should already have in place fiscal regimes for companies that determine the rules under which windfall taxes can be imposed (see Baunsgaard and Vernon, forthcoming). Where that is not the case, one can argue that the large size of windfall profits for a small number of producers combined with the need to finance a substantial relief effort, could justify a strictly temporary windfall tax. It is critical that windfall taxes be well designed to preserve investment incentives. Specifically, they should be imposed only on excess profits, allowing producers to recover their operating costs, get a reasonable return on fixed investments, and keep a portion of the excess profits. In the case of renewable energy, governments usually protect producers from downside risks through guaranteed feed-in tariffs or other measures, which provides symmetry in the treatment of unexpected shocks and therefore, a justification for excess rents to be taxed. Nonetheless, it is critical to make sure that incentives for continued strong investments in the renewable energy sector are preserved.

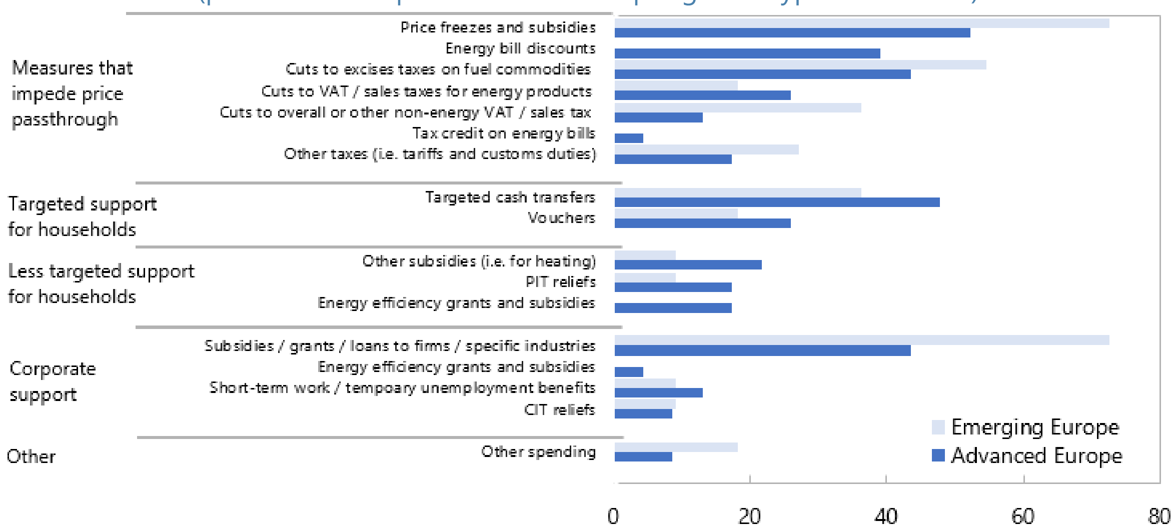
28. Even as support is extended to vulnerable households and firms, the broader fiscal stance should remain consistent with macroeconomic policy objectives. In countries where inflation is currently running well above target, fiscal policy changes should not add to aggregate demand to avoid exacerbating price pressures. Targeted support for low-income households could be funded by raising progressive taxes (which affect high-income households) and/or controlling expenditure. Relief targeted to vulnerable households typically contributes less to aggregate demand than broad-based tax cuts or price controls.

Policy Responses by European Economies to Date

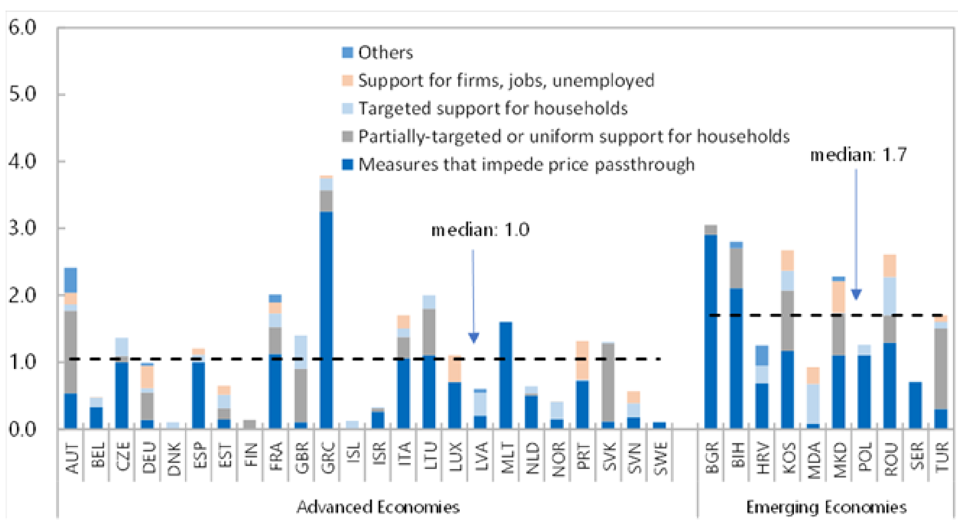
29. European countries have implemented a wide range of support measures aiming to cushion the effects of higher energy prices (Annex 4). Most measures have been announced as temporary, though in some cases they have been extended and/or expanded over time. While some measures preserve the price signal, most are in the form of tax or fee reductions or outright natural gas and electricity price controls, especially in Central and Eastern Europe (Figure 14-a). The estimated fiscal cost of the measures varies considerably across European countries (Figure 14-b). Emerging market economies have typically spent more than advanced ones. Targeted transfers to households account for a small fraction of the overall fiscal costs in most countries.

Figure 14. Policy Measures

14-a. Policy Adoption by Type
(percent of European countries adopting each type of measure)



14-b. Fiscal Cost of Energy Support Measures (Excluding Loan Guarantees)
(In percent of GDP; 2022)



Source: IMF European Department Desk Survey.

Note: For several countries, the Survey quantifies none or only part of the energy support measures. Below-the-line measures are not included. Therefore, the sum of individual categories may not add up to the total fiscal cost of these measures for each country. Each category contains the following measures: (i) Measures that impede price pass-through: energy bill discounts (i.e. reduction in renewable energy surcharges, fees, and social tariffs), price freezes and subsidies, cuts to excise taxes on fuel commodities, cuts to VAT/sales tax for energy products, cuts to overall or other non-energy VAT/sales tax (decrease or exemptions), tax credit for energy bills, and other taxes (i.e., tariffs, customs duties, property tax, carbon tax); (ii) Targeted support for households: targeted cash transfers, vouchers; (iii) Less/Untargeted support for households: heating subsidies, 90 euro for 90 (Germany), additional pay hike for civil servants and pensioners, energy efficiency grants and subsidies (households), and Personal Income Tax (PIT) and other tax reliefs; (iv) support for firms: subsidies/grants/loans to firms/specific industries, energy efficiency grants and subsidies (firms), short-term work/temporary unemployment benefits, Corporate Income Tax (CIT) reliefs; and (v) Others: grants to local governments, gas/commodity/food procurement/reserves, rent freeze, energy subsidies for households and firms (no disaggregation available).

- **Measures that impede price pass-through.** Many European countries have taken measures to limit the pass-through from international to retail energy prices, which contain price increases for all consumers. Such measures have included price controls/caps, reduced natural gas and electricity charges and network fees (Austria, Italy, Germany, Luxembourg, Spain, Portugal), rebates for energy products, as well as VAT and excise tax reductions (most European countries). In nearly all countries, these measures account for a larger share of the fiscal cost of responding to the energy price shock than the targeted measures implemented so far.

- **Targeted measures.** Many countries have extended benefits to vulnerable households under existing social support programs (France, Germany, Spain, Belgium, Ireland, Norway, Luxembourg), and in some cases introduced new targeted programs (Germany, U.K., Denmark, Belgium, Poland). While in some cases support has been provided in proportion to energy consumption, several programs aimed to preserve the price signal and incentives to reduce energy consumption by providing a fixed benefit, in line with best practices (Italy, France, Germany, Spain, Norway, Estonia).

- **Measures to support firms.** In the EU, temporary support to firms was allowed under the European Commission's (EC) Temporary Crisis Framework introduced in March 23, 2022. Several EU and non-EU countries have announced measures to support firms (Bosnia and Herzegovina, Bulgaria, Estonia, France, Germany, Greece, Italy, Luxembourg, Netherlands, Serbia, Slovenia, Spain, U.K.).[31] In some cases, the implemented or announced measures may distort firms' incentives to reduce energy consumption (Italy, France, Germany, Luxembourg, Spain, Estonia, Slovakia, Bulgaria).[32] Note that the cost of firm support measures in Figure 14-b includes both support targeted to specific firms or sectors, and non-targeted electricity or gas price subsidies (which are effectively price-suppressing measures).

[31] Italy offered tax credits to SMEs for investments in intangible assets and training, and the Netherlands is compensating small firms through lower energy taxes. Meanwhile, France, Spain, and Luxembourg used existing or introduced new public loan guarantee schemes, while the U.K.'s state loan program was designed for firms taking customers from insolvent firms.

[32] Italy has introduced support for businesses with a tax credit for energy-intensive companies (equivalent to 20 percent of the cost of energy consumed). Luxembourg introduced an aid scheme to compensate certain qualified energy-intensive and commercial firms for part of the additional costs of higher electricity and natural gas prices (i.e., covering between 30 and 70 percent of the additional costs, conditional on firm losses). In France, business grants of up to €25mn are provided to compensate firms for surging energy costs (when bill increases exceed a certain percent of turnover). In Bulgaria, businesses were also partially compensated for electricity price increases above a threshold. In Spain, an 80 percent reduction in electricity transmission fees for 600 electro-intensive firms was introduced, and Italy, Estonia, and Slovakia reduced electricity operation/network fees to varying degrees too.

V. Implications of the Energy Price Surge for Climate Policy in Europe

30. With concerns about energy security high on the political agenda in Europe, an important question is whether energy security is compatible with the planned green transition. The EU has pledged to reduce greenhouse gas (GHG) emissions 55 percent below 1990 levels by 2030 in the EU Green Deal plan. Specifically, emissions covered by the EU ETS (power and industry) would be reduced by 61 percent by 2030 (relative to 2005 levels), and emissions in the Effort Sharing Regulation (ESR) sectors (transportation, buildings, and agriculture) should be reduced by 40 percent. The U.K. has committed to reducing GHGs 68 and 78 percent below 1990 levels by 2030 and 2035, respectively. This section discusses whether reducing Europe's dependency on imports of Russian fossil fuels is consistent with achieving these targets and the broader ramifications for climate mitigation strategies.

31. The role of natural gas as a potential transitional fuel is likely to diminish further. CO_2 emissions per unit of energy are about 40 percent lower for natural gas than for coal. Historically, energy experts had envisaged that natural gas could play a role in the energy transition by providing backstop to intermittent renewable energy sources. However, the last decade has increasingly found that emissions benefits of natural gas over coal are likely to be overstated due, for example, to the prevalence of methane leaks in natural gas extraction and distribution.[33] Additionally, if the availability of natural gas diminishes or its price relative to other fuels remains high due to energy security concerns, there could be greater reliance on oil and potentially on coal in the short term, as well as greater incentives to invest in green energy over the medium term. Upgrading and building of LNG terminals and storage facilities could ease the substitution away from Russian natural gas. Higher demand for LNG in Europe may, however, have unintended consequences for global emissions as several large emerging economies depend heavily on LNG, including Bangladesh, Pakistan, India, and Indonesia.[34] A persistent increase of LNG prices may result in blackouts and substitution to coal in these countries, which could set back global efforts to lower emissions.

32. The near-term impact of higher energy prices on emissions in Europe is ambiguous. The sharp increase in fossil fuel prices depresses energy demand and, in turn, emissions. On the supply side, switching from natural gas (either because it has seen the highest price increase or because of a shut-off) to oil and coal would increase GHG emissions in ESR sectors (excluding any emissions embodied natural gas from leaks and venting) and put upward pressure on allowance prices in the EU ETS.[35] Substitution towards lower-carbon power sources is taking place (renewables and nuclear; Figure 15), but in most cases there is limited spare capacity in low-carbon generation in the short term. In principle, the net emissions effect of demand- and supply-side factors is ambiguous and may vary by country, depending on available capacity that can quickly be made operational (e.g., in some countries coal mine closures or nuclear plant decommissioning are being postponed).

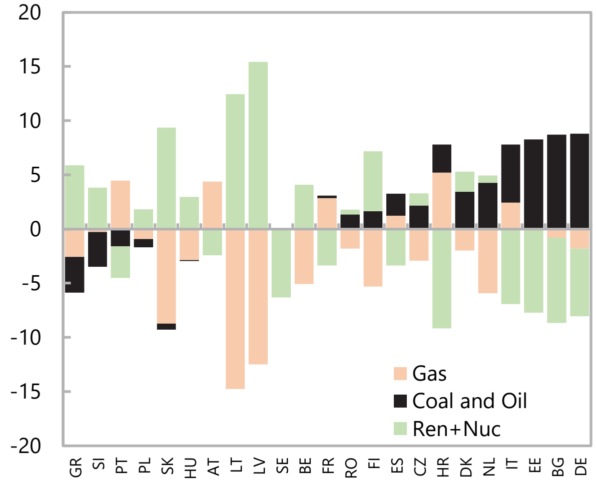
[33] An increasing number of studies have found such a "coal-to-gas" bridge is incompatible with the Paris Agreement's temperature goals, due in part to the higher emissions intensity of natural gas from venting and leaks of methane. See, for example, Ganti et al. (2021).

[34] Some suppliers have already defaulted on their long-term contracts with these countries (see, for instance Stapczynski and Mangi (2022)).

[35] The EU ETS does not cover embodied emissions from leaks and venting in imported natural gas, but LNG and natural gas can have different emissions profiles due to these factors. Gas from shale, for example, produces 30 to 100 percent more methane emissions from venting and leaks than conventional gas, which may make its total emissions 20 percent or more greater than coal (see Howarth et al.,2011). Additionally, LNG is subject to additional energy-intensive, transformational (liquefaction) and distributional processes (via shipping). However, LNG and natural gas are treated equally under the ETS, and hence substitution between the two is not considered to change emissions. Additionally, there are infrastructure limits to this type of substitution (i.e., limited capacity of LNG terminals, insufficient pipeline capacity between countries that have ample LNG import capacity and those that do not).

Figure 15. Change in Energy Generation Mix

(In percentage points; March-May 15 2022 vs. March-May 15, 2021)



Sources: ENTSOE; and IMF staff calculations.

33. **Emissions reductions on the demand side are potentially significant, while the offsetting increases in emissions on the supply side are difficult to quantify ex-ante.** An illustrative analysis, which assumes that fossil fuel prices follow current futures prices, suggests that (in the absence of other measures) higher baseline energy prices in 2030 will imply lower emissions in the ETS and ESR sectors (Box 1). However, the estimation does not take into account supply-side factors—such as the extent of reduction in reliance on natural gas (the decline in piped gas net of substitution to LNG), and the ability of economies to accelerate the transition to renewable fuels, which are difficult to project with any degree of precision. Therefore, in practice, further measures are likely to be needed to offset the negative effect of supply-side factors on emissions (as envisaged in RePowerEU).

Box 1. Illustrative Estimation of the Impact of Higher Energy Prices on Emissions

This Box presents the results from a simulation of the effects of high energy prices on CO_2 emissions in Europe. Futures prices suggest that fossil fuel prices are likely to remain well above their pre-crisis levels by 2030. The simulation compares the effect on carbon emissions of two scenarios:

- *Pre-crisis baseline* based on futures prices for 2030 as of January 2021 ($80/ton, $17/MWh, and $49/barrel for coal, natural gas, and oil, respectively).[36]
- *Price surge scenario* which assumes that coal, natural gas, and oil prices follow futures market prices as of early May 2022 (average coal, natural gas, and oil prices are at $296/ton, $110/MWh, and $103/barrel in 2022, and fall steadily to $184/ton, $32/MWh, and $70/barrel respectively by 2030, remaining significantly higher than the pre-crisis 2030 baseline).

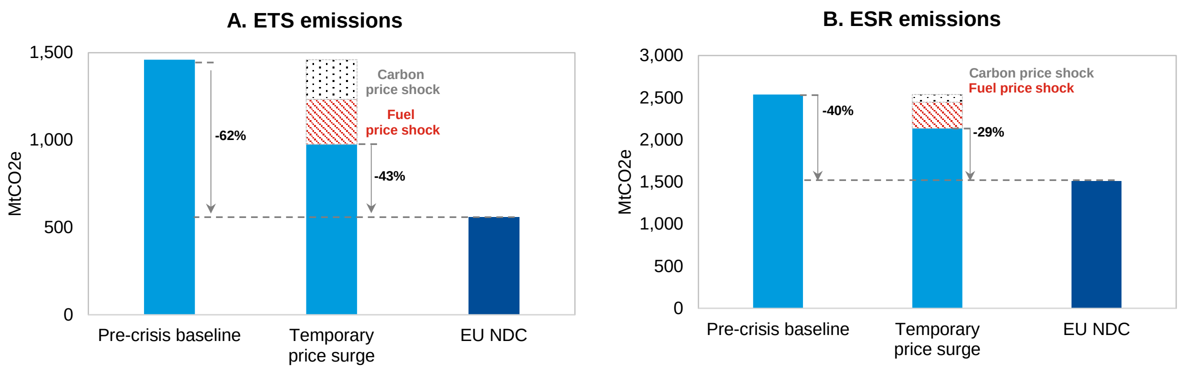
The simulations also reflect the increase in carbon prices and price futures since early 2021. In the pre-crisis baseline, carbon prices increased from €34 per ton/CO_2 in 2022 to €40 in 2030, while in the price surge

[36] These projections reflect an average between the IMF's World Economic Outlook (WEO) and the International Energy Agency (IEA).

scenario, the nominal ETS price rises from €87 per ton/CO_2 in 2022 to €112 by 2030. A full pass-through of higher global energy prices and carbon prices into retail prices is assumed, which allows complete behavioral adjustments over time. As a simplifying assumption, the prices (but not quantities) of nuclear and renewable energy are kept at their pre-crisis levels in real terms.[37]

In the price surge scenario, the combination of higher projected carbon prices and energy prices would reduce emissions by about a third relative to the pre-crisis baseline in the ETS sectors and about 22 percent in the ESR sectors. The emissions reduction necessary to reach the EU 2030 targets is, then, about two thirds of the needed reduction projected in the pre-crisis baseline. The simulation is hypothetical and accounts mainly for the demand effects of higher energy prices. It does not account for new mitigation efforts, including new non-price measures, nor for potential natural gas shortages and substitution with more polluting fuels on the supply side. Moreover, the analysis does not consider that, under the EU's emission goals, the ETS cap would tighten as much as needed to achieve the target emissions under the ETS.

Figure 16. EU Emissions and Targets for ETS and ESR Sectors by 2030



Source: IMF staff estimates using CPAT.
Note: ETS = emissions covered by the EU Emissions Trading System; ESR = emissions covered by the Effort Sharing Regulation; EU NDC refers to the EU 2030 Paris Agreement targets. The ETS chart illustrates the hypothetical case of how much emissions would decline without a further increase in the carbon price (in practice, the carbon price will adjust to meet the emissions target).

34. **The European Commission's RePowerEU plan aims to reduce dependence on Russian gas while still meeting the "Fit for 55" emissions goals.** As part of the plan, the EU aims to lower Russian imports by two thirds by the end of 2022 and to reduce them to zero well before 2030[38] With a likely diminished role of natural gas, the plan recognizes that achieving the EU's Fit for 55 emissions targets will require concerted efforts to increase the share of renewable energy by 2030, thereby limiting the need for increased dependence on coal to make up for reduced natural gas use. The plan seeks to accelerate the green transition through increased incentives to invest in renewables and in energy efficiency. Total investment of €300 billion by 2030 is required to meet the objectives of the REPowerEU Plan (Table 1). Financing would come from the remaining €225 billion of loans under the Recovery and Resilience Facility, potential transfers of cohesion policy and common agricultural policy funds to RePowerEU projects, as well as €20bn in grants from ETS permit sales.

[37] The price of materials used in the construction of new renewable energy installations may increase with higher demand or for geopolitical reasons; but at the same time the costs of renewable technologies and their associated networks are likely to continue to fall as these technologies mature.

[38] On July 26, 2022, EU member states reached a political agreement on a voluntary reduction of natural gas demand by 15 percent between August 2022 and March 2023. The considered regulation would also give the Commission the ability to impose a mandatory gas demand reduction on Member States in an emergency, with some exemptions and possibilities to request a derogation from the mandatory reduction target.

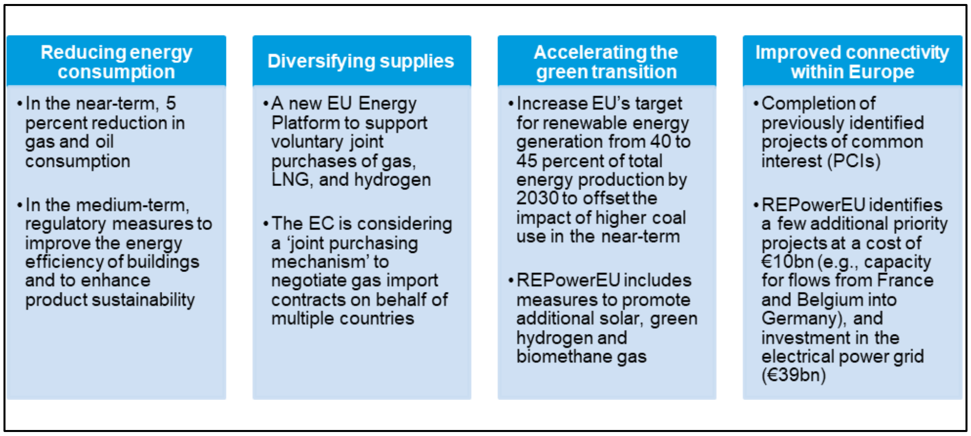


Table 1. Measures to Reduce Dependence on Russian Gas in addition to the Fit –for 55 Package

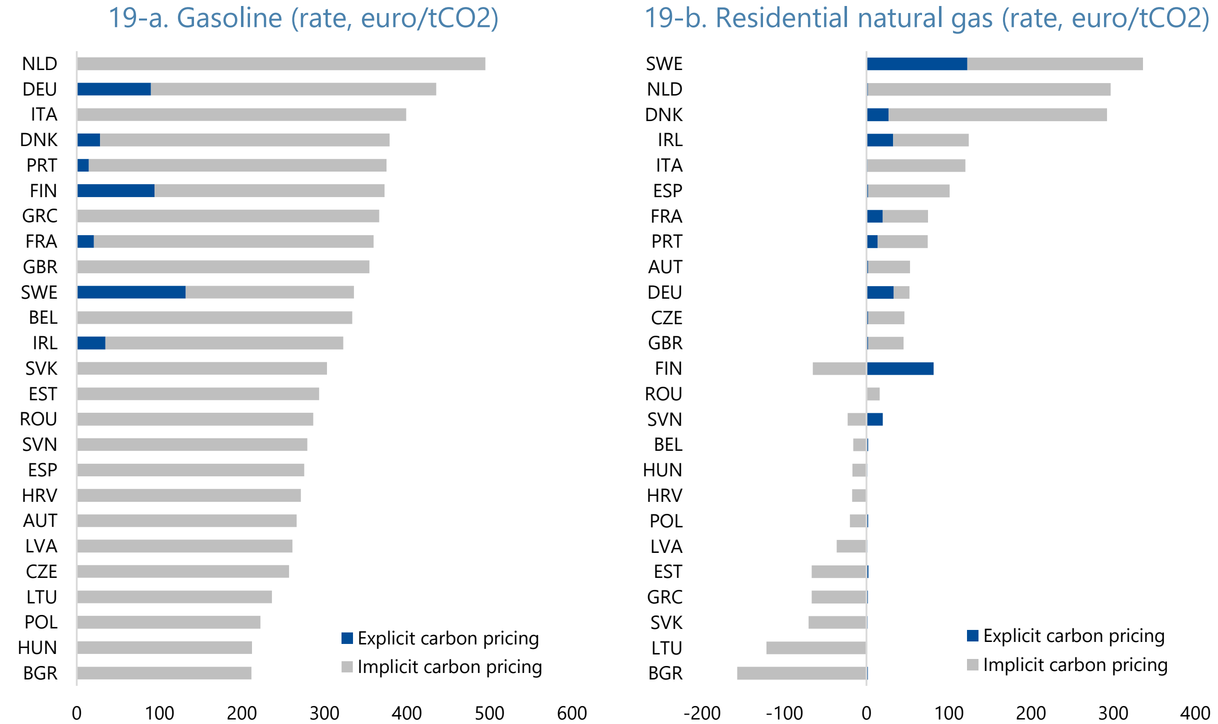
Measure	Natural Gas Saving (bcm, 2030)	Investment (EUR bn, 2022-2030)
All Fit-for-55 measures by 2030	116	
Short-term preparedness		
Diversification (additional LNG using existing infrastructure)	50	
Diversification of pipeline imports using existing infrastructu	10	
Delayed phase-out and more operating hours for coal	24	2
Abandoned phase-out nuclear plants	7	0.5
Fuel switch in the residential and service sectors	9	
EU Save: Demand measures (behavior)	(10)	
EU Save: Industry curtailment		
Medium-term (until 2027)		
New LNG infrastructure and pipeline corridors		10
Additional investments in the power grid and storage		39
Biomass in power generation	1	2
Energy Efficiency and Heat Pumps	37	56
Photovoltaic and wind	21	86
Sustainable biomethane	17	37
Reduced use in industry	12	41
Long-term (by 2027 and beyond)		
Renewable hydrogen	27	27
Total	310	300

Source: European Commission, REPowerEU Plan.

35. The anticipated decline in fossil fuel prices over the coming years may provide an opportunity to scale up carbon pricing in sectors where coverage is currently low and uneven. If international fossil fuel prices decline (as implied by futures markets), it would become possible to extend the coverage and raise the level of carbon pricing, without increasing retail energy prices relative to their recently experienced levels. The scope for raising road fuel taxes may be limited, as these taxes are already high in most countries (Figure 17). When weighting fuels by their carbon content and not adjusting for behavioral responses, the implicit and explicit carbon price on road fuels is about €200-500 per ton CO_2 (though high taxes are justified by non-climate externalities like local air pollution, traffic congestion, and accidents).[39] In contrast, implicit and explicit carbon

[39] Diesel is more polluting (in terms of local air pollutants) than historically thought. Policymakers could, therefore, use the opportunity to better align taxes on diesel (which are often lower than those on gasoline) with these costs.

Figure 17. Explicit and Implicit Carbon Prices for Selected Fuels, 2022



Source: IMF staff calculations.
Note: explicit pricing refers to a carbon tax or ETS; implicit pricing refers to excise taxes on fuel weighted by their carbon content.

prices of building fuels are lower: indeed, residential gas is subsidized in 10 EU countries. Once gas prices normalize, carbon prices can be introduced either in the form of national carbon taxes or ETSs (e.g., as in

Germany or Sweden) or in the form of an EU-wide ETS for buildings and transport (as envisaged in the Fit for 55 plan), starting at low levels and increasing gradually over time. Scaling up carbon pricing will have to go hand-in-hand with support for vulnerable households.

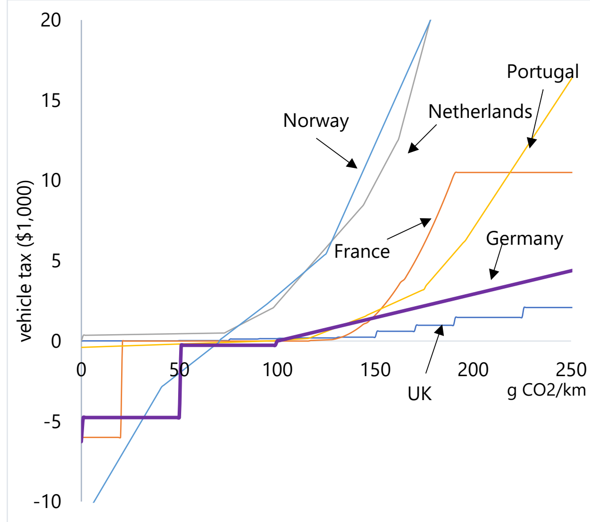
36. Mitigation strategies should include reinforcing non-pricing measures like regulations, fiscal incentives, and public support. Non-pricing sectoral instruments promote fewer behavioral responses to reduce emissions than carbon pricing,[40] but they can have greater social acceptability, as they avoid significant increases in energy prices. The EU and individual countries already have in place a range of sectoral targets (e.g., for renewable generation shares, electric vehicle sale shares, emissions requirements for new and existing buildings) and non-pricing policies to implement them (e.g., feed-in tariffs, renewable portfolio standards, energy efficiency and CO_2 emissions rate standards, or public support for insulation and building retrofits). Given the goal of enhancing energy security and the uncertain path of emissions in Europe in the near term, governments should incorporate sectoral approaches into their strategies for reducing fossil fuel reliance.

37. Well-designed fiscal incentives and regulations can accelerate the transition to electric /other zero-emission vehicles and increase building efficiency. The transportation and building sectors are less responsive to emissions pricing than power and industry. Additionally, the necessary emissions cutback would be difficult to achieve through pricing alone, as the needed carbon prices would be unrealistically high. Therefore,

[40] For example, unlike higher fuel taxes, non-pricing instruments like emissions rate standards do not encourage people to drive less or to retire old vehicles faster (if they apply only to new vehicles). See Parry et al. (2022)

fiscal incentives and regulations have an especially important reinforcing role in this regard, complementing carbon pricing. For example, many European countries include elements of feebates[41] in their vehicle tax systems and those systems with the strongest incentives (Figure 18), have been the most successful in deploying electric vehicles. These incentives could play a pivotal role as countries implement pledges to phase out internal combustion engine vehicles.[42] In the building sector, new buildings can be subject to stricter emissions requirements; real estate taxes can be linked to the energy rating of the building to encourage retrofits; and feebates and regulations can promote electrification and the adoption of energy-efficient appliances.

Figure 18. CO2-Based Components of Vehicle Taxes, Selected Countries



Sources: ACEA (2018), and IMF staff calculations.
Notes: Circulation taxes for Germany are expressed on a lifetime basis assuming a 13-year life and 7 percent discount rate.

38. Public investments in enabling infrastructure, connectivity, and measures to advance critical technologies—as envisaged in the RePowerEU plan—will be key to achieving both decarbonization and energy security in Europe. Public investment in clean technology infrastructure networks that would not be provided by the private sector (even with high carbon prices) is needed. This could include high-voltage smart grids to accommodate renewables, electric vehicle charging stations, and pipelines for green hydrogen. Improving connectivity within and between countries can help achieve a more stable and diversified supply of energy from renewable sources. Finally, public support is needed for developing critical technologies (e.g., energy storage, carbon capture and storage, direct air capture) and bringing these technologies to the market.

39. Conversely, any new investments in fossil fuel extraction should be evaluated carefully to avoid stranded assets or an increase in reliance on polluting energy sources. Some investments can pay off relatively quickly and have temporary effects (e.g., delaying coal mine closures). However, investments in fossil fuels or electricity production based on such fuels with a longer time horizon should be avoided.

40. An explicit price floor for future ETS permit prices would help maintain robust incentives for energy-efficient and low-carbon investments. The high volatility of fossil fuel prices may increase uncertainty over the future levels of ETS permit prices. Since higher fossil fuel prices tend to lower energy consumption, raise energy efficiency, and encourage a shift to renewables, the expected carbon price necessary to reach emissions goals may fall when fossil fuel prices increase. However, carbon prices tend to induce a stronger response than increases in fossil fuel prices, which may be seen as temporary. To provide certainty for renewable and other low-carbon investments, it could be desirable to introduce an exogenous and progressively increasing price floor in the ETS system. The price floor could be implemented though minimum prices for allowance auctions and, if needed, by automatically withdrawing permits through the Market Stability Reserve (MSR) when prevailing market prices fall to the price floor. The risk of price spikes is also a concern—indeed, some of the two billion tons of CO_2 allowances accumulated in the MSR are being sold in 2022 (to raise revenue for the REPowerEU

[41] Feebates provide a sliding scale of fees on products or activities with high emissions intensity and a sliding scale of rebates for products with low emissions intensity (for a discussion, see Parry (2021)).
[42] For example, electric vehicles account for three quarters of new vehicle sales in Norway (IEA 2022).

plan). These sales, in practice, limit the rise in carbon prices. Specifying an exogenous price ceiling to rule out extreme price spikes (with the ceiling set high and rising over time) would be a more efficient way of preserving a robust price signal than discretionary sales via the MSR.

VI. Conclusions

41. International fossil fuel prices increased sharply in 2021 as global demand recovered from the COVID-19 pandemic and soared further after Russia's invasion of Ukraine in February 2022. The run-up in prices has been large from a historical perspective, particularly for natural gas, which has seen a five-fold increase in prices between early 2021 and mid-2022. This large terms-of-trade shock has reduced the real income of fuel-importing European economies and led to a sharp increase in inflation. Policymakers have responded mostly with broad-based measures aimed at reducing the pass-through from wholesale to retail prices. However, such measures are fiscally costly and delay the needed compression in energy demand. The reduction in real income coming from the energy price shock cannot be prevented and fiscal efforts should focus mostly on providing support for low-income households.

42. The impact of the energy price surge on households' budgets has been significant, though uneven both across and within countries. Simulations based on changes in futures prices in international energy commodity markets and observed pass-through to retail prices for energy and non-energy products indicate an average cost of living increase for European households of close to 7 percent of consumption in 2022. There is significant variation across countries, depending on how much households rely on fossil fuels and on the national regulations of retail energy markets. In most countries, the burden of higher energy prices is regressive as energy products represent a higher portion of lower-income households' consumption baskets. Had the entire nominal change in wholesale natural gas prices been passed on to retail prices, the average burden on households would increase to 8.3 percentage points of consumption.

43. Policy responses to the surge in energy costs should aim to preserve the price signal while providing targeted support. For households, lump-sum cash transfers, vouchers, or fixed discounts on utility bills are appropriate means of providing income support without distorting marginal energy prices, thus conserving the incentive to reduce energy consumption. As an example, fiscal measures to fully offset the consumption losses of the bottom 20 (40) percent of households would have an average annual estimated cost of 0.4 (0.9) percent of GDP in European economies. Non-targeted measures typically have a larger fiscal cost, presenting a rising burden for countries with limited fiscal space. When targeting is not possible, a second-best choice is to provide support through uniform lump-sum transfers, which preserve the price signal and are progressive (since poorer households benefit more than richer ones as a share of their income). Support for firms could be justified only when the price shock is large but temporary, and firms are liquidity constrained. In this case, limited support measures for viable firms that would have ceased operating in the absence of support policies could help prevent economic scarring. In practice, it is difficult to implement a well-targeted support scheme for firms without introducing distortions and disincentivizing energy conservation. With the current price shock proving to have a highly persistent component, the case for continuing to support firms is weak in most cases.

44. The emphasis of the policy response in Europe should shift rapidly from broad-based price-suppressing measures to targeted transfers. In some countries, the fiscal costs of measures introduced since the summer of 2021 are estimated to exceed 1.5 percent of GDP by end-2022. Most of these costs come from non-targeted relief measures such as cuts in VAT/excise taxes or price caps, while only a small share comes from income support to lower/middle-income households. To limit fiscal costs, and elicit larger demand adjustments, in line with EU countries' new voluntary targets to reduce consumption, emphasis should shift to targeted policies without delay. Where inflation pressures are high and demand is robust, it would be advisable to offset the fiscal easing implied by the relief measures through an increase in progressive taxes or reductions in other expenditures (well-designed windfall taxes may also be considered in some cases) to ensure that fiscal policy does not add to aggregate demand and run counter to the effort of central banks to rein in inflation.

45. For climate mitigation policy, the energy price surge presents both opportunities and risks. The rise in fossil fuel prices would promote incentives to conserve energy and to increase the use of renewables, with a positive effect on emissions reductions. However, a concerted effort is needed to limit the risk of a persistent rise in the use of coal as energy imports from Russia are phased out. Non-pricing instruments, like feebates and regulations, can reinforce incentives for low-carbon investments, especially in the transport and building sectors. Public support can help scale up renewables, upgrade the electric power grid, improve connectivity, and accelerate the development and deployment of critical technologies. The expected gradual reduction in global fuel prices in the future presents an opportunity to strengthen carbon pricing without causing an increase in retail energy prices relative to prior levels. Finally, price floors (and perhaps ceilings) could help maintain a robust price signal in the ETS sector.

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Annex 1. Methodology – The Climate Policy Assessment Tool

The analysis uses the Climate Policy Assessment Tool (CPAT) which provides, on a country-by-country basis, projections of fuel use and GHG emissions for the power, industry, transport, and residential sectors, as well as non-energy emissions including in the agricultural and land use sectors. The impacts of carbon pricing and changing energy prices on fuel use and emissions depend on the price responsiveness of fuel use in different sectors which is parameterized to the midpoint of broader energy modelling and empirical literature. For a description of the model see Black et al. (2022), Annex 1.[1]

In this paper, CPAT is used to link increases in international energy commodity prices to: (i) European wholesale prices for petroleum/oil products, coal, natural gas, and electricity; (ii) country-specific changes in energy product retail prices; (iii) changes in retail prices of non-energy consumer goods and services (through country-specific Input-Output Tables (IOTs)); and (iv) budget shares for goods and services by income group from household budget surveys (HBSs) to assess (the distribution of) burdens on households. The model is used for the incidence analysis in section III and the climate analysis in section V.

(i) **Wholesale prices** for fossil fuels are assumed to increase by the difference between: (i) the estimated (via projections based on futures prices as of May 2022) average prices of about $295/ton for the international coal price, $100/barrel for crude oil, and $110/MWh for natural gas; and (ii) the baseline prices for 2022 of $80/ton, $50/barrel, and $20/MWh respectively, which are projections based on futures prices as of January 2021. The calculations for 2030 are analogous. The EU ETS prices are also obtained from futures markets. ETS prices are assumed at $97/ton CO_2 in 2022 and $131/ton CO_2 in 2030 (compared to $43/ton CO_2 in 2022 and $49/ton CO_2 in 2030, expected in early 2021). The computed wholesale price increases for fossil fuels are the same for all countries. For electricity, the methodology differs depending on the horizon. For the incidence analysis, which covers 2022, the wholesale electricity price increases are computed based on the increases in energy product prices and CO_2 permit prices that affect energy input costs (and substitution among energy inputs) in the power sector (using the same model as in Figure 4). For the climate analysis, which adopts a longer time horizon, wholesale electricity price increases are based on an engineering model that considers the costs of alternative electricity generation technologies (many of which vary with changes in fossil fuel prices). Prices for renewables are kept unchanged in all cases.

(ii) **Retail energy prices** for petroleum/oil products, natural gas, coal, and electricity in 2022 (section III) are obtained by scaling the wholesale price increases described above. The scalar is chosen such that the ratio of retail to wholesale price increases (in percent) matches a given country-product observed pass-through coefficient. For transport fuels, observed pass-through as of February 2022 is used. For coal, natural gas, and electricity, the maximum pass-through since March 2021 is used. The climate analysis in section V considers a longer horizon (2030), so it assumes, instead, that the entire nominal change in wholesale prices is transferred to end-users.

(iii) **Price increases for other consumer goods** (due to higher fossil fuel/energy product input prices) are calculated, taking into account pass-through of producer fossil fuel/energy product cost increases onto consumer prices domestically (i.e., non-flat supply curves). In particular, non-fossil fuel/energy product sector price increases are obtained as the sum-product of: i) each sector's input intensity in each fossil fuel/energy product; and ii) the price increase of each fossil fuel/energy

[1] CPAT has been jointly developed by IMF and World Bank staff and evolved from an earlier IMF model. CPAT (or earlier versions of it) have been routinely used in bilateral and multilateral analysis of climate mitigation policies. See, for example, Parry et al. (2021a, b, c), IMF (2019a, b) and Parry, Mylonas and Vernon (2021).

product induced by the international commodity price increase. Sectoral fossil fuel/energy product intensities are generally obtained from IOT direct requirements matrices. For the countries analyzed in this paper, these matrices are sourced from the GTAP-10 database[2], which includes data for 65 sectors[3].

(iv) The **burden on household consumption deciles** d = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10} from higher retail prices following the international energy price surge is calculated as:

$$\text{(A)} \qquad \sum_g \pi_t^{dg} \cdot \rho_t^{dg}$$

where *g* stands for the main categories of goods/services consumed by households, π_t^{dg} is the share of decile *d*'s total consumption spent on good/service *g* at time *t*, and ρ_t^{dg} is the relative price increase for good/service *g* following the price surge. [4] [5]For example, for a good with a budget share of 3 percent of total household consumption, expression (A) implies that a 2 percent increase in said good's price will reduce decile d's consumption by 0.06 percentage points. Adding up the direct and indirect effects yields an estimate of the total effect (or burden). This is, then, scaled by 1 minus 0.25 to account for deadweight losses[6].

In addition to what is mentioned under section III, the analysis described above is subject to several shortcomings. For example, some of the incidence from higher international commodity prices could be passed backwards into lower producer prices in the medium-to-long run. If this results in lower capital returns, some of the incidence could be borne by capital owners or even workers (e.g., in the form of lower wages). See also additional commentary in Parry, Mylonas and Vernon (2019), IMF (2019a, 2019b), Heine and Black (2019) and Shang (2021).

[2] See: https://www.gtap.agecon.purdue.edu/databases/v10/index.aspx

[3] These cover the following five fossil fuels/energy products: coal ("coa"), electricity ("ely"), oil ("oil"), natural gas ("gas", "gdt") and petroleum products ("pc"). The IOT matrices are adjusted such that their fossil fuel/energy product-specific sectoral burdens from the price surge considered here are consistent with the economy-wide burdens in CPAT prior to any energy use adjustments in response to said price hikes.

[4] Burdens include: (i) extra household expenditures on goods due to their higher prices (a first order effect); and (ii) the value to households of forgone consumption induced by price changes (a second-order effect).

[5] Data on household budget shares is obtained from the 2015 EU HBS for most countries in the sample, except Slovenia (for which data is obtained from the 2010 EU HBS). Data for Greece is obtained from the 2019 national HBS. Data for the UK is obtained from the 2015–16 Living Costs and Food Survey. Households are grouped into population-weighted, per-capita consumption (or, "welfare") deciles and budget shares are computed by calculating the share of each CPAT good/service category consumption expenditure in total household consumption expenditure.

[6] These are losses in consumer surplus, due to increased taxation and/or crisis-induced price hikes in fuel markets; they account for the (private) welfare loss from households reducing fuel consumption.

Annex 2. Distributional Impact Analysis – Supplementary Tables

Table A1. Total Budget Shares for Energy Products by Country and Decile, 2022
(In percent of total household consumption)

Country | Decile	1	2	3	4	5	6	7	8	9	10	Average
Austria	8.5	8.8	9.1	9.0	8.8	9.2	9.5	8.9	8.6	8.2	8.9
Belgium	10.4	9.8	9.1	8.5	8.2	8.0	7.7	7.3	7.3	5.6	8.2
Bulgaria	12.0	12.6	12.0	11.9	11.9	11.5	11.0	10.1	10.4	8.8	11.2
Croatia	15.9	15.9	15.2	13.5	14.2	14.4	13.7	13.1	14.2	12.6	14.3
Czech Republic	18.8	17.8	16.7	16.7	16.5	17.0	15.4	14.7	14.8	12.6	16.1
Denmark	8.5	8.4	8.5	9.2	8.5	7.6	8.4	8.0	7.7	7.0	8.2
Estonia	12.8	11.8	12.6	11.3	11.4	10.9	10.8	9.8	9.2	7.9	10.9
Finland	5.1	5.7	6.5	6.5	6.5	6.8	6.5	6.2	5.8	5.2	6.1
France	10.2	8.9	9.1	9.0	8.9	8.4	8.2	8.1	7.7	6.3	8.5
Germany	10.1	10.1	10.1	10.3	10.4	10.4	10.5	9.6	9.0	8.4	9.9
Greece	10.6	10.9	10.9	10.6	10.3	10.5	9.4	9.5	9.0	7.1	9.9
Hungary	12.0	13.3	13.2	13.6	13.8	14.1	13.8	13.7	12.9	12.1	13.2
Ireland	10.6	10.6	10.2	10.0	9.8	9.4	8.7	8.3	7.6	6.7	9.2
Italy	13.4	12.6	11.5	11.3	10.6	10.0	9.4	8.9	8.5	7.2	10.3
Latvia	10.5	11.9	12.4	11.9	12.0	13.0	12.1	11.2	11.4	9.8	11.6
Lithuania	10.6	11.1	10.6	10.2	10.0	10.0	10.3	9.3	9.4	8.7	10.0
Netherlands	9.9	9.5	9.1	9.0	8.5	8.4	8.4	8.2	8.0	7.4	8.6
Poland	14.7	14.8	14.0	13.9	13.4	12.8	12.5	11.9	11.2	10.1	12.9
Portugal	16.7	15.7	14.6	14.2	13.7	12.9	11.8	11.2	10.8	9.2	13.1
Romania	11.6	13.2	13.2	13.0	12.5	12.5	12.5	12.5	12.0	12.5	12.5
Slovak Republic	16.0	14.8	14.8	14.4	14.8	14.4	13.8	13.7	12.3	10.6	14.0
Slovenia	11.9	11.0	11.0	11.0	10.9	10.4	10.4	9.8	9.5	8.3	10.4
Spain	10.2	10.2	9.8	9.7	9.2	9.0	8.7	8.2	7.8	6.6	8.9
Sweden	8.0	10.3	11.4	10.4	9.7	9.1	9.4	8.8	7.7	7.1	9.2
United Kingdom	17.8	13.8	13.0	11.7	11.4	10.6	10.5	9.4	8.5	6.1	11.3
Average	11.9	11.8	11.5	11.2	11.0	10.8	10.5	10.0	9.7	8.5	10.7

Source: IMF staff estimates using CPAT. Note: Energy products include: coal, electricity, natural gas, oil, gasoline, diesel, kerosene, LPG. Budget shares calculated based on household budget surveys (see Annex 1 for more information) and assumed constant over time.

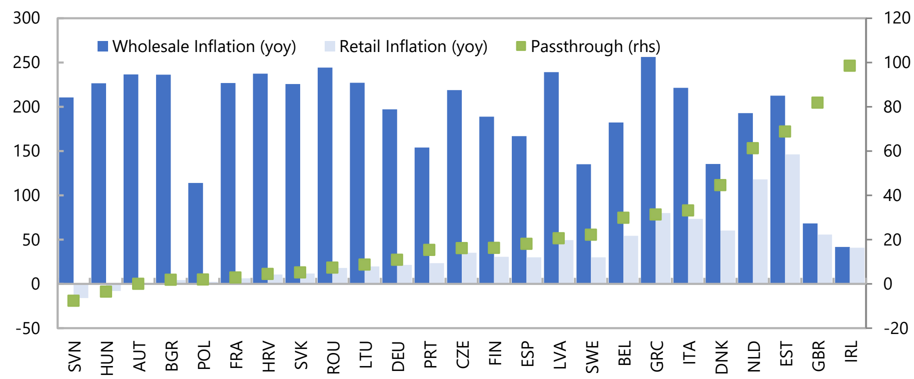
Table A2. Percent Price Increases for Household Energy Consumption by Country and Product, 2022
(In percent, 2021-2 Price Surge Scenario; Hypothetical High Pass-through)

Country | Product	Coal	Electricity	Natural Gas	Gasoline	Diesel
Austria	39.0	18.4	127.5	40.7	42.6
Belgium	15.4	96.5	222.7	37.4	37.1
Bulgaria	73.2	9.4	262.2	47.6	48.8
Croatia	13.8	18.9	35.9	29.1	30.8
Czech Republic	49.9	62.4	95.4	54.6	56.2
Denmark	45.6	107.0	211.3	33.0	40.2
Estonia	78.9	259.3	253.0	36.6	39.5
Finland	209.2	54.3	91.2	34.8	39.6
France	15.1	11.5	86.7	32.8	35.4
Germany	40.8	38.1	68.3	33.4	39.7
Greece	6.4	142.1	220.1	29.8	36.4
Hungary	18.5	2.3	2.4	27.7	26.9
Ireland	32.2	72.7	100.8	42.6	46.9
Italy	6.7	130.1	110.0	31.2	34.6
Latvia	74.4	87.4	188.0	36.0	39.8
Lithuania	149.2	35.1	115.8	40.5	44.6
Netherlands	15.4	209.1	193.1	29.9	38.7
Poland	111.6	18.4	76.9	34.4	34.9
Portugal	24.7	41.9	72.5	29.1	33.8
Romania	46.8	52.3	128.9	41.4	42.0
Slovak Republic	19.7	20.7	35.1	29.5	33.4
Slovenia	28.1	77.4	89.5	37.1	38.9
Spain	24.7	96.3	40.6	36.2	40.5
Sweden	39.9	53.1	39.1	41.5	41.4
United Kingdom	69.3	99.0	173.7	39.5	38.4
Average	49.9	72.5	121.6	36.3	39.2

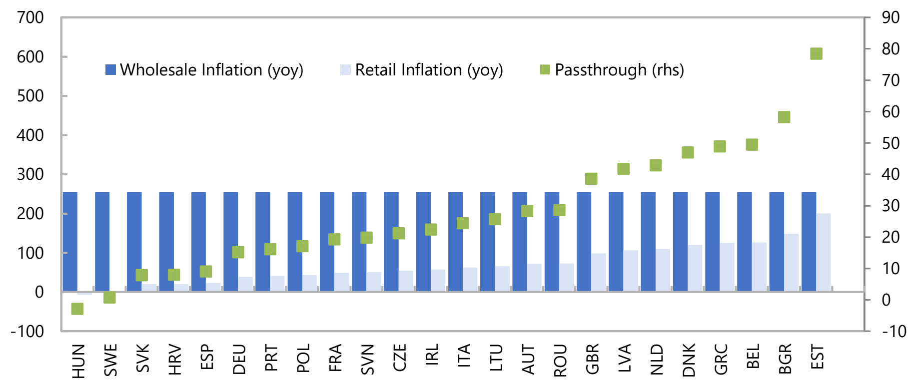
Source: IMF staff estimates using CPAT.

Annex 3. Fuel Products: Pass-through from Wholesale Inflation to Retail Inflation

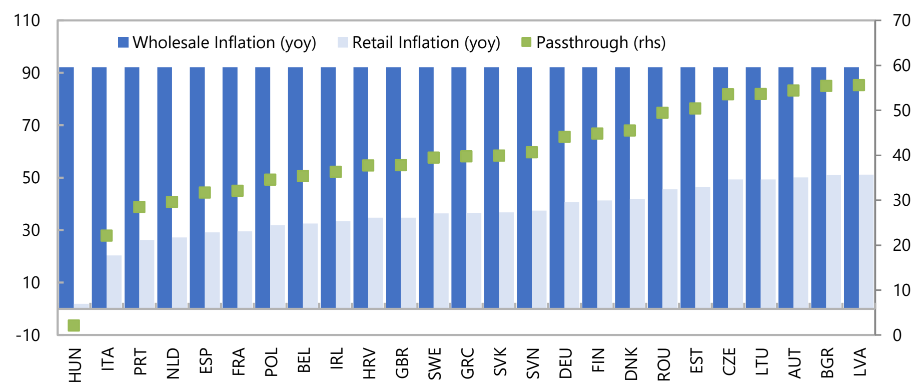
Electricity Prices: May 2022
(In percent)



Natural Gas Prices: May 2022
(In percent)



Liquid Fuel Prices: May 2022
(In percent)



Source: Bloomberg L.P., ENTSOE, Haver Analytics, and IMF staff calculations.
Note: Wholesale inflation is measured by the TTF Index for natural gas, and by Brent Crude Oil Index for liquid fuels. Retail inflation is measures by the corresponding HICP subcomponent (451, 452, 722). All underlying variables are in Euro. Passthrough is computed as the ratio (in percentage) of retail to wholesale y-o-y inflation as of May 2022.

Annex 4: New Measures Implemented to Cushion the Impact of High Energy Prices

	Measures that impede price pass-through							Targeted support for households		Partially-targeted or uniform support for households			Support for firms				Other
	Price freezes and subsidies	Energy bill discounts (i.e. reduction in renewable energy surcharges, fees and social tariffs)	Cuts to excises taxes on fuel commodities	Cuts to VAT / sales taxes for energy products	Cuts to overall or other non-energy VAT / sales tax	Tax credit on energy bills	Other taxes (i.e. tariffs and customs duties)	Targeted cash transfers	Vouchers	Other subsidies (i.e. for heating)	PIT reliefs	Energy efficiency grants and subsidies	Subsidies / grants / loans to firms / specific industries	Energy efficiency grants and subsidies	Short-term work / tempoary unemployment benefits	CIT reliefs	Grants to local governments, gas / commodity / food procurement / reserves, energy subsidies for households and firms
DEU		√	√					√		√	√		√		√	√	√
FRA	√		√					√	√		√		√		√		
GBR	√	√					√	√		√			√				
ESP	√		√		√		√	√		√			√				
ITA		√		√		√							√			√	
SER	√		√				√						√				
BGR	√												√				√
TUR					√		√				√		√		√	√	
MDA								√					√				
BEL		√	√	√				√	√						√		
CZE			√						√								
DNK								√									
EST	√	√	√						√				√				
FIN											√		√				
GRC	√			√	√			√					√				
HUN	√		√														
LVA	√	√						√									√
LTU	√			√							√	√					
LUX	√	√	√		√			√				√	√				
NOR	√		√					√						√			
POL	√		√		√			√									
ROU	√			√					√				√				
SVK	√	√															
SWE	√		√				√		√	√		√					
MKD	√		√	√	√		√	√	√				√				√
ISL																	
ISR							√										
CHE													√				
MLT	√																
MNE			√		√								√				
KSV	√		√					√		√			√				
SMR		√		√						√							
BLR	√																
NDL			√	√				√	√			√					

Source: IMF European Department Desk Survey

PUBLICATIONS

Surging Energy Prices in Europe in the Aftermath of the War: How to Support the Vulnerable and Speed up the Transition Away from Fossil Fuels

Working Paper No. WP/2022/152