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WPS6294

Policy Research Working Paper 6294

Climate Change Policies and Employment in Eastern Europe and Central Asia

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The World Bank
Europe and Central Asia Region
Human and Sustainable Development Unit
December 2012

Policy Research Working Paper 6294

Abstract

This paper analyzes the differential impact of climate change policies on employment in Eastern Europe and Central Asia. In particular, the paper examines (i) how vulnerable labor markets are in Eastern European and Central Asian countries to future carbon regulation, and (ii) what countries can do to mitigate some of the potential negative effects of these regulatory changes on employment. In many aspects, the nature of the shock associated with climate regulation is similar to that associated with an increase in energy prices. Constraints on carbon emissions put a price on climate-damaging activities and make hydrocarbon-based energy production and consumption more expensive. As a result, firms in energy-intensive industries may react to higher energy prices by reducing production, which in turn would lead to lower employment. In the presence of frictions in labor markets, these sector shifts will cause resources to be unemployed, at least in the short term. Using principal component analysis, the paper finds that Eastern European and Central Asian countries vary greatly in their vulnerability and adaptability of employment to carbon regulation. Since the economy takes time to adjust, policy-makers will need to ensure that the incentives are there for new firms to emerge and employ workers, and that workers have the skills to respond to that demand. Moreover, governments have a role to play in ensuring that workers that are displaced have a proper safety net that will not only help in protecting their welfare, but will also allow workers to make more efficient labor market transitions.

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Produced by the Research Support Team

The World Bank Group

Climate Change Policies and Employment in Eastern Europe and Central Asia

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Key Words: Climate Change Policy, Employment, Europe and Central Asia

JEL: J60, J68, Q40, Q58

Sector Board: Sustainable Development, Human Development

[1] We thank Igor Kheyfets Uwe Deichmann for helpful comments and suggestions.

1. INTRODUCTION

An agreement on climate change targets has been the goal of the international community for some time. Under the Kyoto Protocol of the United Nations Framework Convention on Climate Change (UNFCCC), industrialized countries and economies in transition committed in 1997 to reduce greenhouse gas emissions by about 5.2 percent between 2008 and 2012 compared to 1990. Follow-up summits in Copenhagen (2009) and Cancun (2010) focused on post-2012 emission targets and their allocation. A 2 to 2.5°C increase in global temperatures above preindustrial levels by 2050 has been accepted as a target but intermediate targets for 2020 have also been suggested, including an indicative range of 25 to 40 percent reductions compared to 1990 for developed and transition countries (World Bank, 2011a).

The European Union, in particular, has been a leader in climate change action, setting ambitious mitigation targets for its members for 2020 in advance of an international agreement. By 2020, EU emissions are to be cut by 20 percent (or 30 percent if a global deal is reached) of its 1990 levels; energy efficiency is to be increased by 20 percent; and 20 percent of energy used is to come from renewable sources (EU 20-20-20 goal)[2]. In addition, an EU-wide cap-and-trade system (the Emissions Trading Scheme) has been adopted since 2005 to put a carbon emission cap on energy-intensive industries. . Other non EU member states in ECA have also made various levels of commitment to climate actions as reflected in their national communications to UNFCCC and Copenhagen commitments.

Ambitious climate targets will require de facto changes in energy prices to reach levels that generate the proper incentives for cutting emissions. In developing countries, this involves removing subsidies to bring energy prices closer to market rates; in the developed world, the goal is to internalize environmental costs into energy prices. An increase in energy prices will result in an adjustment of the economic structure and production processes that could have significant employment effects especially in the short term. Specifically, higher energy price will spur demand shifts from high-carbon to low-carbon sectors. In the presence of frictions in labor markets, these sectoral shifts can cause displayed employment in the short term.

An energy price shock is not very different *a prima facie* from other price shocks – oil prices or terms of trade shocks, for example. A key difference, however, is that an energy price shock is likely to be permanent in nature, requiring significant adjustments on the part of firms, workers and consumers. These changes, nonetheless, are not new to ECA. The region inherited a highly subsidized energy system from the Soviet era. Since the collapse of central-planning in the 1990s, transition economies embarked on a large scale energy market reform, including energy tariffs reform. Many countries, especially the new EU member states and the Balkans, have significantly increased fuel prices. However, there is still a large gap between prevailing energy prices and a carbon-reflective energy price and many countries will continue to face upward pressure on energy prices. In addition, energy-intensive industries still account for a large share of output and employment in ECA, which makes ECA vulnerable to further energy price shocks. In this paper, we analyze (i) how vulnerable labor markets are in ECA countries to future energy price changes, and (ii) to what extent have the countries been prepared to mitigate some of the potentially negative impacts.

[2] European Union (2008)

The contribution of this paper is that, it looks at the potential employment impacts of climate policy in the context of ECA through a simple framework. The paper introduces the concept of 'adaptability' as a complementary element when analyzing the employment effects of climate change policy. Lastly, the paper zooms in on the policy discussion that emerges from the analysis on vulnerability and adaptability, with a focus on areas that need to be strengthened to mitigate the impact of energy price changes in employment. The approach of the paper complements, therefore, past and ongoing efforts in assessing the potential impact of energy price shocks on employment.

Several caveats should be heeded when interpreting the results of this paper. First, it is important to note that we do not attempt to quantify the impact of an increase in energy prices on employment. To completely capture the employment impact of a price on carbon, we would want to examine how consumers and producers would respond to the changes in relative prices in the economy. We would also want to estimate the how the government uses or refunds the revenues from the carbon taxes. Rather than modeling all general equilibrium adjustments, the paper is an attempt to highlight the relative vulnerability of different countries in the region to such a regulatory change and their relative capacity to adapt. Secondly, we do not fully consider the potentially positive effects on employment due to carbon regulation as new industries and new jobs may develop in response to stronger incentives for cleaner activities.[3]

The paper is organized as follows. Section 2 summarizes related literature. Section 3 introduces the conceptual framework, focusing on two aspects: (i) vulnerability, calculated by a country's output and employment in energy-intensive sectors combined with the estimated energy price increase after regulation; and (ii) adaptability, given by a country's capacity to redeploy labor and shift production effectively to other, greener sectors. Section 4 presents the main empirical results using principal component analysis and discusses the main determinants of each country's vulnerability and adaptability to climate change policies. Section 5 discusses policy options aimed at helping countries adapt to an energy price shock. Section 6 concludes.

2. LITERATURE

The literature analyzing the effects of energy price changes on employment remains limited. Most of the existing work has taken one of two approaches: either using a computable general equilibrium (CGE) model that considers the direct and indirect effects of a price change on employment throughout the whole economy, or a sector-specific approach that analyzes in more detail the potential employment effects of an energy price shock in a particular sector.

Some recent studies find evidence of a small employment dividend from carbon cost increases. McNeill and Williams (2007) survey several studies and conclude that "economic instruments which link revenue recycling to the lowering of labor costs for employers do have positive employment effects". In a 2009 study, Fæhn, Gómez-Plana, and Kverndokk, employ a CGE model of the Spanish economy to evaluate the employment effect of a 25 percent reduction in carbon emissions via permits. Even when permit revenues are recycled to household's lump sum, the model finds a 0.01 percent increase in employment of

[3] Ongoing work at the World Bank specifically looks at the issues of "green jobs".

unskilled workers with no change for skilled workers. While this result depends in part on the fact that the fossil fuel-intensive part of the Spanish economy is not very labor intensive, it is important to note that, as in most studies, this model does not include a distinct sector for clean energy production which could get additional boost from such a permit scheme; further, the employment effects are increased when permit revenues are recycled via labor tax reductions, as found also in McNeill and Williams (2007). Similarly, Lutz and Meyer (2010) conduct a macro-econometric study for the European Union; under a variety of energy price, labor market, and revenue recycling scenarios, they simulate employment increases ranging from 0.02 to 0.77 percent.

In general, studies using macro econometric and CGE models persistently find that policies such as carbon permit sales or carbon taxes can have small, positive effects on employment when revenues raised are recycled via reductions in existing distortionary taxes. In some cases, employment gains can be realized even when tax revenues are returned lump sum to households. Effects on employment through substitution to cleaner fuels have gone largely unexamined. These substitution effects are likely to be nontrivial, however. Kammen, Kapadia, and Fripp (2006) report that "across a broad range of scenarios, the renewable energy sector generates more jobs than the fossil fuel-based energy sector per unit of energy delivered".

There have been few empirical studies directly analyzing the impact of climate mitigation policies on employment. However, there is a rich literature on the employment effects of oil price shocks. Despite the fact that the effects of climate policy on energy prices is likely to be more permanent than past oil price shocks, this literature can reveal plausible transmission mechanisms between energy prices and the real economy, including employment. This strand of literature has focused on the mechanisms by which consumption and employment may be affected by energy price increases. On the one hand, higher energy prices are expected to reduce discretionary income, as consumers have less money to spend after paying their energy bills. Consumers may also increase their precautionary savings and delay or forgo purchase of energy-using durables (Bernanke, 1983, Pindyck, 1991). These effects imply a reduction in aggregate demand, output and the corresponding employment in response to an energy price increase. On the other hand, higher energy prices are also likely to cause reallocation of capital and labor away from energy intensive industries as consumers switch to more energy efficient durables and as firms also switch away from production technologies that are energy-intensive. In the presence of frictions in capital and labor markets, these sectoral shifts will cause resources to be unemployed, at least in the short term (Davis, 1987; Hamilton, 2008).

While most studies of oil shocks and economic activity focus on the United States, there are a few recent notable exceptions. Miguel, Manzano, and Martín-Moreno (2003) examine oil shocks and the Spanish economy. The study suggests an immediate 0.3 percent drop in hours worked in response to a one-standard deviation oil price shock. Cuñado and De Gracia (2003) compare macroeconomic responses to oil shocks among fifteen European countries. This study ignores effects on employment but instead considers effects on industrial production indexes; however, the study is useful for showing significant differences among some countries in economic responses to oil prices across Europe. For example, industrial production initially increases and then falls in the United Kingdom, but in Germany and several other countries the decline in production is immediate. Papapetrou (2001) considers oil shocks and the Greek economy and finds that oil price shocks explain a significant proportion of the fluctuations in

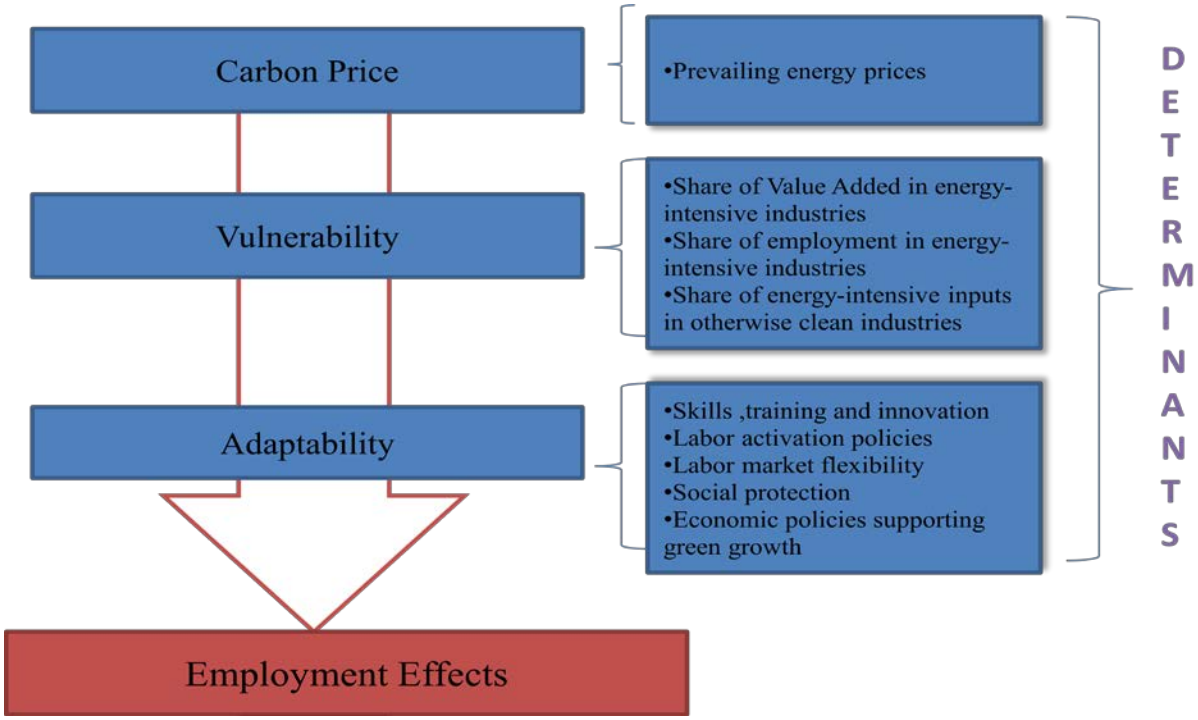
output growth and employment growth, and there is an immediate negative response of employment to oil price shocks. Most of the above studies point to a direct but relatively small impact of oil price increases on employment. They provide a hint of the likely impact of an energy price shock on employment. For example, an energy price of $3 - $166 per ton of CO_2 equivalent is recommended by various climate models to achieve a 550ppm target (Aldy et al, 2010). When we translate the suggested energy prices into the cost of oil, it results in an increase in price from $2 to $71 per barrel of oil. This is well within the 'natural' variation of oil price dynamics we have observed in recent years. Overall, existing evidence in the literature suggests that the potential negative impact of an energy price on employment is likely to be small and manageable.

3. CONCEPTUAL FRAMEWORK: CLIMATE CHANGE POLICIES AND EMPLOYMENT

In this paper, we consider the introduction (or increase) of prices on carbon emissions, and their effects on employment. Figure 1 depicts the expected transmission mechanisms of an energy price shock on employment. As will be discussed at length, this paper focuses on two interrelated dimensions for understanding the potential effects of a change in energy prices on employment: how vulnerable ECA countries are (i.e. estimated energy price increase after regulation, the share of value added and employment in energy-intensive sectors); and how adaptable they are to this change.

Figure 1 – Climate Change Policies and Employment

A simple conceptual framework



Source: Authors own elaboration

The final impact of the shock on employment will depend on the following three factors:

I. The size of the shock, determined by current energy prices and fuel mix

The extent to which the introduction of carbon regulation will affect employment is closely related to prevailing energy prices in individual countries. The ECA region inherited from the Soviet era a highly subsided energy system.[4] Since the collapse of central-planning in the 1990s, transition economies embarked on a large scale energy market reform program, including energy tariffs reform. Many countries, especially the new EU member states and the Balkans, have significantly increased fuel prices. However, in the medium to long run, all ECA countries are likely to face continued upward pressure on electricity prices. The EU and EU accession countries will have to conform to EU climate policies. In these countries, energy prices will need to rise to internalize environmental costs and to achieve the EU20-20-20 goal.

In CIS countries, there is still a large gap between cost-recovery price and prevailing energy prices. Governments need to remove electricity subsidies to maintain fiscal stability. Finally, demand for electricity is expected to increase at an annual rate of 3.1 percent between 2005 and 2010 in ECA.[5] Since much of the supply capacity is old and needs to be retired or rehabilitated, enormous amount of capital investment is needed to keep up the supply. The estimated investment amounts to US$3.3 trillion, including US$1.5 trillion for primary energy development and US$1.5 trillion for the power infrastructure.[6] To fully meet the capital needs, tariffs would have to rise to cover the costs.

II. The vulnerability of the economy to energy price increases

Countries have different economic and employment structures; since an introduction (increase) in the price of carbon is an actual change in relative prices, some industries will be more affected than others. In particular energy producers or energy-intensive industries will be most hardly hit. To the extent that a country's output depends heavily on these energy-intensive industries and has a large share of its employment in these sectors, countries will be highly vulnerable to an energy price shock. In addition, countries that have a large share of employment in otherwise clean industries but that rely to some extent on energy-intensive ones (as inputs), will also be affected. We measure the exposure of an economy to energy price shocks by the share of energy-intensive industries in value added, the share of energy-intensive industries in employment and combine these with .the estimated energy price increase after regulation.[7]

Using the UN sectoral classification, we consider the following sectors as energy-intensive: mining, quarrying, utilities, transport (air and land), and manufacturing.[8] Most of these sectors are already

[4] In 1991, of all non-OECD subsidies to fossil fuels (including electricity), totaling $270-$330 billion, roughly two-thirds were in ECA. In 1991, subsidies in the former Soviet Union states amounted to 10-13 percent of GDP. (Myers and Kent, 2001)
[5] World Bank (2010)
[6] *Ibid.*
[7] Due to the lack of data, we do not systematically measure employment in "clean" industries depending on their reliance on dirty inputs.
[8] It is worthwhile to note that we will be displaying results in this paper for overall manufacturing, although we also performed the same analysis for the and energy-intensive branches of the manufacturing sector, namely, iron and steel, chemical and petrochemical, non-metallic minerals (such as glass, ceramic, cement etc.), and paper and pulp. These are the top four energy consuming branches, accounting more than half of the total manufacturing energy use in ECA (Zhang, 2012). To see the results

regulated by EU ETS. Road transport, although not yet covered by EU ETS, is a major emitter of greenhouse gases (responsible for 21 percent of EU greenhouse gas emissions, for example), and is also considered a sector that will be significantly affected by future carbon regulation in this study.

III. The capacity of the country to adapt to energy price increases

Exposure by itself - the share of national output and employment in energy-intensive industries - does not fully determine the impact of the shock on employment. Importantly, countries have the capacity to adapt to a change in relative prices, especially if it is a permanent one like in this case. This adaptation capacity will determine how easy or how difficult it will be for firms and workers to shift from energy-intensive jobs to "cleaner" jobs.

We consider five main dimensions critical for adaptability: (i) labor market flexibility; (ii) the quality and availability of skills, training systems and capacity to innovate; (iii) the existence of active labor market policies and programs; (iv) the readiness of social protection systems to act as a safety-net for displaced workers[9], and (v) economic policies supporting green growth[10]. Many of the relevant determinants of a country's capacity to adapt to a change in energy prices are difficult to capture in quantitative indicators, especially for all the countries in the ECA region. In the last part of this paper, therefore, we discuss in more detail each one of the adaptability dimensions and provide guidelines on the direction in which countries in the region may want to move in order to be better positioned to face a change in the price of carbon. Next, we discuss the nature of the employment vulnerability and adaptability challenges for ECA countries in the context of climate change policies.

4. VULNERABILITY AND ADAPTABILITY TO CLIMATE CHANGE POLICIES IN ECA[11]

In this section, we describe the differences across countries in terms of their exposure (or vulnerability) to the energy price shock while also underlining the strengths and weaknesses in the region's capacity to adapt to the shock. We will distinguish between four types of countries; (a) countries that are highly vulnerable to the energy price shock but also have the potential to respond and adapt, (b) countries that are highly vulnerable and have only a limited capacity to respond if no reforms are implemented, (c) countries that are relatively less vulnerable but that could adapt if the shock is larger than expected, (d) countries that are relatively less vulnerable but would have difficulties adapting to an energy price shock if it does take place.

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for the more detailed manufacturing branches and a detailed explanation of why we decided to use overall manufacturing for the purposes of the paper, see Annex 1.

[9] The first four dimensions are the commonly accepted requirements for a flexible and secure work and life balance. See European Commission Directorate-General for Employment, Social Affairs and Equal Opportunities (2007) for more details. See also McMillan and Rodrik (2011) for a discussion on the particular role of labor market flexibility and skills in determining structural change.

[10] As discussed later, in the empirical exercise, we only measure the first four. We discuss the fifth dimension only qualitatively in Section 5 due to data limitations.

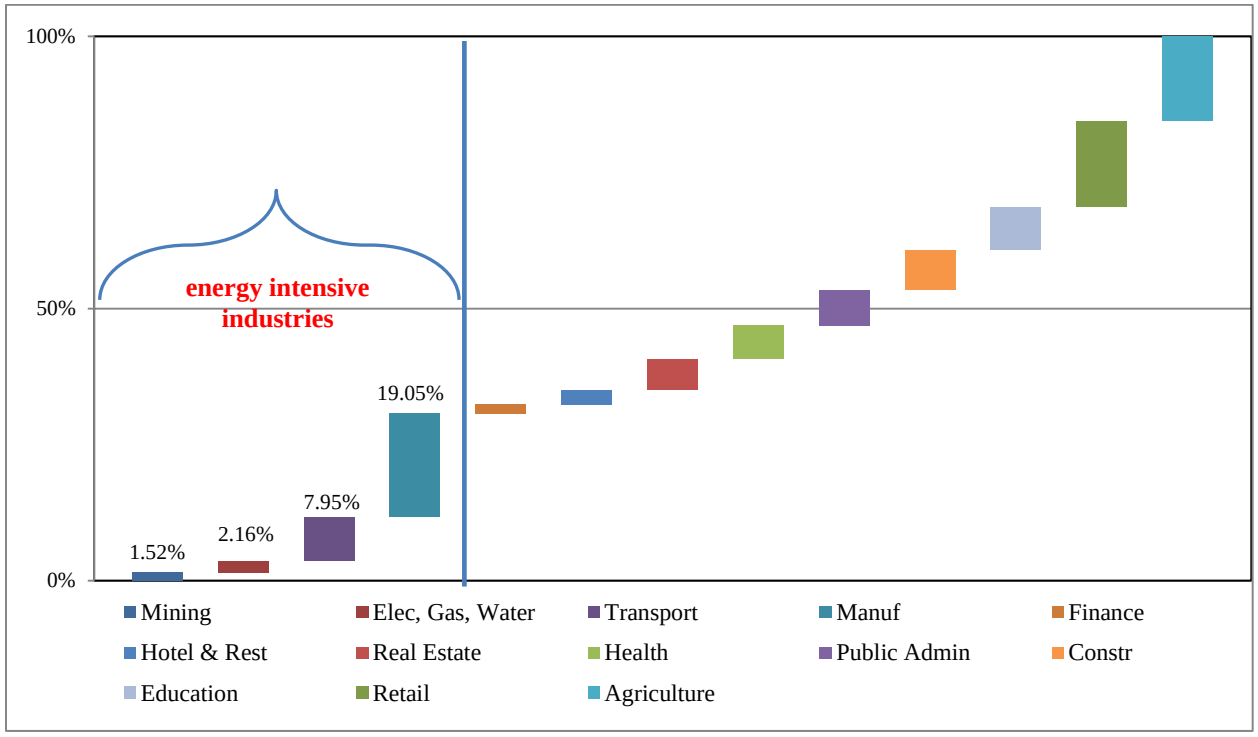
[11] The ECA countries included in this study are Armenia, Azerbaijan, Bulgaria, Croatia, Estonia, FYR Macedonia, Georgia, Hungary, Kazakhstan, Latvia, Lithuania, Moldova, Poland, Romania, Russian Federation, Serbia, Slovak Republic, Turkey, and Ukraine.

I. Vulnerability

Estimating how vulnerable countries are to changes in energy prices is a complicated task, not only methodologically but also due to the lack of publicly available data even for basic analysis as performed here. We have discussed already some of the methodological choices we have made in this paper in, for example, performing a static analysis and shying away from general equilibrium effects. We define energy-intensive industries as per the European Union Emission Trading Scheme list discussed in the previous section. We measure vulnerability as the combination of three main indicators: 1) estimated energy price increase after regulation; 2) the share of employment in energy-intensive industries; and 3) the share of value-added in the same energy-intensive industries[12]. In ECA, a significant share of employment and value added is in energy-intensive industries – around 30 percent of employment and around 40 percent of value added (Figure 3 and Figure 4, respectively).

Figure 3 – Energy-Intensive Sectors Take Up to 30 Percent of Employment in ECA

Cumulative percentage of employment, by sector, 2008



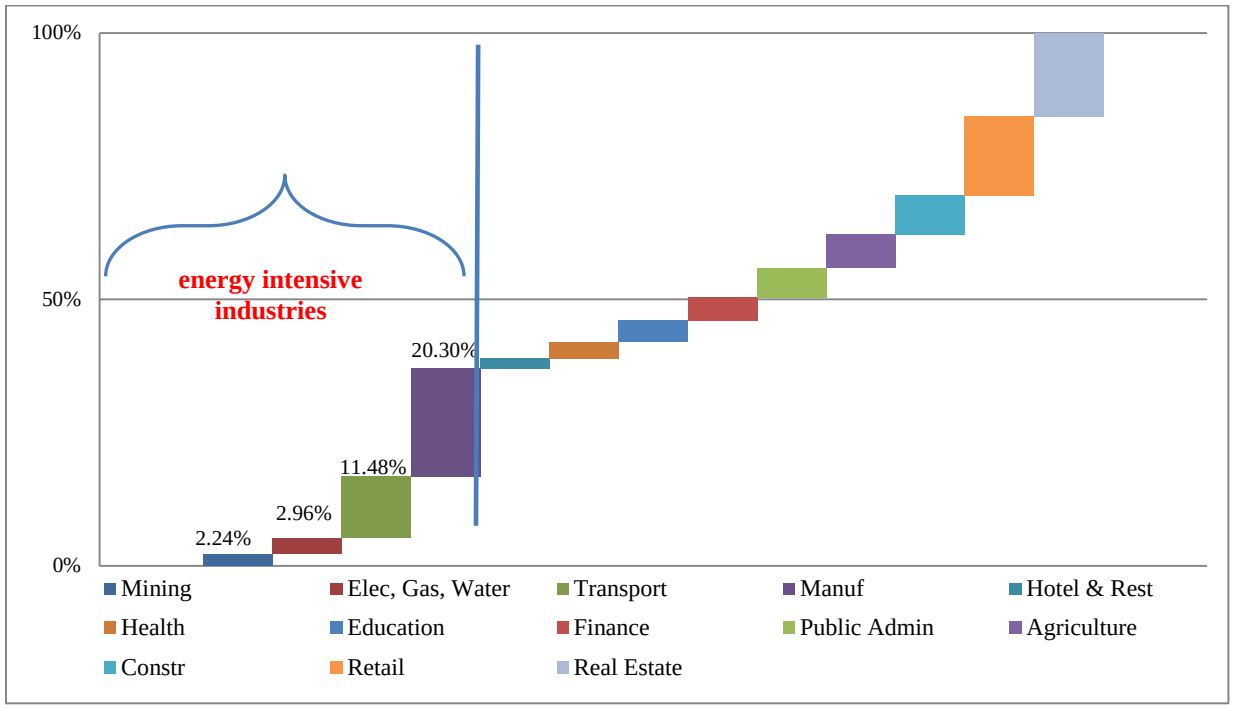
Source: Authors' calculation based on UN Data

Note: The figure is a representation of unweighted averages across ECA countries. The names of the sectors had been shortened to fit the axis. The full names are Mining and Quarrying; Electricity, Gas and Water Supply; Transport, Storage and Communications; Manufacturing; Financial Intermediation; Hotels and Restaurants; Real Estate; Health and Social Work; Public Administration and Defense, Construction; Education; Wholesale and Retail Trade; and Agriculture

[12] In terms of data, the first component we use while calculating vulnerability is the potential energy price hikes as mentioned in the previous section. This data was derived from IEA (2011) and ERRA tariff database. We rely on United Nations Statistics Division (UN) data for both employment (at the ISIC Rev 3 level) and value added statistics (at the SNA93 2.1 level).

Figure 4 - Energy-Intensive Sectors Take Up to 40 Percent of Value Added in ECA

Cumulative percentage of value added, by sector, 2008



Source: Authors' calculation based on UN Data

Note: The figure is a representation of unweighted averages across ECA countries. The names of the sectors had been shortened to fit the axis. See previous note for full names of sectors.

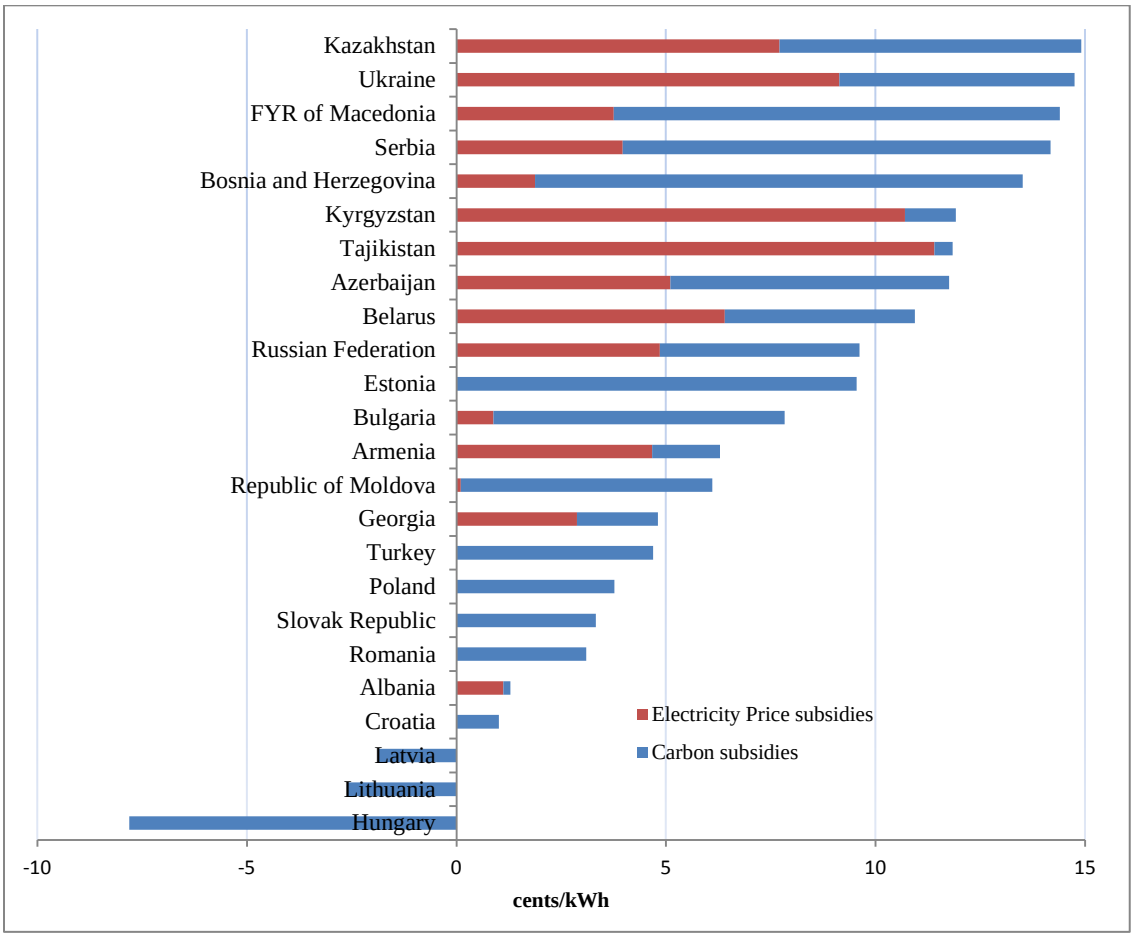
ECA countries are significantly more vulnerable than the more developed countries in Western Europe, with the exception of Norway being an oil producer (Figures 5 and 6). There is significant variation within the ECA region in the exposure or vulnerability of countries to an energy price shock.

Looking at the potential price increase data and assuming the long-run marginal cost of generation is determined by the average cost of building a gas-fired combined cycle power plant, the average cost recovery price of electricity supply in ECA will be around 12.5 cents per kWh.[13] Also assume an energy price at $15 per tones of CO_2 equivalence. We estimate the potential price hikes facing individual countries. As shown in Figure 5, some CIS countries, notably Ukraine, Russia and Armenia, need to make the largest adjustments in order to move tariff close to cost recovery. Meanwhile, some EU and EU accession countries, such as Estonia, Bosnia and Herzegovina and Macedonia that rely more heavily on fossil fuel fired generation, are likely to be hit hard once an energy price is fully implemented. At the other end of the scale, Latvia, Lithuania and Hungary already have prices higher than the social price adopted in the analysis.

[13] World Bank (2009); World Bank (2012)

Figure 5 - Potential electricity price hikes ($ cents/kWh)

CIS countries are expected to experience the highest energy price increases



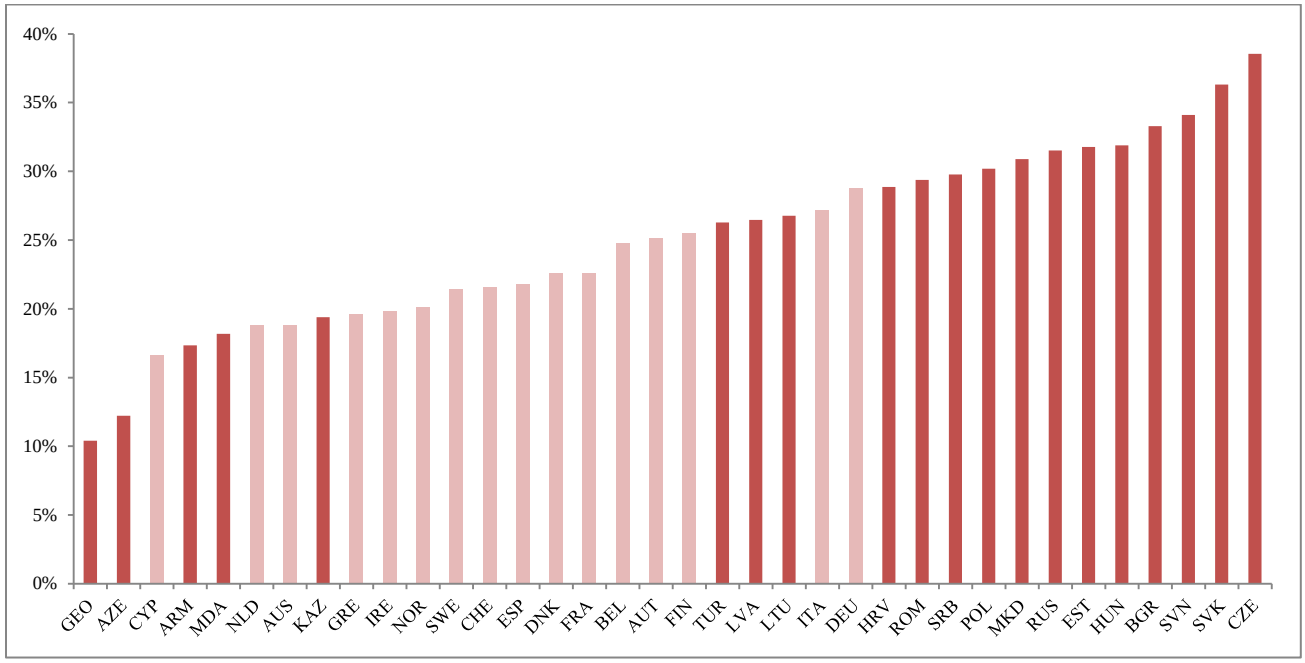
Source: World Bank staff calculation based on IEA (2011) and ERRA tariff database.

Note: Electricity price subsidies are determined by the gap between prevailing electricity price and the average long-term cost recovery price at 12.5 cents/kWh. Carbon subsidies are determined by the CO2 intensity of power generation and an energy price at $15 tons per CO_2 equivalence.

In terms of employment, the new member states of the European Union; i.e. Czech Republic, Slovak Republic, Slovenia, Bulgaria, Hungary, Estonia as well as Russia and FYR Macedonia were the most vulnerable, with around one third of their employment in energy-intensive industries. Poland, Serbia, Romania, Croatia, Latvia, Lithuania and Turkey also had a significant portion of their jobs mapped to these industries. At the other end, the South Caucasus countries (Georgia, Azerbaijan and Armenia) were the three countries in the ECA region with the lowest dependency on energy-intensive employment (Figure 6) as of 2007.

Figure 6 – ECA Countries are More Likely to Employ Workers in Energy-Intensive Sectors Compared to Other EU Countries

Share of employment in energy-intensive industries as a percentage of total employment (2007)



Source: United Nations Statistics Division

Note: The Western European countries are marked with lighter-colored bars. Energy-intensive industries comprise the following sectors: mining, quarrying, other utilities, construction, transport (air and land), storage and communications..

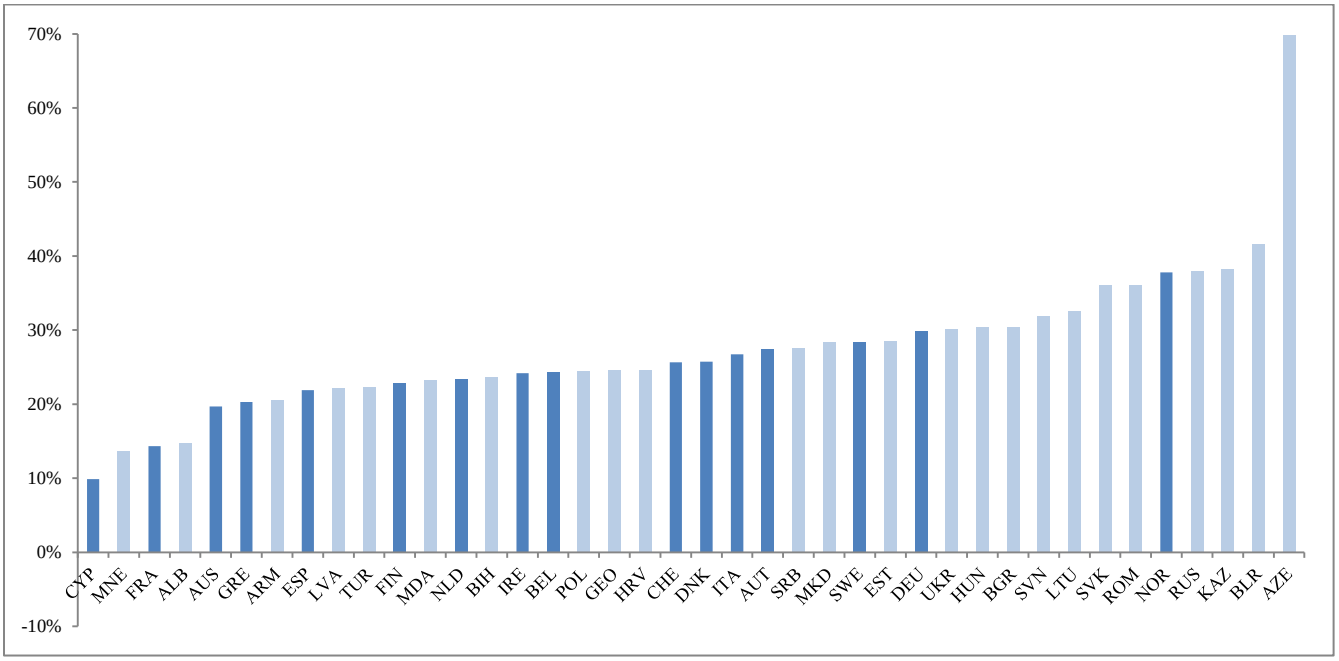
In the event of an energy price introduction or increase, the employment effect is likely to go beyond those workers directly employed in energy-intensive industries. As discussed in our conceptual framework, two other channels will also be very relevant in the short to medium term: the effect of the energy price shock on the capacity of the energy-intensive sectors to generate further employment and to contribute to the overall aggregate demand (and therefore, to the creation of jobs in other sectors); and, second, the effect of the energy price shock on otherwise considered clean industries that depend on energy-intensive inputs.

As of 2007, Azerbaijan, an important oil producer, was the country whose output was most dependent on energy-intensive industries (close to two thirds). Kazakhstan, Belarus, Russia, and Romania all had at least one third of their output derived directly from energy-intensive industries.[14] On the other hand, Montenegro presented the lowest dependency of output on energy-intensive industries within ECA – at 14 percent – followed by Albania, Armenia, Latvia, Turkey, and Moldova, all below 25 percent (Figure 7). As one can see, dependency on energy-intensive industries in terms of value-added does not necessarily translate into dependency in employment. Since sectors have varying labor (and capital) intensities, a sector can represent a large share of value added while making up a small share of overall employment. This is the case, for example, of large oil and gas producers such as Azerbaijan.

[14] Albania and Romania have a very large portion of value added and employment in construction while Bulgaria has a very large transport sector.

Figure 7 - ECA Countries are More Likely to Have Value Added in Energy-Intensive Sectors Compared to Other EU Countries

Share of value added in energy-intensive industries as a percentage of total value added (2007)



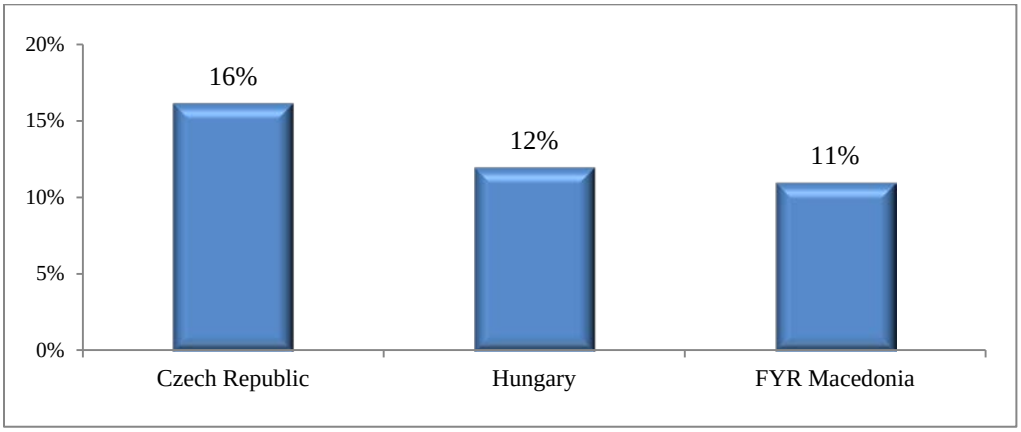
Source: United Nations Statistics Division

Note: The Western European countries are marked with lighter-colored bars. Energy-intensive industries comprise the following sectors: mining, quarrying, other utilities, construction, transport (air and land), storage and communications.

The required data to quantify the effect of the energy price shock on otherwise clean industries is not available for most ECA countries since it requires national input-output matrices. However, this information is available for a few countries, namely Czech Republic, Hungary, and Macedonia FYR. For these countries, the data shows that this channel is potentially very important when analyzing the effects on aggregate employment of an energy price shock (see Figure 8).

Figure 8 – Clean Industries Can Also Use Significant Energy-Intensive Inputs

Share of value added in clean industries accounted for by inputs from energy-intensive sectors (as a percentage of total value added in clean industries, 2008)



Source: Eurostat ESA 95 Supply, Use and Input-Output tables

Given data restrictions, we limit the analysis on vulnerability in the rest of the paper to indicators on the share of employment and value added in energy-intensive industries, and the expected energy price increase. For illustrative purposes, we combine these three dimensions into a single indicator of vulnerability to energy prices using principal component analysis - a way of identifying and simplifying patterns in the data when there is more than one dimension (see Annex 3 for a description of the methodology used).

From this analysis, three groups of countries emerge in terms of their relative vulnerability to an energy price introduction or increase (Table 1). The countries that are highly vulnerable are large oil producers such as Kazakhstan, Russian Federation and Azerbaijan.[15] In addition to these three, Ukraine with one third of its value added derived from energy-intensive sectors as well as expecting the second highest energy price hike also belongs to the high vulnerability group. FYR Macedonia is another highly vulnerable country since it has a significant proportion of its total employment in energy-intensive sectors as well as being the country expecting the third highest price increase after Kazakhstan and Ukraine. New member states of the European Union represent the lower end of the vulnerability scale. This is because they expect a much lower price increase and less of their value added comes from energy-intensive sectors compared to the rest.

Table 1 - Principal Component Analysis – Vulnerability Results

Level of Vulnerability	Country
Low	Bulgaria, Croatia, Hungary, Latvia, Lithuania, Poland, Slovak Republic
Medium	Armenia, Estonia, Moldova, Romania, Serbia, Turkey
High	Azerbaijan, Georgia, Kazakhstan, Macedonia FYR, Russian Federation, Ukraine

Source: Authors' calculations

II. Adaptability

While some countries may be very vulnerable to a change in energy prices given the high dependency of their value added and employment on energy-intensive industries, social and labor market policies and institutions may be able to cushion negative effects by creating the right incentives for rapid mobility to growing (and greener) sectors, re-skilling workers, promoting innovation and providing a safety net to displaced workers. However, social and labor market policies and institutions, if not adequate, could also amplify the negative effects caused by the price shock. There are five main dimensions that will determine a country's capacity to adapt to an energy price change[16]:

[15] We have manually added Azerbaijan to the high vulnerability section because we have left it out when we ran the PCA analysis due to its outlier status with 66 percent of its value added originating from energy-intensive industries. This high number skews the PCA analysis as literature suggests. It is widely recognized that the Kernel PCA can be extremely sensitive to outlying observations, and conclusions can be misleading (Deng, Yuan and Sudjianto, 2007)

[16] Annex 4 describes the definitions and data sources used to construct the different adaptability indicators included in the analysis. Annex 5 also presents the values of adaptability indicators by country.

a. Labor market costs and flexibility

Labor market flexibility refers to the regulatory and institutional framework governing the hiring and firing of workers and the costs associated with employment. With everything else constant, most countries where labor markets are flexible are likely to experience the most immediate (and possibly largest) labor restructuring as a result of increases in energy prices. However, these are also the countries where workers will find it easier to move to cleaner and more productive jobs and sectors (McMillan and Rodrik, 2011).

We measure labor market costs and flexibility through indicators of employment protection legislation (EPL), the tax wedge, the minimum wage level and the maximum length of fixed contracts (see Annex 5 for country specific details). We divide our results into three groups of countries in terms of their relative labor market flexibility (Table 2). The countries that have high labor market flexibility such as Albania, Azerbaijan, Bulgaria, Georgia, Kazakhstan, Russian Federation and Slovak Republic have relatively low employment protection legislation (EPL) and relatively low tax wedges. The lower labor market flexibility in countries like Croatia, Latvia, Lithuania, Macedonia FYR, Romania, Slovenia, and Turkey is due to a combination of relatively higher EPL and tax wedge in these countries. For instance, Turkey has significantly higher EPL (3.49) and tax wedge (41.8) rates compared to Georgia that stands on the other end with much lower EPL (0.38) and tax wedge (26.7) rates. There is significantly less variation across countries in terms of minimum wage levels and the length of fixed contracts.

Table 2 - Principal Component Analysis – Labor Market Flexibility Results

Labor Market Flexibility	Country
Low	Croatia, Latvia, Lithuania, Macedonia FYR, Romania, Slovenia, Turkey
Medium	Armenia, Czech Republic, Estonia, Hungary, Moldova, Poland, Serbia, Ukraine
High	Albania, Azerbaijan, Bulgaria, Georgia, Kazakhstan, Russian Federation, Slovak Republic

Source: Authors' calculations

b. Skills, training and innovation

In response to the permanent increase in energy prices, governments will need to ensure that their citizens are well-equipped to transition from employment in energy-intensive industries to other industries that are less vulnerable to an energy price shock. The role of training and skills, therefore, will be more crucial than ever for enabling workers to secure employment in new and emerging industries in a timely manner, and for firms to be able to innovate and create those cleaner jobs.

Skills, training and innovation reflect, therefore, the ability of a country's workforce to adapt to changing conditions and move to new industries. To capture these dimensions, we use gross domestic expenditure on R&D (GERD) as a percentage of GDP, percentage of labor force (ages 15-64) with secondary education, the ratio of vocational/technical secondary enrollment to general secondary enrollment, the average years of total schooling and the latest PISA math score.

The countries with higher level of skills, training and innovative capacity – as measured by our indicators- are the new EU member countries (with the exception of Bulgaria and Romania) and Croatia (Table 3). This is because they are spending more resources on research and development (the range is between 0.7 - 1.9 percent of their GDP), the ratio of labor force with secondary education is much higher than the other countries' (up to almost 80 percent in Czech Republic and Slovak Republic), and their PISA math scores are much higher (512 in Estonia while the ECA average is around 455) – the latter a possible indicator for education quality. The other end of the spectrum includes Albania, Armenia, Georgia, Kazakhstan, Macedonia FYR, Moldova, and Turkey who rank much lower in all indicators. The PISA scores are low (377 in Albania, for example), the ratio of labor force with secondary education is around 60 percent and they spend significantly less resources on research and development (0.2 to 0.8 percent).

Table 3 - Principal Component Analysis – Skills, Training and Innovation Results

Labor Market Skills, Training and Innovation	Country
Low	Albania, Armenia, Georgia, Kazakhstan, Macedonia FYR, Moldova, Turkey
Medium	Azerbaijan, Bulgaria, Lithuania, Romania, Russian Federation, Serbia, Ukraine
High	Croatia, Czech Republic, Estonia, Hungary, Latvia, Poland, Slovak Republic, Slovenia

Source: Authors' calculations

c. Active labor market policies

Active labor market policies (ALMPs) help workers make more effective transitions across industries through training, employment services, incentives for entrepreneurship, among other interventions (Betcherman, et.al, 2004). These programs are implemented to enhance labor supply (e.g., training); increase labor demand (e.g., public works, hiring and wage subsidies); and improve the functioning of the labor market (e.g., employment services). ALMPs are often targeted to the long-term unemployed, workers in poor families, and particular groups with labor market disadvantages.

Despite clear data and methodological limitations, the existing literature suggests that ALMPs could play an important role in bring workers closer to jobs (World Bank, forthcoming). Not surprisingly, however, the impact very much depends on the design of the programs, how integrated the different functions are, what incentives are in place in the governance structure to program managers to respond to the need of the beneficiaries an how well these programs are targeted to the neediest (Betcherman, et.al, 2004).

Comparable country data on the spending quality of ALMPs is, however, very limited. Hence, in this paper, we proxy the quality of ALMP with spending in these programs per unemployed[17], granted it is far

[17] During periods of extended labor-market weakness, falling resources per job-seeker can be a particular concern as independent job-search is more difficult when unemployment is high. Job-seekers may therefore depend more heavily on job-search assistance and other labor market programs.

from being the ideal indicator. Since there is only one indicator, we do not need to use PCA. Instead, Table 4 shows the top, middle and bottom terciles.

Table 4 - Active Labor Market Policy Spending Results

Active Labor Market Policy Spending	Country
Low	Albania, Armenia, Bulgaria, Georgia, Macedonia FYR, Moldova, Serbia, Ukraine
Medium	Czech Republic, Hungary, Kazakhstan, Latvia, Russian Federation, Slovak Republic, Turkey
High	Azerbaijan, Croatia, Estonia, Lithuania, Poland, Romania, Slovenia

Source: Authors' calculations

There is significant variation in ALMP spending per unemployed in the ECA region. On the one hand, countries like Azerbaijan, Croatia, Estonia, Lithuania, Poland, Romania, and Slovenia are relatively high spenders - almost all are spending more than 1000 USD on average. On the other hand, Albania, Armenia, Bulgaria, Georgia, Macedonia FYR, Moldova, Serbia, and Ukraine all spend under 200 USD per person.

d. Social protection

Given the need to provide a safety net for workers that are displaced by the introduction or increase in the price of carbon, the social protection dimension refers to the readiness of the social assistance and the unemployment benefit system to respond to the shock. Social protection has been identified as a critical component of not only a proper response to climate change challenges, but more broadly, of any government response to economic and social shocks (EU, 2008; World Bank, 2011b).

As indicators of this dimension, we use the total spending on social assistance benefits, the duration of unemployment benefits, benefit levels (average unemployment benefit/average wage) and a quality indicator of last resort social assistance and child benefit programs developed by the ECA Social Protection team[18] for the readiness of social benefits to respond to shocks.

Table 5 - Principal Component Analysis – Social Protection Performance Results

Social Protection Readiness	Country
Low	Latvia, Macedonia FYR, Moldova, Russian Federation, Slovenia, Serbia, Turkey
Medium	Albania, Azerbaijan, Bulgaria, Croatia, Kazakhstan, Poland, Romania
High	Armenia, Czech Republic, Estonia, Georgia, Hungary, Lithuania, Slovak Republic, Ukraine

Source: Authors' calculation

[18] The ECA SP team monitored social benefits responses on a monthly basis using administrative data in 14 countries from 2008-10 to track the response of benefits to the global crisis. See findings in report by Isik-Dikmelik (forthcoming).

Armenia, Czech Republic, Estonia, Georgia, Hungary, Lithuania, Slovak Republic, and Ukraine have social protection systems that, in general, appear to be more robust and able to respond to shocks. These countries are characterized by relatively higher spending on social protection and higher quality (targeting, coverage and generosity) social programs. For the low readiness countries, the situation is reversed. Social protection in these countries appears particularly weak in terms of spending and the quality of last resort social assistance and child benefit programs. It is important to note that there is significantly less variation across countries in terms of unemployment benefit duration and amount.

5. IMPROVING ADAPTABILITY: POLICY IMPLICATIONS

Putting together results from the previous section, a typology emerges of four types of countries depending on whether they have high/low vulnerability to an energy price shock and high/low capacity to adapt to such a change. After looking at the vulnerability and adaptability components of our analysis separately, we now combine them – using PCA analysis- to see the relative position of countries in terms of how vulnerable and adaptable they are to an energy price change.

Some countries may be highly vulnerable but have a high capacity to adapt to the increase in the price of carbon, for example; others may be in the opposite situation, with very little capacity to adapt. There is significant variation within ECA. As an illustration, we use three levels of vulnerability and three levels of adaptability according to the PCA grouping as shown in Table 6. Figure 9 provides more detail indicating each country's actual PCA score in a continuum instead of broad categories. The higher the PCA score, the higher the vulnerability and the adaptability.

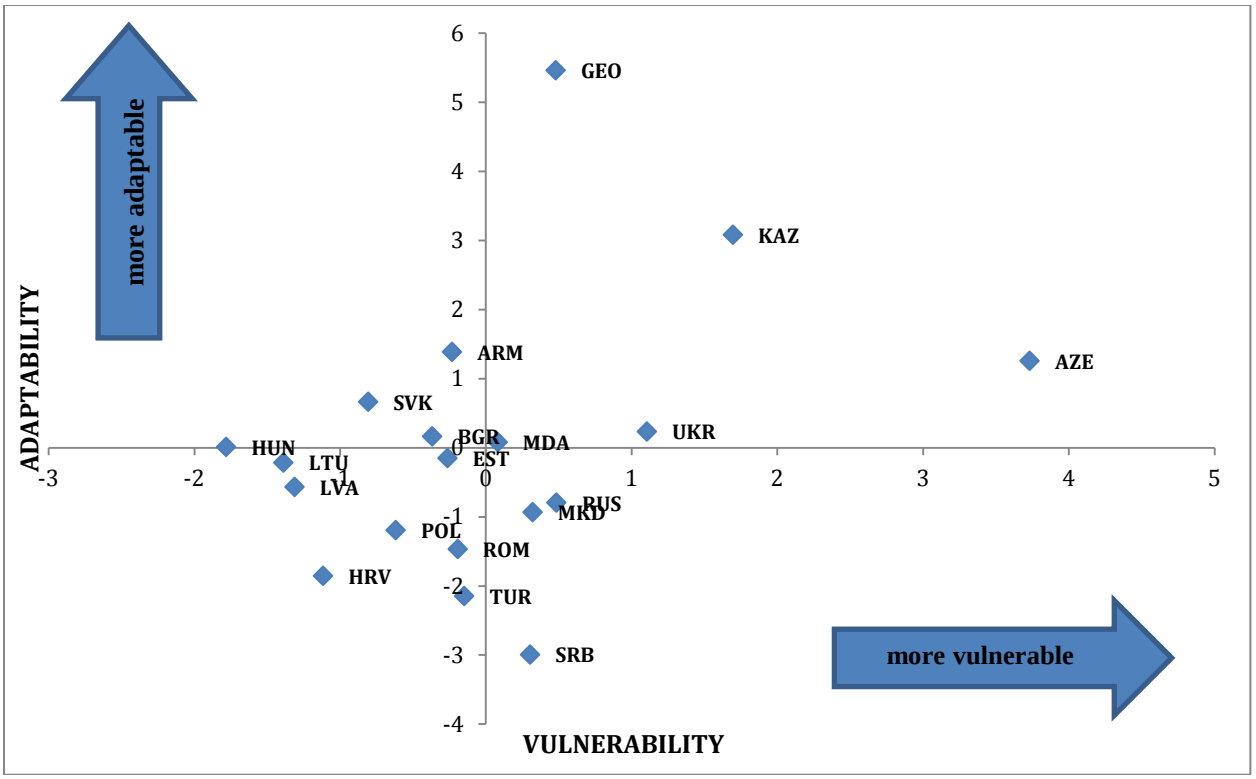
Table 6 - Principal Component Analysis Results

	High Adaptability	**Medium Adaptability**	**Low Adaptability**
High Vulnerability	Azerbaijan, Georgia, Kazakhstan, Ukraine		FYR Macedonia, Russian Federation
Medium Vulnerability	Armenia	Estonia, Moldova	Romania, Serbia, Turkey
Low Vulnerability	Slovak Republic	Bulgaria, Hungary, Latvia, Lithuania	Croatia, Poland

Source: Authors' calculation

Figure 9 – Policy Action is Most Urgent in High Vulnerability/Low Adaptability Countries

Principal component analysis – relative position of ECA countries in terms of vulnerability and adaptability



Source: World Bank Staff calculation. See Annex 5 for details on data.

Note: Countries with high vulnerability (higher values) are those with higher shares of employment and value added originating from energy-intensive industries, as well as those that expect a higher energy price spike. Countries with high adaptability (higher values) are the ones with high LM flexibility, high skills, high social protection readiness, and higher spending on ALMPs. The value 0 represents the average position in terms of vulnerability and adaptability across all countries in our sample. This analysis was performed taking into account the overall manufacturing sector. To see a more detailed breakdown of the manufacturing sector resulting in a similar analysis, see Annex1.

The analysis is designed as a simple tool to see each county's individual stance as well as how they compare with the rest of ECA; for policy-making, however, what is important is to identify the areas within each dimension in which they may have weaknesses. FYR Macedonia and Russian Federation are highly vulnerable and not very adaptable while Slovak Republic has low vulnerability as well as high adaptability which mean it is the most favorable country in our analysis.

The policy challenges are likely to be different for all countries depending on their position in the above graph. The reform agenda for countries in the bottom right part of Figure 8 is the most urgent. Moreover, the reform agenda will differ by country since, as discussed in section 4, "unprepared countries" are unprepared in their own way. Based on the existing literature, we have identified five key policy areas where governments should focus in order to better prepare their firms and workers for an energy price shock: labor market costs and flexibility; skills, training and innovation; active labor market policies; social protection; and economic policies supporting green growth.

Poland can serve as an informative example to policy makers across the region as a country that is highly dependent on coal and other energy-intensive inputs, but that has put in place policies to help weather the negative impacts of a carbon shock or other economic shocks; at the same time, it is a country that illustrates the need for a continuous reform agenda in social sectors (Box 1). The Polish case illustrates

that (i) carbon mitigation is possible, (ii) the policy actions required to improve preparedness must span a wide range of social and economic areas but are manageable, and (iii) many of the policies that can help firms and workers transition into cleaner and more productive industries are the same policies needed to help populations weather other economic shocks as well.

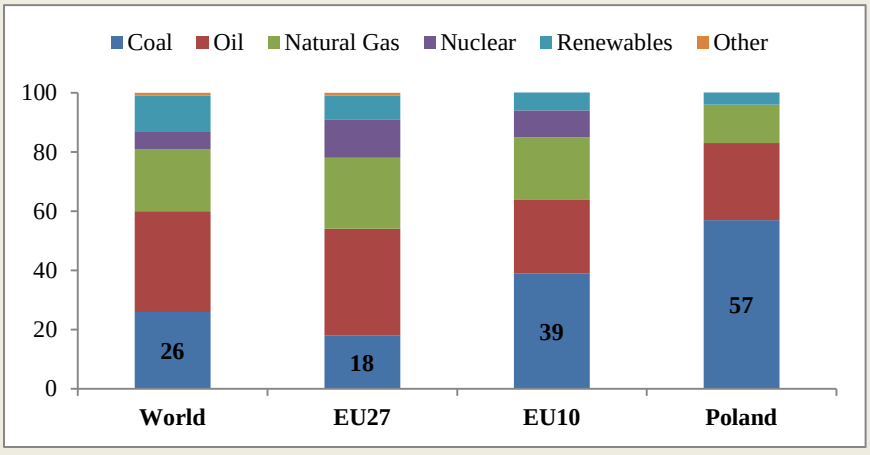
Box 1 - Carbon Mitigation and Successful Adaptation: Poland

Poland's economy is twice as energy-intensive as the EU average. However, Poland has made significant progress in reducing overall carbon emissions by almost 30 percent since transition to a market economy began[19]. Carbon mitigation is not a new issue in Poland. Poland's particular challenge is its reliance on domestic coal. Eighty five percent of Poland's green house gas emissions come from the energy sector, and more than 90 percent of electricity comes from coal-fired power plants which emit the highest levels of CO_2 per unit of electricity of any power generation technology. Poland is an outlier with regards to the dominance of coal in its energy sector; both within Europe and in the world (Figure 10). In addition, the share of natural gas (13 percent) and renewable energy (5 percent) are significantly below the EU average, while no energy is being generated by nuclear technologies.

Poland's progress in adapting to new climate and energy price realities relies not only on reducing CO2 emissions, but also on making its policies – especially in the labor market and skills production system - more conducive to a successful transition to a low carbon economy. In terms of labor market costs and flexibility, Poland still has a relatively high tax wedge compared to other countries in the region but a low to average rigidity in employment protection legislation. This is probably one area where additional improvements could facilitate labor reallocation towards new sectors or jobs. Poland, however, spends significant resources on active labor market programs compared to peer countries, and these programs have been playing an increasingly important role in improving the matching of workers and jobs.

Figure 10 – Poland is Heavily Dependent on Energy-Intensive Industries

Energy consumption by type of fuel (2007)



Source: European Commission, World Bank staff calculations

Although there have been important reforms in social protection, there is still room for improvement. Poland

[19] From 564 million metric tons of CO2e in 1988, greenhouse gas emissions collapsed along with output through 1990 (declining 20 percent), as inefficient, often highly energy-intensive plants shut down during the early years of transition. The period of 1996 to 2002 witnessed another 17 percent decline in emissions but while GDP expanded. Overall, although Poland's GDP near doubled during 1988 to 2008, its GHG emissions were reduced by about 30 percent.

is the country in the region with the lowest spending in social assistance relative to GDP (1.6 percent), its resources are very well targeted to the poorest with almost half of the benefits being means-tested but there is still a significant share of social assistance benefits that go the richest quintile (around a quarter). Similar to social assistance, unemployment benefits are among the least generous in the region, although with a very long average duration (18 months).

Poland has also made significant reforms in the education sector. As part of its 1999 structural reform of the education system, the Government of Poland introduced a new type of school—the "gymnasium"—to provide lower secondary education. In the course of their evaluation of Poland's reform, Jakubowski, et al. (2010) found that delaying specialization and exposing students to general education for one additional year was shown to correspond to an average increase of one-quarter of a standard deviation in the math and reading PISA scores. This, in fact, may explain the improvement over time in Poland's PISA scores. In addition, Poland has introduced per capita financing in tertiary education to better align financing incentives with outcomes and results.

Innovation has also played an important role in Poland's story so far. A transition towards a low-emissions economy is highly likely to benefit Poland in the near future. The demand for products and processes with lower greenhouse gas emissions will accelerate as more countries adopt abatement targets. Innovation will be critical in this growing market for clean technology—the expertise and equipment related to new developments in areas such as renewable energy (in particular, wind power, solar power, biomass, hydropower, and biofuels), electric motors and low emission transportation, energy efficient lighting and appliances, and green buildings. The energy sector, the dominant source of today's emissions, is also central in the adoption of cleaner technology. Given the well-established fact that the private sector acting alone will tend to under invest in research and development (R&D), governments who are moving early towards abatement, such as Poland's, need to consider whether active support to clean technology R&D is an important complementary policy measure (World Bank, 2011a).

Source: Jakubowski, et al. (2010); ECA Social Protection Databse; World Bank (2011a)

a. Labor Market Flexibility

Labor market flexibility refers to the ease with which firms hire, maintain and fire workers as determined by regulation (employment protection legislation, minimum wage, and the maximum length of temporary contracts), interventions (the level of the tax wedge indicating the cost of hiring workers) and institutions (the bargaining power of workers, measured by union density).

Labor market flexibility would allow workers to move to other (greener) sectors more easily. McMillan and Rodrik (2011) find that countries with more flexible labor markets experience greater growth-enhancing structural change. This also stands to reason, as rapid structural change is facilitated when labor can flow easily across firms and sectors. The rate at which structural change in the direction of modern activities and greener growth takes place can be facilitated by ease of entry and exit into industry, the flexibility of labor markets, a population with more general and non-cognitive skills, labor market policies that improve employability, social protection that provide income support for workers during transitions, and economic policies that support new industries while limiting distortions. Moreover, McNeill and Williams (2007) also show that combining labor market reforms – in the form of lower labor taxation – with climate change policies could actually lead to an increase in employment.

The reasoning is simple: If the costs of hiring and firing workers are too high, it becomes too expensive for firms create jobs. In countries where the labor market is still too heavily regulated, it is essential to increase flexibility so that the labor market can better respond to rapidly changing demand. Labor markets in most of ECA, despite having become more flexible over time, still have important rigid elements, particularly in terms of employment protection legislation (EPL), easiness to start a new business and tax regulations.

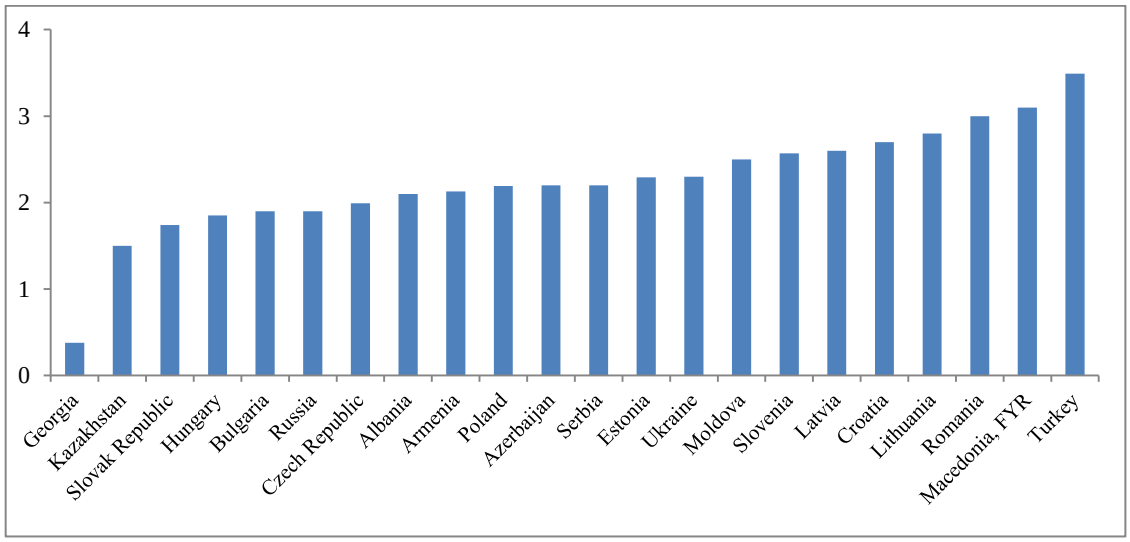
EPL is a form of labor market regulation that restricts employers' ability to dismiss workers and can reduce flows into, but also out of unemployment. Strict EPL can slow new employment if restrictions on dismissing workers make employers wary before taking on someone new. For this reason, restrictions on dismissal could increase the likelihood of unemployment, the duration of unemployment, the attraction of using fixed-term contracts, and past a certain threshold, can even cause employers to turn to the untaxed, unregulated labor market and hire informally. Beyond affecting flows into and out of employment, EPL creates an "insider-outsider" divide. Those that have a protected job ("insiders") are relatively guarded from losing it, while the inactive and unemployed ("outsiders") find it more difficult to gain employment. EPL changes the distribution of jobs with important implications for first-time job seekers, youth (especially), women, the disabled, and other disadvantaged groups (World Bank, forthcoming). The higher the EPL, the more difficult the transition to new sectors could be.

Despite significant reforms, EPL remains rigid in several ECA countries (See Figure 11). In Turkey, for example, EPL is rigid for both permanent and – especially – temporary workers, contributing to maintaining resources in inefficient informal and semi-formal activities. Süral (2009) argues that simplification is needed in the regulatory environment. Otherwise such a strict EPL will continue to be featherbedding for the informal sector by pushing the firms and workers into it. This is why the OECD, in its Economic Survey of Turkey 2006, states that "the Government needs to improve conditions for job creation in the formal sector by adopting more flexible employment protection regulations, replacing severance payments with unemployment insurance."[20] The cost of complying with labor regulations such as those on severance pay is high by international standards, as a result of which the employers increase working hours instead of creating employment (Süral, 2009). In FYR Macedonia, the high level of EPL in is considered mostly due to the stringency of the legislation on temporary employment and collective dismissals[21], although significant reforms continue to be implemented in these areas. For high EPL countries where there remain important restrictions to hiring and firing, reducing these – while ensuring some safety net for displaced workers – could facilitate the needed structural transformation.

[20] OECD (2006)
[21] ILO (2008)

Figure 11 – In Many Countries, Employment of Insiders Still Very Protected

Employment protection legislation in ECA, 2007



Source: Institute for the Study of Labor (IZA), OECD

Note: Higher numbers denote stricter EPL regimes. All sub-indexes are normalized in the 0–6 range (OECD Standard)

Just as important as being able to adjust the size of the workforce, the business environment needs to be open for entrepreneurs to start new businesses. Enabling private sector growth requires a regulatory environment where new entrants with drive and good ideas, regardless of their gender or ethnic origin, can get started in business and where firms can invest and grow, generating more jobs. Economic activity requires good rules—rules that establish and clarify property rights and reduce the cost of resolving disputes; rules that increase the predictability of economic interactions and provide contractual partners with certainty and protection against abuse. The objective is regulations designed to be efficient, accessible to all and simple in their implementation[22]. This is another area where countries in the region have made significant reforms. However, in some countries there are still important restrictions and high costs to doing business (Table 7).

Labor taxes are another important determinant of the cost and the ability of firms to hire workers. They are composed of both social insurance contributions by employers and employees and the personal income tax of employees as a share of total labor costs. Critically, labor taxes in ECA are relatively higher at lower earnings levels. A comparison with other EU, OECD and neighboring countries shows that the tax wedge on labor at lower wage levels (33 percent of average wages) tend to be relatively high. The tax wedge measures the difference between labor costs and take-home pay of workers. For a single person with no children who receives a gross wage 33 percent of the average wage, only few EU-15 countries—like Sweden, Germany, Belgium, and Finland—charge higher taxes than most of the EU's new member states (Figure 12) (Koettl and Weber, 2012).

[22] World Bank (2012a)

Table 7 – For Some Countries, Improving the Business Environment Should Remain a Priority

Doing Business, 2012

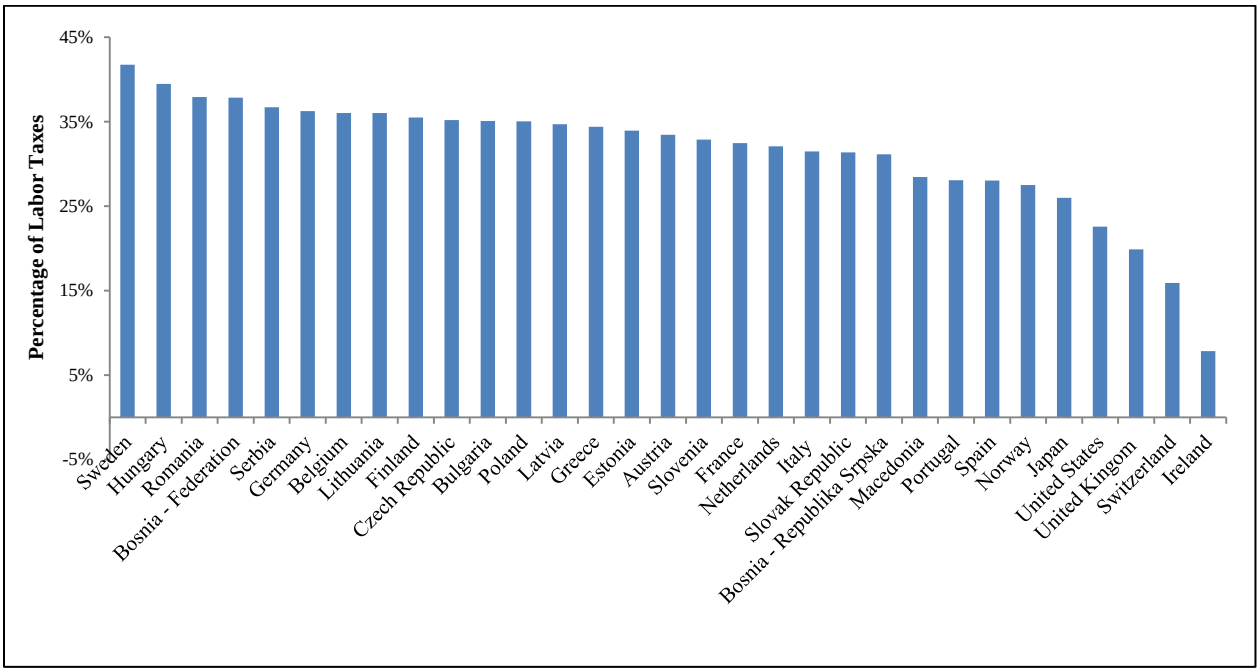
Economy	Ease of Doing Business	Starting a Business	Paying Taxes
Georgia	16	7	42
Latvia	21	51	67
Macedonia, FYR	22	6	26
Estonia	24	44	51
Lithuania	27	101	62
Slovenia	37	28	87
Kazakhstan	47	57	13
Slovak Republic	48	76	130
Hungary	51	39	117
Armenia	55	10	153
Montenegro	56	47	108
Bulgaria	59	49	69
Poland	62	126	128
Czech Republic	64	138	119
Azerbaijan	66	18	81
Belarus	69	9	156
Kyrgyz Republic	70	17	162
Turkey	71	61	79
Romania	72	63	154
Croatia	80	67	32
Moldova	81	88	83
Albania	82	61	152
Serbia	92	92	143
Kosovo	117	168	46
Russian Federation	120	111	105
Bosnia and Herzegovina	125	162	110
Tajikistan	147	70	168
Ukraine	152	112	181
Uzbekistan	166	96	157

Source: World Bank, 2012a

Note: Economies are ranked on their ease of doing business, from 1 – 183. A high ranking on the ease of doing business index means the regulatory environment is more conducive to the starting and operation of a local firm. This table only shows the ECA countries within the international ranking. The rankings for all economies are benchmarked to June 2011.

Figure 12 - Labor Taxation is Higher for Low-Wage Earners in ECA Countries

Labor taxes, 2007



Source: Koettl and Weber (2012) based on OECD Tax and Benefit model.
Note: Columns represent the tax wedge for low-income earners (singles with no children at 33 percent of average wage) in 2008 (for Bosnia, Macedonia, and Serbia, 2009).

The historical reliance of ECA countries on labor taxation cannot be easily disentangled from the generous social insurance systems. A redesign of tax systems aimed at reducing social contributions will need to be balanced with expenditure demands, fiscal constraints and the existing tax structure. Within this overall fiscal framework, countries may be able to facilitate the moving of workers to cleaner industries through the use of well designed tax incentive schemes.

It is important to recognize that in many countries high labor market flexibility often does not go hand in hand with generous social protection systems; however, this does not need to be the case. Overall, there is a negative correlation between flexibility and protection across countries. This correlation is even stronger when considering only high-income countries. As incomes increase, countries gravitate toward one of two work models: one that forgoes flexibility or another that forgoes protection. In that sense, transition countries might in the future embark on a pathway towards one of the two work models. Some already seem to have chosen—like Georgia seems to have chosen the high flexibility/low protection model, and Slovenia the low flexibility/high protection model (World Bank, forthcoming). Nevertheless, some countries, like Denmark, Austria, Switzerland, and Ireland to a lesser extent - have managed to find a balance between flexibility and protection. A reform of labor market institutions needs to be balanced: increasing labor market flexibility should be accompanied by (i) other reforms that improve the overall business environment and (ii) improving the safety nets available for workers when they are out of work. The 'flexicurity' model in Denmark is a benchmark of getting this balance right (See Box 2).

Box 2 - Balancing Flexibility and Protection: Denmark's Flexicurity

Every year, one out of five Danes loses his or her job. But they don't lose their incomes. Unemployment benefits replace close to two thirds of their earnings, and the government helps them find work. This combination of flexibility for employers and income security for workers is called "flexicurity". The arrangement has been in place since at least the 1970s. But it has evolved over time, principally in that the active labor programs component has been strengthened. It seems to work well. Between 1995 and 2008, Danish unemployment rates averaged 4.9 percent, while the rest of the EU15 suffered rates close to 8.5 percent. Danish employment laws have evolved from a system in which unemployment benefits were paid by labor and trade unions, not the government. In the 1970s and 1980s, unemployment rates remained high, while those without jobs got good incomes.

The arrangements were reformed in the 1990s. The OECD Employment Protection index for Denmark has fallen from 2.4 in 1983 to 1.5 in 2009. Unemployment insurance financed from contributions and taxes covers around 80 percent of the labor force. Benefits last up to four years, replacement rates cannot exceed 90 percent of wages. After four years, recipients have to switch to social assistance which means a reduction of between 20 and 40 percent of benefits. Active labor market programs, like job search assistance and training nudge the unemployed back to work. The unemployment rate dropped from 10 percent in 1993 to 3.3 in 2008. The incidence of long-term unemployment—those without work for more than a year—fell from a third of total unemployment in 1994 to one tenth in 2009.

Despite liberal firing and hiring practices, employment has not fluctuated too much in response to output variability. But the spending on active labor programs is sizeable: in 2010, it was almost €10 billion. Denmark spent 4.5 of GDP just for all labor market programs in 2008 (a good year). So the main drawback is the high fiscal burden, which can become enormous in a protracted slowdown. The Danes have flexicurity because of their history, and can afford it in part due to high participation rates of 81 percent. Those wishing to learn from the Danes should note this too.

Although flexicurity has been praised for keeping unemployment low in Denmark, some reservations need to be mentioned. Andersen and Svarer (2007) point out that this model is not automatically leading to low unemployment. On the contrary, changes in the labor market may cause unemployment, and the transfers offered by the welfare state may become an absorbing state. Essentially, this is a variant of the well-known finding that if there is a passive player in a tripartite relation, the passive player ends up carrying all the costs. This was the case in Denmark from the mid of the 1970s to the mid of the 1990s with high and persistent unemployment and a growing ''transfer'' obligation on the part of the welfare state. Further, it is difficult to assess how much flexicurity contributed to the improved performance of the labor market, since other factors like macroeconomic performance count as well. Bredgaard and Larsen (2007) underline that competitive labor markets may exclude certain groups of employees, which fail to meet expectations of employers. Finally, spending a lot on active labor market policies become less effective if there are not enough jobs to go around—a likely problem in a protracted recession.

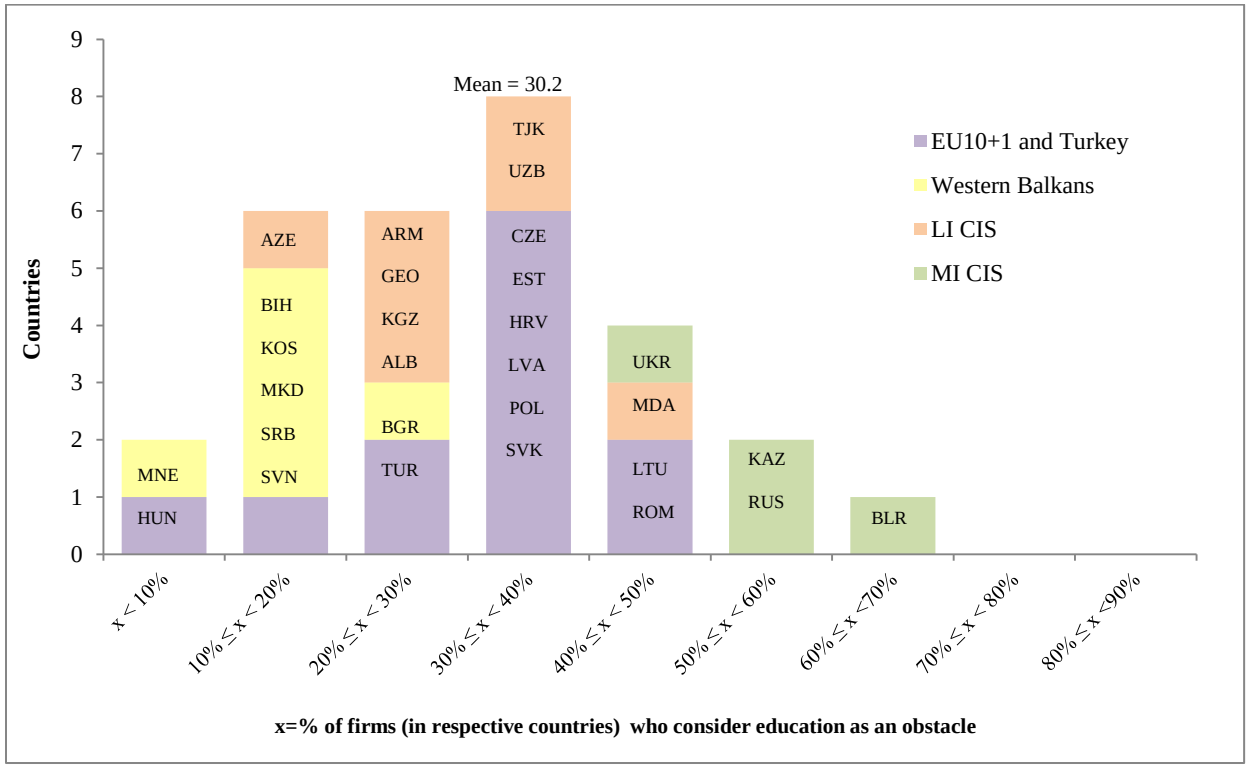
Source: World Bank, forthcoming; Andersen and Svarer (2007); Bredgaard and Larsen (2007)

b. Skills, Training and Innovation[23]

There appears to be a critical mismatch between the current skills of workers in many ECA countries and the types of skills demanded by the region's employers: (i) education and training institutions in the region provide inappropriate types of skills to their graduates; and (ii) large proportions of students lack basic competencies in literacy and numeracy (World Bank, 2012b). Figure 13 below illustrates that a large share of employers in many ECA countries rate insufficient or inappropriate worker skills as "major" or "very severe" constraints to growth. Skills constraints appear most severe in CIS countries (Belarus, Kazakhstan, Moldova, Russian Federation and Ukraine). In other countries, such as Montenegro and Hungary, constraints appear the least severe. In other words, maintaining the status quo in their education and training policies risks leaving many of the region's economies lagging in the rapidly changing global environment. These mismatches are likely to get accentuated as the type of skills demanded by firms continues shifting as a result of a greener economy.

Figure 13 – Lack of Appropriate Skills Hinder Business in ECA

Distribution of firms in ECA region that consider worker skills a "major" or "very severe" constraint, 2008



Source: World Bank (2012b).
Note: LI = low-income, MI = middle income

Though students, workers and firms are the principal actors involved in accumulating skills and utilizing knowledge in the labor market, governments play an important enabling role in the process[24]. Government policies shape the environment and set the rules in which industrial and labor-market interactions take place; therefore, government's role is crucial for ensuring that such interactions produce

[23] This section was prepared for this paper by Igor Kheyfets (ECSH2)
[24] De Ferranti, et al. (2003)

a socially desirable outcome. When it comes to anticipating and reacting to labor market vulnerabilities in response to the increase in the price of carbon, specific government policies will be important for determining each country's ability to adapt and overcome the short-term effects of this price shock.

At the core of a society that can more easily weather a future economic shock or technological transformation is a strong system of high-quality basic education. A labor force with well-developed cognitive and non-cognitive skills will stand a better chance of withstanding an energy price shock and adjust quickly to shifting labor market conditions. Other factors being equal, countries with well-educated workers—both in terms of the quantity and the quality of education—are better equipped for this transition. In particular, education systems that deliver more years of schooling through general (as opposed to specialized vocational) education and whose students achieve higher levels of cognitive skills—like the ones measured by the Programme for International Student Assessment (PISA) — may be better positioned to take advantage of new labor market opportunities. Annex 5 shows Croatia, Czech Republic, Estonia, Hungary, Poland, Slovak Republic and Slovenia score particularly well along these indicators. On the other hand, Albania, FYR Macedonia, and Kazakhstan perform less in these dimensions compared to the rest of the region. In this latter group, improving the quality of education and its relevance for the labor market is a fundamental need.

A third area of skills development that will be crucial to fostering employment in response to a higher price of carbon is one that focuses on a broad range of non-cognitive abilities. Chief among these is the penchant for entrepreneurship among the country's students, workers and business owners together with sense of leadership, responsibility, and problem solving capacity. Non-cognitive skills can be difficult to measure through existing national and international assessments. However, there are new measurement efforts starting in several ECA countries[25] that aim at assessing both the demand and the supply dimension of cognitive and non-cognitive skills. Firm surveys in Macedonia and Ukraine have found that in addition to technical skills, the lack of non-cognitive generic skills appears especially binding. Also in OECD countries and some middle-income countries, non-cognitive skills are as important as cognitive and technical skills in firms' hiring decisions (World Bank, forthcoming).

Responding to an energy price shock, therefore, will require a combination of strong basic education systems that produce workers with portable skills, innovation policies that allow for easy adaptability of knowledge, and an environment in which individuals with key non-cognitive abilities such as entrepreneurship are rewarded (World Bank, 2011c).

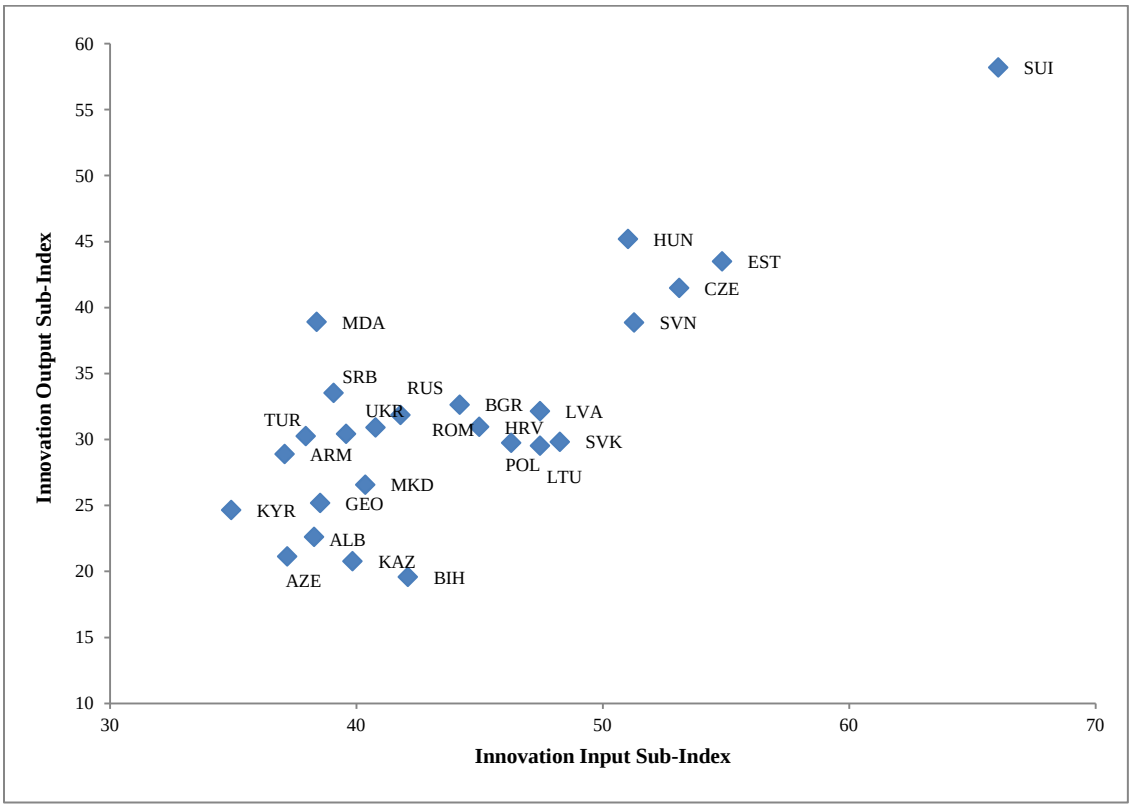
Another vital area for ensuring labor market adaptability in the face of an industrial transition is the society's scope for innovation. This concept can take many forms: from the creation of knowledge to its commercialization and acquisition from abroad to its dissemination and use.[26] Nevertheless, countries with advanced public and private systems of research and development (R&D) are better prepared to innovate their way toward a new industrial order. A labor force with a high degree of cognitive and non-cognitive skills, paired with national systems that enable and encourage innovation, will respond more favorably in adapting to an energy price shock. It is no surprise that many businesses are born and jobs are created in places where talented well-educated individuals are matched with enabling environments and government policies that are friendly to innovation. Figure 14 shows those scoring well in these

[25] See World Bank, 2010 for details on skills measurement.
[26] See Rodriguez (2008) for a more detailed discussion on innovation.

areas: Czech Republic, Estonia, Hungary and Slovenia. South Caucasus countries (Armenia, Azerbaijan, Georgia) and Albania, however, invest significantly less in R&D.

Figure 14 – There is Significant Variation Within ECA in Terms of Innovation; Yet The Region is Well Behind the Top Performer, Switzerland

ECA innovation index, 2011



Source: INSEAD, the Global Innovation Index 2011

Note: The chart compares ECA countries with each other in terms of Innovation Input Sub-Index (covers the Institutions, Human Capital and Research, Infrastructure, Market Sophistication, and Business Sophistication in a given country) and Innovation Output Sub-Index (covers Science Outputs and Creative Outputs in a given country). Switzerland (SUI) is also included in the scatter plot for benchmarking as the highest performer in the Global Innovation Index

There are several ways in which governments can anticipate the need to shift away from energy-intensive industries by enacting forward-looking skills, training and innovation policies. In particular, countries may: (i) delay the transition to vocational specialization by extending general education, as Poland did; (ii) align vocational and job training programs to future demand from clean industries; (iii) assess and invest in the development of relevant non-cognitive skills; and (iv) create an enabling environment that fosters innovation.

As discussed above, investing early in the flexibility and portability of workers' skills will be of utmost importance for meeting the challenges of a possible industrial transition. High quality basic education that endows children with strong cognitive and non cognitive skills, therefore, must be at the center of any renewed skills policies. Moreover, an emphasis on building general competencies can be achieved by delaying vocational specialization to the upper secondary or post-secondary phase, while increasing the number of years devoted to comprehensive general education. For example, a recent education sector

reform that extended compulsory general education in Poland by one year was shown to significantly enhance the academic performance of fifteen-year-olds (see Box 3).

Box 3. Extending general education improves cognitive skills in Poland

As part of its 1999 structural reform of the education system, the Government of Poland introduced a new type of school—the "gymnasium"—to provide lower secondary education. Following the reform, Polish students would complete nine years of compulsory general education (six in primary school and three in the gymnasium) instead of the previous eight prior to entering general or vocational upper secondary education.
In the course of their evaluation of Poland's reform, Jakubowski, et al. (2010) found that delaying specialization and exposing students to general education for one additional year was shown to correspond to an average increase of one-quarter of a standard deviation in the math and reading PISA scores. Interestingly, this improvement was evident for both low and high achievers; and the improvement in the scores of likely vocational students was as high as one standard deviation.

The authors suggest that delayed vocationalization improved academic performance "through increased hours of math instruction, possibly more exposure to testing, and increased motivation on the part of students and teachers." Moreover, because PISA measures basic cognitive skills in math and reading, it follows that students who benefited from an extra year of general education in the gymnasium were acquired more of the skills that would allow them a greater degree of future flexibility in the labor market.

Source: Jakubowski, et al. (2010)

When introduced later in the education cycle, however, vocational education and technical training programs can serve an important role in preparing workers for the jobs of tomorrow. But in order for such programs to be relevant, they will need to be aligned with future labor market needs. At present, many vocational education systems in Eastern Europe and Central Asia are designed to impart skills that are outdated. Instead of multi-year institutions that graduate welders, carpenters and so forth (professions that can be learned on the job or in much shorter job training courses), vocational programs at the upper secondary and post-secondary level could be reoriented, for instance, to produce skilled professionals in the high-tech clean industries of tomorrow.

In addition to enhancing basic cognitive and technical/vocational skills, governments will need to improve the manner in which they assess and invest in important non-cognitive skills. Qualities such as entrepreneurship, leadership, teamwork, creativity and many others will be crucial for preparing workers to compete for jobs in new industries, but at present governments have little or no information on how these skills are distributed and whether/how these could be taught. The education systems of tomorrow, therefore, will need to be able to effectively measure non-cognitive skills and improve the policies aimed at imparting these skills to future workers[27].

[27] In two salient studies, Heckman, et al. (2006) and Heckman and Rubinstein (2001) find that in the United States non-cognitive skills are quantitatively important determinants of post-secondary educational attainment. Controlling for measured cognitive ability, they use data from the U.S General Educational Development (GED) high school equivalency testing program to show that GED recipients fail to complete high school and hence to pursue a college education because they lack in non-cognitive skills such as self-discipline and perseverance.

Finally, governments can support bringing innovation and technology to market in a variety of ways. A first step is for them to design instruments that promote private risk-taking and stimulate markets for private risk capital. Good instrument design principles include providing a good institutional environment (investment climate, intellectual property rights legislation, and avoiding corruption and regulatory capture in project selection by using international peer review); not crowding out private investment and other funding sources (by requiring the matching of public funds with private cash contribution); and minimizing distortions. Government interventions should be designed to promote private risk taking and stimulate the private risk capital market (World Bank, 2011c).

c. Active Labor Market Policies

Active Labor Market Policies (ALMPs) in the appropriate labor market context could be useful and relevant tools to help workers transition in between jobs and sectors. ALMPs aim to bring workers into employment, keep them in their jobs, and increase their productivity/earnings as well as to improve the general functioning of labor markets. As a result, they are expected to raise participation and inclusion via improving employment opportunities. In contrast to passive labor market policies (unemployment insurance and transfers), active policies redistribute incentives to reduce passive support and improve self-sufficiency and adaptability via increasing and enhancing labor supply (for example, by strengthening workers' employment incentives and via training), increasing labor demand (for example, by providing incentives to employees and public employment), and raising the efficiency of labor market matching more efficient (for example, employment services).

It is important to note that evaluations of ALMP programs have provided mixed results. Comprehensive packages of services, programs that are oriented to labor demand and linked to real workplaces, and careful targeting are good design features found in successful ALMP programs. Similarly, the lessons from the existing experience suggest that, not surprisingly, program impacts are usually more positive when the economy is growing. Finally, the international experience indicates that it is critical to customize the policy mix in response the needs of different population groups (Betcherman, et.al, 2004).

With this in mind, Brown and Koettl (2012) emphasizes that ALMPs can tackle various labor market challenges ranging from matching inefficiencies to skill mismatches. ALMPs can be targeted to various groups like employed or unemployed workers, low-skilled or long-term unemployed workers, to inactive or informal workers, young or old or disabled workers, and even refugees and migrants. Based on their different objectives, ALMPs are classified in Brown and Koettl (2012) in the following manner:

Table 8 - Relevant Instruments, Targets, and Intended Effects of ALMPs

Different types of ALMPs

Main objective	Instruments	Target groups	Intended effects
Incentivize retaining employment	Work sharing	Insiders	Reduce outflow from employment
	Wage subsidies for currently employed	Insiders	Reduce outflow from employment
	Short work	Insiders	Reduce outflow from employment
Incentivize creating employment	Hiring subsidies for newly employed	Outsiders	Increase inflow into employment

	Business start-up support	Outsiders	Increase inflow into employment
Provide employment-conditional income support	Public works	Outsiders	Decrease poverty Strengthening labor market attachment of participants Increase inflow into employment
	Employment-conditional "in-work" benefits	Outsiders and insiders	Decrease poverty Decrease "working poor" Increase inflow into employment Reduce outflow from employment
	Sanctions on insufficient job search efforts	Outsiders	Intensify work search efforts Increase inflow into employment
Provide human capital enhancement	On-the-job training	Outsiders	Increase inflow into employment Increase productivity
	Classroom training	Outsiders	Increase inflow into employment Increase productivity
Improve labor market matching	Job search assistance	Outsiders	Improve job search efficiency Increase inflow into employment
	Employer intermediation services	Outsider and insiders	Improve job sear efficiency Improve matching quality Increase inflow into employment
	Counseling and monitoring	Outsider	Improve job search efficiency Increase inflow into employment

Source: Brown and Koettl, 2012
Note: "Insiders" refers to those who are currently employed, "outsiders" to the unemployed, long-term unemployed, discouraged, informal workers, and inactive.

The study underlines that ALMPs aiming at retaining employment – such as wage subsidies, short work etc. - should be used only for very short periods and in severe recessions. In the case of an increase in energy prices – given the likely permanent nature of the shock – ALMPs aimed at retaining employment in energy-intensive industries are not sustainable. The ALMPs that support recovery from a crisis by putting in place incentives to create new jobs are more cost-effective. Moreover, these types of ALMPs could play a critical role in fostering employment in new, cleaner industries.

In fostering employment, ALMPs that invest in human capital and improve labor market matching are more likely to play a more effective role. Recent studies have shown that longer-term evaluations provide evidence on more positive impacts of policies, whereby training programs, which long have been regarded as too expensive; can be indeed cost-effective from a longer-term perspective. They are especially effective the nearer they are to regular jobs and targeting disadvantaged outsiders (Brown and Koettl, 2012).

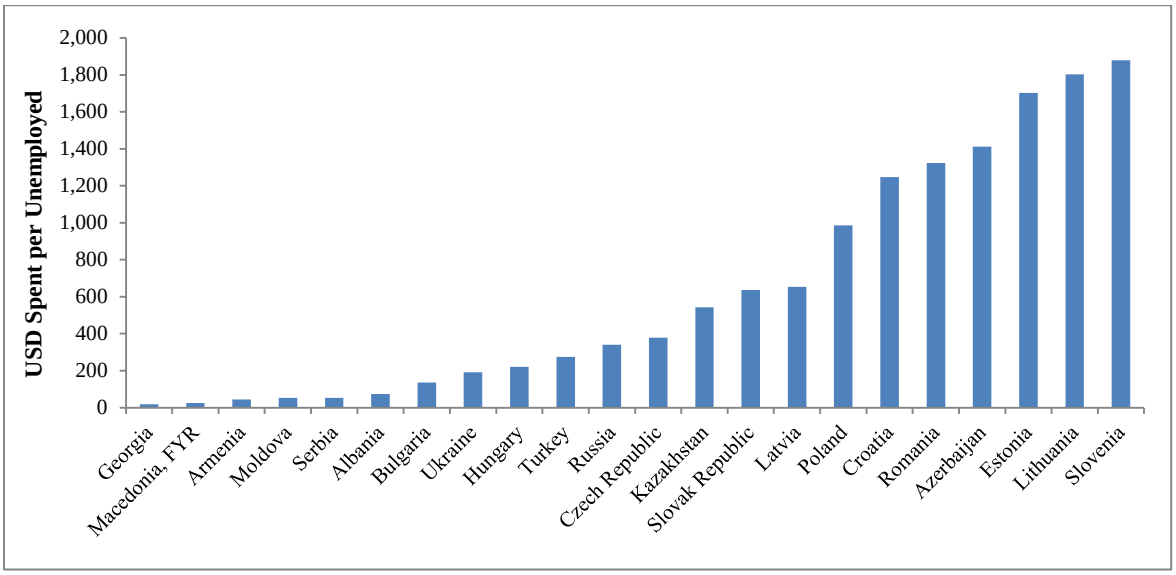
Across OECD countries, job subsidies and other demand-side employment incentives have become more important, while direct job creation programs (e.g., public works) have been gathering less funding. Start-up incentives for new businesses are only a small part of total spending, but they have been very sizable during the early transition phase in Eastern European countries. An increasing share of active spending

under the "disability" category reflects a growing recognition of sickness and disability as a major labor-market issue (Immervoll, 2011).

ECA countries spend significantly less than the OECD average, but spending is particularly low in Georgia, FYR Macedonia, Armenia, Moldova, Serbia and Albania (See Figure 15). In ECA, ALMPs remain very small in most countries, so it is difficult to expect them to have a large impact if not expanded significantly (as exemplified by Nordic countries). There is need for more rigorous evaluations of what works and under which conditions; how to design activation policies for different population groups; what should be priority groups. The comprehensive labor market reforms in 2003 and 2005 in Germany including changes to ALMPs can present important lessons for policy makers (See Box 4).

Figure 15 – ALMP Spending in Many ECA Countries Remains Low

ALMP spending per unemployed, 2007



Source: Authors' calculation based on IZA and UN population data

Box 4 - Comprehensive Active Labor Market Policy Reform in Germany

Having faced high unemployment rates for more than a decade, Germany introduced far-reaching reforms of its unemployment and social assistance benefits between 2003 and 2005 (the so-called "Hartz" reforms), adhering to a three-part reform strategy: (1) improving employment services and active labor market programs (ALMPs); (2) activating the unemployed and social assistance beneficiaries; and (3) fostering employment demand by deregulating the labor market. To this end, the reform radically modernized the organizational structure of public employment services and social welfare centers, modified many of the already existing ALMPs, and introduced a set of new ones. The reform fundamentally changed the institutional and legal framework that determines the rights and duties of the unemployed and social assistance beneficiaries. Furthermore, employment protection was reduced in some segments of the labor market.

Public employment services and social welfare centers were modernized along the lines of New Public Management. This includes results-based accountability of local employment agencies, outsourcing of many services and open competition between public and private service providers. The former employment offices were (partially) merged

with social welfare centers and converted into costumer-orientated one-stop centers, offering individual profiling, job search assistance, social services, and administration of benefit payments. Furthermore, a new activation strategy according to the principles of "rights and duties" was put in place. First, the entire unemployment and social benefit system was redesigned, aligning incentives to take up work. Unemployment benefit levels and durations were reduced. Eligibility for subsistence allowances were changed according to a person's ability to work rather than previous contribution payments. Benefit recipients were made subject to sanctions, mainly though benefit reductions, if duties are not complied with. Second, priority was given to measures that support unemployed workers who are pro-actively seeking integration into regular employment, most importantly through wage subsidies and start-up subsidies. Third, jobs with reduced social security contributions were introduced ("midi-jobs" with monthly earnings of roughly between EUR 300 and 800), and the regulation for jobs exempt from such contributions was reformed ("mini-jobs" with roughly less than EUR 300 per month) with the clear intention to provide higher incentives for individuals to take on employment in the low-wage sector.

The results of reforms on temporary employment are mixed. Between January and October 2006, the number of Hartz IV claimants (beneficiaries of the newly combined long-term unemployment assistance and social assistance) in jobs liable for social insurance contributions ("midi-jobs" or regular jobs) increased by 47 percent, while the number of Hartz IV claimants working part-time increased by 30 percent and the number in marginal employment ("mini-jobs") rose by 14 percent. This is certainly partly due to the fact that workers who were surviving on low wages without any form of income support before the reform were able to boost their income with Hartz IV benefits after the reform. The reform of temporary work regulations significantly increased the number of employees in the temporary work sector in the two quarters after the reform. However, Caliendo and Wrohlich (2006) carried out an ex-post evaluation to identify the short-run effects of this reform and a found limited and differentiated impact looking only at single males.

The German experience points out that even for a country with relatively rigid labor market regulations and policies, reforms are possible although they are politically difficult to achieve. This type of reform could help make the labor market more flexible and the workers more adaptable in their transition into new jobs from old jobs. Another revelation is that systematically evaluating the impact of ALMPs would enable policy makers to use the lessons learned in adjusting their employment programs in order to have more effective and efficient programs in the future.

Source: Authors' review of literature based on Caliendo and Wrohlich (2006); Goethe Institut (2007); Jacobi and Kluve (2006); RWI Essen et al. (2005)

Finally, successful ALMPs require that governments have an overarching strategy, for example, setting up solar panel installation trainings is more likely to be successful in the presence of a long-term solar support policy. This means that labor market policies should be closely coordinated with overall climate mitigation policies.

d. Social Protection

Climate change policy, as discussed in this paper, will generate significant labor reallocation across sectors in many countries, with potentially important redistributive effects. In some countries, workers will need to be reallocated between sectors and it will likely take significant time and training for them to find new jobs. In any case, having a strong social protection system will be key; not only in providing a safety net, but also in accommodating the climate change policy shock and helping workers make efficient labor market transitions (World Bank, 2011b).

Yet, there is significant variation in the readiness of social protection systems to respond to shocks across countries in the region as discussed in Section 2. The recent financial and economic crisis has provided

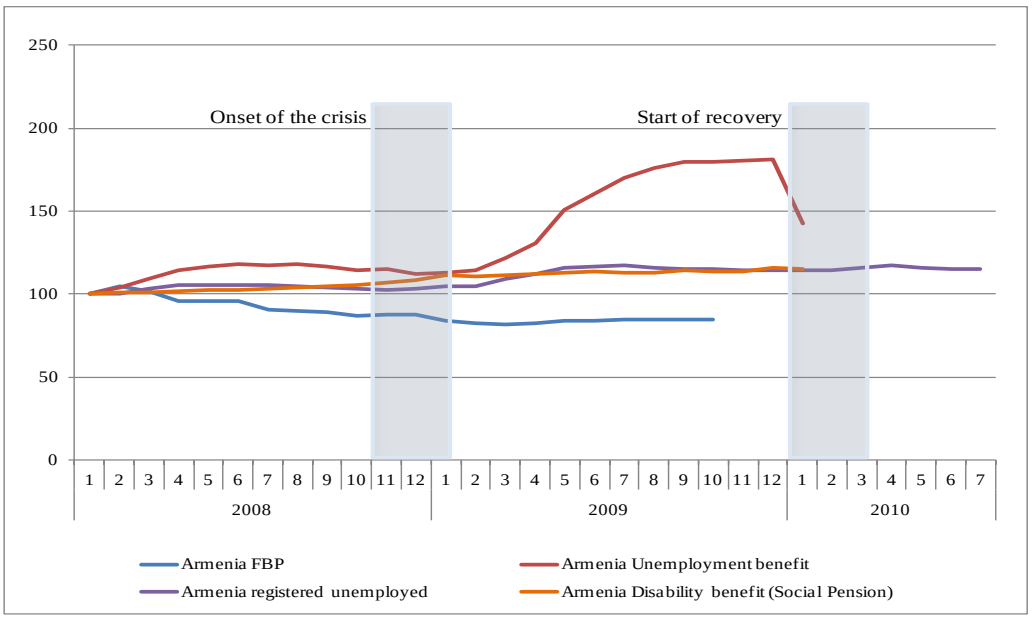
good testing ground for social protection systems in the region because its main transmission channel was the labor market (World Bank, 2011d). Social assistance and unemployment insurance are important instruments in mitigating the negative effects of economic shocks. Ideally, these benefits should be designed to work as "automatic stabilizers," expanding in times of crisis and contracting counter-cyclically as the economy recovers. A recent World Bank study investigates the actual response of social benefits to systematic shocks in practice by tracing the actual response of social benefits during the global economic crisis for 14 countries in the Europe and Central Asia region from 2008 (pre-crisis benchmark) to 2010 (Isik-Dikmelik, forthcoming).

Isik-Dikmelik (forthcoming) takes two criteria into account in determining which countries can be expected to respond to a crisis effectively: the pre-crisis preparedness level and the severity of the crisis itself. Using administrative and household survey data and information, the pre-crisis preparedness level of countries is assessed by looking at the performance of last-resort social assistance programs; the pre-crisis existence and coverage of unemployment benefits; the pre-crisis existence and coverage of child allowance programs; and the readily available administrative data from management information systems.

Based on this analysis, before 2009, countries that were well positioned to respond to a crisis were Armenia, Croatia and Montenegro. Figure 16 shows the timeline and the extent of the response of unemployment benefits during the crisis in Armenia. The ones that had a reasonable ability to respond with room for reforms to improve capacity were Estonia, Georgia, Hungary, Poland and Ukraine. Countries that needed concerted strategy of actions and reforms to enhance their ability to respond were Albania, Azerbaijan, Bulgaria, FYR Macedonia, Romania, Serbia and Turkey. Lastly, the countries that needed significant reform to overhaul their social assistance system were Belarus, Bosnia and Herzegovina, Kazakhstan, Kosovo, Kyrgyz Republic, Latvia, Moldova, Russia and Tajikistan.

Figure 16: Armenia: The Response of Unemployment Benefits Has Been Sustained Through 2009, but Started Declining In Early 2010

Indexed number of beneficiaries, 2010

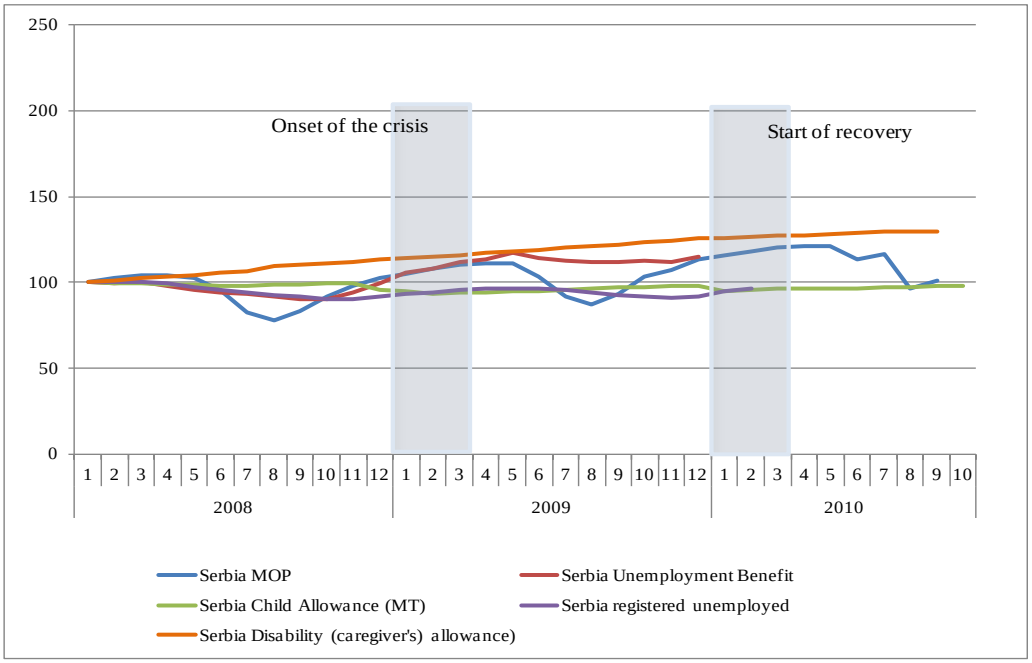


Source: Isik-Dikmelik (forthcoming)

Beyond the generosity of social welfare, the design and incentive structure of benefits are critical. The response of social assistance in Serbia (See Figure 17) reveals the importance of design elements, such as eligibility criteria (and indexing of eligibility thresholds to ensure coverage), to facilitate the ability of benefits to respond to a crisis. Institutional arrangements could also play a role in response to crisis, with central-financing and administration responding more aptly to recessions than decentralized schemes.

Figure 17: Serbia: Only Moderate Expansion of Unemployment Benefits and Last Resort Social Assistance in Serbia

Indexed number of beneficiaries, 2010



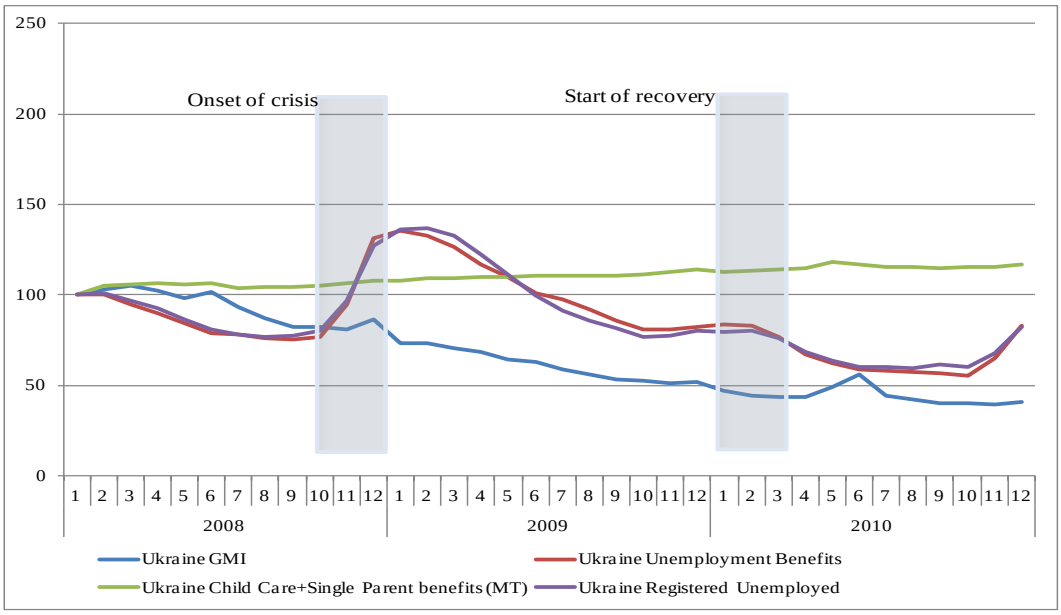
Source: Isik-Dikmelik (forthcoming)

While social protection systems were able to respond in some countries, in others, they were not prepared for the crisis. In these latter cases, important reforms were needed in order for the systems to actually respond. This was the case, for example, in Latvia. While Latvia was severely hit by the crisis, it was relatively unprepared in terms of its social benefits system. This was mainly due to the very low coverage and only moderate targeting of its main poverty program. Following Latvia's sharp GDP contraction in the economic crisis, the immediate policy response was to protect or increase social protection spending to counteract the effects of the economic downturn on households. As a result, spending in social protection increased significantly -- by 21.3 percent between 2008 and 2009. Latvia, like other countries in the region, moved to implement or scaled up a number of social programs (World Bank, 2011e).

This response contrasts markedly with that of Ukraine (Figure 18) where the social protection system underperformed with drastic cuts in coverage of benefits – despite apparent fiscal space for better allocation of spending across targeted benefits.

Figure 18: Ukraine: Modest and Short-lived Response in SB in Ukraine due to Fiscal Pressures

Indexed number of beneficiaries, 2010



Source: Isik-Dikmelik (forthcoming)

Following the recent economic crisis, the World Bank (2011b) has further identified the main dimensions of a successful social assistance strategy and the main policy challenges facing ECA countries: (i) harmonizing or consolidating social assistance programs and strengthening governance to improve efficiency and equity in the face of fiscal constraints, political pressures, and competing social demands; promoting inclusion for specific vulnerable groups (protection); and (ii) increasing the employability, productivity and mobility of the labor force and encouraging effective "activation" to support and incentivize people to get jobs and contribute productively to society, while reducing dependency on social transfers (promotion).

The discussion underlines the fact that reforms are still needed in many countries to make social protection systems more responsive to shocks and more conducive to helping workers make labor market transitions. A good way to start would be to continue the social assistance reforms that most countries put into place during the crisis. The improvement of targeting performance, consolidation of redundant programs and simplifying the administration of benefits should be the aim of these reforms for them to be sustainable and successful in the long run. The key is for policymakers to find the right balance between protection and incentives since they want to avoid having social protection being so generous that it creates disincentives to work.

e. Economic policies supporting green growth

In addition to the four dimensions discussed above, other policies and institutions are likely to also matter in determining a country's capacity to adapt to an energy price change. For example, adaptability will also depend on the ability of a country to develop new (and "green") industries to absorb dislocated labor resources, a key component of climate change policies appears to be likely more labor intensive than

traditional fossil fuel based supply (Bowen, 2012). In addition, energy efficiency improvements, a direct result of higher energy prices, may also generate demand for labor intensive environmental services, such as building retrofitting and weatherization. An UNEP (2011) study suggests that there were more than 2.3 million jobs in the renewable energy sector around the world in 2006, and more in providing improved energy efficiency in buildings, in low-carbon transport and in other environmental activities.

Many ECA countries have already adopted or committed to renewable incentive programs, such as feed-in tariffs or renewable energy portfolio to support renewable energy development. Table 9 summarizes the current share of renewable energy in the fuel mix, the targets of renewable energy programs, and existing renewable energy policies in ECA. For ECA countries, the main employment opportunities of domestic renewable energy programs are likely to be related to construction, installation, and maintenance of renewable energy facilities.

Table 9 - Renewable energy in ECA

Share, Target and Policies

ECA country	Renewable share 2005	EU Directive 2020 Target	Year FIT enacted (years updated)	Renewable sources covered
Armenia			2001 (2009)	All
Azerbaijan			Proposed 2009	
Belarus			1994	All
Bosnia & Herzegovina			2010	All
Bulgaria	9.4%	16.0%	2008 (2009)	PV, wind, small biomass, small hydro
Croatia			2007 (2009)	PV, wind, hydro, geothermal, biomass, biogas
Czech Republic	6.1%	13.0%	2005 (2006, 2010)	PV, wind, small hydro, geothermal, biomass, biogas
Estonia	18.0%	25.0%	2003 (2004, 2007)	Wind, biomass, hydro, others
FYR Macedonia			2007 (2009)	PV, wind, hydro, biomass
Georgia			--	
Hungary			2003 (2005, 2007)	All (separate biomass rates)
Kazakhstan			2009	All?
Kosovo*			-- (may exist?)	
Kyrgyz Republic			--	
Latvia	32.6%	40.0%	c. 1996 (2003, 2007)	Wind, small hydro, biomass, biogas
Lithuania	15.0%	23.0%	2002 (2008)	PV, wind, small hydro, biomass
Moldova			2007	All
Montenegro*			--	
Poland	7.2%	15.0%	-- (uses quota system)	
Romania	17.8%	24.0%	-- (uses quota system)	

ECA country	Renewable share 2005	EU Directive 2020 Target	Year FIT enacted (years updated)	Renewable sources covered
Russian Federation			--	
Serbia*			2009	Wind, PV, biomass, biogas, landfill gas, geothermal, small hydro
Slovak Republic	6.7%	14.0%	2001 (2005, 2009, 2011)	Wind, PV, biomass, cofiring biomass, biogas, geothermal, CHP
Slovenia	16.0%	25.0%	2002 (2004, 2006)	Wind, PV, hydro, biomass, CHP, biogas, landfill gas
Tajikistan			--	
Turkey			2005 (2010/11)	Wind, PV, hydro, geothermal, CSP, biomass, landfill gas
Turkmenistan			--	
Ukraine			2008 (2009)	Wind, PV, small hydro, biomass
Uzbekistan			2010?	Wind, PV, others

Source: World Bank, 2011.

In recent years, many ECA countries have also passed national legislation related to energy efficiency or adopted energy efficiency national action plans (World Bank, 2010). In making energy efficiency investments more attractive, these policies also help create jobs related to energy auditing, manufacturing of energy efficient equipments, and energy service companies etc. The cost savings from energy efficiency improvement could also be recycled into investment in the economy, further generating job gains.

In summary, the development of new green industries could create the basis of a new green employment market. Therefore, government policies that support the development of low-carbon industries may also have important employment benefits. However, as discussed in previous sections, it is also important to provide training and education programs to prepare the labor force will skills required for these new "green" jobs.

6. CONCLUSION

In this paper, we have done a comparative analysis among ECA countries in terms of their employment vulnerability to climate change pricing policies, and their readiness to adapt to such a price shock. We have argued that because energy price changes are likely to be permanent in nature, firms and workers are likely to adapt over time. However, in the short to medium term, there are likely to be significant employment effects, both in terms of overall levels as well as in terms of composition (sectoral, by skills, etc.).

Beyond the extent of the price shock experienced by countries, employment effects are likely to depend on two key factors. First, "vulnerability" - how much employment today is actually linked to energy-intensive industries, those that are most exposed to an energy price change. These effects are likely to take place through three main channels: (i) the number of workers that are directly employed by energy-intensive industries; (ii) the number of workers employed in industries that rely on firms that use inputs from energy-intensive industries (and how strong is this inter-sectoral dependency); and (iii) the general demand effect in the economy as input prices rise, demand falls and employment is affected potentially in all industries. Due to data limitations, in this paper we have focused on the first and third channel, measured by the share of employment and output in energy-intensive industries, respectively. Based on this analysis, we find significant differences across countries in ECA in terms of their employment vulnerability to an energy price shock. Most countries are vulnerable both because they have a sizable share of employment and output in energy-intensive industries (e.g. Armenia, Bulgaria, and Russian Federation). However, there are some exceptions, especially among countries that produce oil and gas) and other capital-intensive industries leading to high overall vulnerability in terms of output, but not so much in terms of direct employment effects in energy-intensive industries (e.g. Azerbaijan and Kazakhstan).

From a policy perspective, however, the employment shock associated with an increase in energy prices does not need to be all bad news. There are certainly risks, but there are also opportunities. However, for governments to be able to take full advantage of these opportunities, they will need to ensure that their economic and social policies are conducive to a structural transformation and that policies generate the necessary incentives for workers and firms to move from energy-intensive to cleaner and more productive sectors and jobs. This is will make economic growth more sustainable.

Therefore, employment effects of an energy price shock depend critically on a second factor: the effectiveness of policies aimed at improving "adaptability", that is, the capacity for the economy to adapt and grow more productive in the wake of the shock. We have argued in this paper that policy actions are needed in five main areas: labor market flexibility; skills, innovation and training; active labor market policies; social safety nets; and incentives for green industries. Here, just as in the vulnerability dimension, there is a wide variation in terms of the current capacity/potential of countries to adapt to the energy price shock. Countries like FYR Macedonia have a long policy agenda in most of these dimensions, whereas in Croatia, Lithuania and Romania, reforms focusing on making the labor market more flexible appear like a good place to start. Kazakhstan is ranking low in their skills, training and innovation front; while Russia's social protection systems do not seem to be ready enough to respond to a shock.

The proposed policy agenda is ambitious but critically it is well-aligned with the existing structural agenda. With the possible exception of demand-side interventions focused on promoting new industries, no new programs or significant modifications are needed to manage, from an employment perspective, the challenges associated with an energy price shock. Nonetheless, the impending rise in energy prices does make policy action more urgent.

REFERENCES

Aldy J. Krupnick, A. Newell, R. Parry, I. and Pizer, W. (2010), "Designing Climate Mitigation Policy," Journal of Economic Literature. 2010 48(4): 903-934.

Andersen, T. and Svarer, M. (2007). "Flexicurity – Labour Market Performance in Denmark," CESifo Working Paper Series 2108, CESifo Group Munich.

Barro, RJ and JW Lee (2010), "A New Data Set of Educational Attainment in the World, 1950-2010", NBER Working Paper 15902, (accompanying data are available at www.barrolee.com).

Bernanke, B. S. (1983). "Irreversibility, Uncertainty and Cyclical Investment" Quarterly Journal of Economics, 98 (1): 85-106.

Betcherman, G., Olivas, K. and Dar, A., (2004), 'Impacts of Active Labor Market Programs: New Evidence from Evaluations with Particular Attention to Developing and Transition Countries', Social Protection Discussion Paper Series no. 0402, World Bank, Washington.

Bredgaard, T., Larsen, F., (2007), Comparing flexicurity in Denmark and Japan; Centre for Labour Market Research at Aalborg University (CARMA) Denmark

Bowen. A. (2012). "'Green' growth, 'green' jobs and labor markets," Let's Talk Development: A Blog hosted by the World Bank's Chief Economist; Washington, D.C.

Brown A.J.G.and J. Koettl. (2012). "Active Labor Market Programs: Employment Gain or Fiscal Drain?" Washington DC: The World Bank.

Brunello, G. (1996). "Labour market institutions and the double dividend hypothesis: An application of the WARM model" in Environmental Fiscal Reform and Unemployment, ed. Carlo Carraro and Domenico Siniscalco, 139-70. Dordrecht: Kluwer.

Caliendo, M. and Wrohlich, K. (2006). "Evaluating the German "Mini-Job" Reform Using a True Natural Experiment," Discussion Papers of DIW Berlin 569, DIW Berlin, German Institute for Economic Research.

Cuñado, J. and De Gracia F. P. (2003). "Do oil price shocks matter? Evidence for some European countries" Energy Economics, 25: no. 2:137-54.

Davis, S. J. (1987). "Allocative Disturbances and Specific Capital in Real Business Cycle Theories" American Economic Review, 77(2): 326-32.

De Ferranti, D., G.E. Perry, I. Gill, J.L. Guasch, W.F. Maloney, C. Sánchez-Páramo, and N. Schady. (2003). "Closing the Gap in Education and Technology" Washington DC: The World Bank.

Deng, X., Yuan, M. and Sudjianto A. (2007). "A Note on Robust Kernel Principal Component Analysis" Contemporary Mathematics 433.

Energy Regulators Regional Association (ERRA) Database. Mor information available on: http://www.erranet.org/Products/TariffDatabase

European Commission Directorate-General for Employment, Social Affairs and Equal Opportunities. 2007. "Towards Common Principles of Flexicurity: More and better jobs through flexibility and security" Luxembourg: Office for Official Publications of the European Communities, 2007

European Union. (2008). "The Climate Action and Renewable Energy Package: Europe's Climate Change Opportunity," on http://ec.europa.eu/clima/policies/package/index_en.htm

European Union Emission Trading Scheme list. Available on http://ec.europa.eu/clima/policies/ets/index_en.htm

European Union KLEMS Database Project. Productivity in the European Union: A Comparative Industry Approach (EU KLEMS 2003-2008)

Eurostat. ESA 95 Supply, Use and Input-Output tables. All available country folders are on: http://epp.eurostat.ec.europa.eu/portal/page/portal/esa95_supply_use_input_tables/data/workbooks

Fæhn, T., A. Gómez-Plana, and S. Kverndokk. (2009). "Can a carbon permit system reduce Spanish unemployment?" Energy Economics 31, no. 4:595-604.

Goethe Institut (2007). Hartz IV – More Dependency on the State. Available at http://www.goethe.de/ges/soz/soz/en2606706.htm.

Hamilton, J. D. (2008). "Oil and the Macroeconomy" New Palgrave Dictionary of Economics: Second edition ed. Steven N. Durlauf and Lawrence E. Blume. Houndmills, U.K. and New York.

Heckman J. J. and Rubinstein, Y. (2001). "The Importance of Noncognitive Skills: Lessons from the GED Testing Program." American Economic Review: v91, n2, pp. 145-49.

Heckman, J. J., J. Stixrud, and S. Urzua. (2006). "The Effects of Cognitive and Noncognitive Abilities on Labor Market Outcomes and Social Behavior." Journal of Labor Economics:24(3) (2006): 411–482.

International Labour Organization (ILO). (2008). "Employment Policy Review Document: The former Yugoslav Republic of Macedonia" Prepared by the International Labour Office and the Council of Europe.

Immervoll, H. (2011). "Activation Policies in OECD Countries: An Overview of What Countries Do" Washington DC: The World Bank.

INSEAD. (2011). "The Global Innovation Index 2011: Accelerating Growth and Development" Geneva: Switzerland

International Energy Agency (2011), http://www.iea.org/stats/index.asp

Isik-Dikmelik, A. (forthcoming). "Do Social Benefits Respond to Crises? Evidence from Europe & Central Asia during the Global Crisis" Washington DC: The World Bank.

Jacobi, L. and Kluve, J. (2006). “Before and After the Hartz Reforms: The Performance of Active Labour Market Policy in Germany.” IZA Discussion Paper No. 2100; RWI Discussion Paper No. 41.

Jakubowski, M., H.A. Patrinos, E.E. Porta, and J. Wiśniewski. (2010). “The Impact of the 1999 Education Reform in Poland” World Bank Policy Research Working Paper No. 5263.

Kammen, D., K. Kapadia, and M. Fripp. (2006). “Putting renewable to work: How many jobs can the clean energy industry generate?” Report of the Renewable and Appropriate Energy Laboratory, University of California, Berkely, April 2004 (corrected January 2006).

Koettl, J. and Weber, M. (2012). “Does Formal Work Pay? The Role of Labor Taxation and Social Benefit Design in the New EU Member States.” IZA Discussion Paper No. 6313

Lutz, C. and B. Meyer. (2010). “Environmental tax reform in the European Union: Impact on CO¬2 emissions and the economy” Zeitschrift für. Energiewirtschaft 34, no. 1: 1-10.

McMillan, M. & D. Rodrik (2011). “Globalization, Structural Change, and Productivity Growth” ILO-WTO 2011.

McNeill, J. and J. Williams. (2007). “The employment effects of sustainable development policies” Ecological Economics 64, no. 1:216-23.

Miguel, C., B. Manzano and J. M. Martín-Moreno. (2003). “Oil price shocks and aggregate fluctuations” The Energy Journal 24, no. 2:47-61.

Mortensen, D. and C. Pissarides. (1994). “Job creation and job destruction and the theory of unemployment” Review of Economic Studies 61, no. 3:397-415.

Myers, N. and Kent, J. (2001), Perverse Subsidies: How Tax Dollars Can Undercut the Environment and the Economy, Island Press: Washington, D.C.

OECD. (2006). OECD Economic Surveys: Turkey. Paris: OECD Publishing.

Papapetrou, E. (2001). “Oil price shocks, stock market, economic activity and employment in Greece” Energy Economics 23, no. 5:511-32.

Pearce, D. (1991). “The role of carbon taxes in adjusting to global warming” Economic Journal 101, no. 407: 938-48.

Pindyck, R. S. (1991). “Irreversibility, Uncertainty and Investment” Journal of Economic Literature, 29(3): 1110-48.

Rodriguez, A. (with C. Dahlman and J. Salmi). (2008). “Knowledge and Innovation for Competitiveness in Brazil” Washington DC: The World Bank.

RWI, ISG, GISA, IWH, M. Burda und M. Kvasnicka. (2005). Evaluation der Maßnahmen zur Umsetzung der Vorschläge der Hartz-Kommission – Modul 1f: Verbesserung der beschäftigungspolitischen Rahmenbedingungen und Makrowirkungen der aktiven Arbeitsmarktpolitik, June. BMAS Forschungsbericht (Research report of the Federal Ministry for Labour and Social Affairs).

Sancho, F. 2010. “Double dividend effectiveness of energy tax policies and the elasticity of substitution: A CGE appraisal” Energy Policy 38, no. 6:2927-33.

Shapiro, C. and J. Stiglitz. (1984). “Equilibrium unemployment as a worker discipline device” American Economic Review 74, no. 3: 433-44.

Süral, N. (2009). “Economic Implications of Employment Protection Legislation in Turkey: Has Turkey Found its Juste Milieu?” Comparative Labor Law and Policy Journal

United Nations System of National Accounts. 1993. National Accounts Statistics, Main Aggregates and Detailed Tables: http://unstats.un.org/unsd/nationalaccount/madt.asp

UNEP 2011: Towards a green economy*: a synthesis for policy makers*, UNEP, Geneva.

World Bank. 2010. “Stepping up skills for more jobs and higher productivity” Washington DC: The World Bank.

——————— 2011a. “Transition to a Low-Emissions Economy in Poland” The World Bank Poverty Reduction and Economic Management Unit Europe and Central Asia Region: February 2011.

——————— 2011b. “Social Protection and Labor Strategy 2012-2022.” Washington DC: The World Bank.

——————— 2011c. “Igniting Innovation: Rethinking the Role of Government in Emerging Europe and Central Asia” Washington DC: The World Bank.

——————— 2011d. “The Jobs Crisis: Household and Government Responses to the Great Recession in Eastern Europe and Central Asia” Washington DC: The World Bank.

——————— 2011e. “Lessons from Latvia: Adjustments in the Social Sectors” Washington DC: The World Bank.

——————— forthcoming. “Golden Growth: Restoring the Lustre of the European Economic Model” Washington DC: The World Bank.

——————— 2012a. “Doing Business: Doing Business in a More Transparent World” Washington DC: The World Bank

——————— 2012b. “Skills, Not Just Diplomas: Managing Education for Results in Eastern Education and Central Asia” (Sondergaard, L. and M. Murthi with D. Abu-Ghaida, C. Bodewig, and J. Rutkowski). Washington DC: The World Bank.

Zhang, F. (2012). “Industrial Energy Efficiency in Europe and Central Asia,” Washington DC: The World Bank

Annex 1. Vulnerability of ECA countries to a carbon shock using different sectoral breakdowns

There are different data sources that contain information on value added and employment by sector for ECA countries. However, in the information that is publicly available, there is variation on the number of countries covered as well as in the level of sectoral disaggregation presented.

There are five main data sources that could be used:

- National input-output matrices: This is the most detailed source of information and would be the ideal data to use in this type of analysis. This is especially the case since input-output would allow us to measure the extent to which what we consider clean industries in this paper also rely on energy-intensive inputs. However, only three ECA countries have both value added and labor input information in their matrices, in the cases where they exist for recent years.

- European Union (EU) KLEMS database: very detailed because derived from country's input-output matrices, but only available for EU members states.

- United Nations Statistics Division data for both employment (at the ISIC Rev 3 level) and value added statistics (at the SNA93 2.1 level): Value added data available for all ECA countries while the employment data is available for all ECA countries except Bosnia and Herzegovina, Kosovo, and Turkmenistan.

- Eurostat labor force survey data: The employment data covers only a fraction of ECA countries (those that are EU members, Turkey, Croatia and FYR Macedonia); it has the same level of disaggregation as the UN data - NACE Rev.2 – and no value added/GDP data

For this paper, we use the United Nations Statistics Division data given its more comprehensive coverage and a level of disaggregation by sector that still allows us to discuss the *relative* degree of countries' vulnerability to an energy price shock. The potential price increase data is taken from International Energy Agency (2011) and the Energy Regulators Regional Association (ERRA) tariff database.

Since there are a number of countries that are common to the UN dataset and to those with more detailed sectoral information, one can test the sensitivity of results to the level of sectoral disaggregation used. Table A1 shows the shares of value added and employment in energy-intensive industries when using the UN data, EU KLEMS and the input-output matrices for the available countries.

While quantitatively the degree of vulnerability of countries to a change in carbon prices is different depending on the data source, the *relative* position of countries in terms of the vulnerability is maintained. For the countries where data is available, UN and input-output matrices provide similar rankings of countries. When comparing UN data with the KLEMS database, results are also consistent in most cases. There are very few exceptions. The most important one is Slovenia which comes out relatively less vulnerable in the UN data than in KLEMS. Estonia is also relatively less vulnerable in the UN data in terms of value added, although in terms of employment results are consistent across both datasets.

Finally, in term of employment, Latvia also comes out relatively less vulnerable in the UN data than in KLEMS. While the ranking of the individual countries is consistent across databases, we focus the analysis on more general groupings (high, medium and low vulnerability both for value added and employment). This should further reduce the impact in the conclusions of any small discrepancies that may arise because of the sectoral level of aggregation used. This allows us to be reasonably confident in the use of the UN data as a base for the discussion in this paper.

Table A1. Share of value added and employment in energy-intensive industries from different data sources, in percent

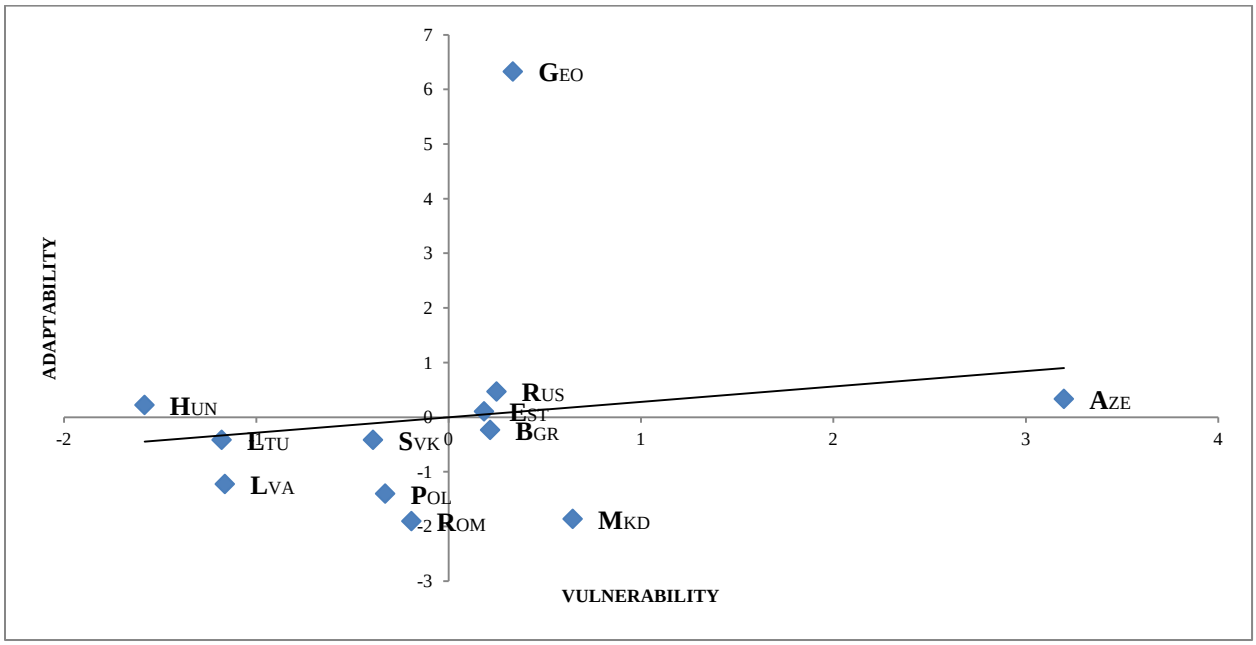
	Value Added			Employment		
	KLEMS	I-O	UN	KLEMS	I-O	UN
Albania			0.26			0.09
Armenia			0.34			0.18
Azerbaijan			0.66			0.13
Bulgaria			0.29			0.18
Croatia			0.20			0.18
Czech Republic	0.41	0.16	0.25	0.32	0.15	0.19
Estonia	0.31		0.23	0.35		0.23
Georgia			0.21			0.10
Hungary	0.31	0.11	0.16	0.27	0.14	0.17
Kazakhstan			0.38			0.19
Latvia	0.24		0.22	0.29		0.23
Lithuania	0.37		0.24	0.24		0.20
Macedonia, FYR		0.12	0.20		0.14	0.16
Moldova			0.21			0.14
Poland	0.31		0.21	0.23		0.16
Romania			0.25			0.16
Russia			0.27			0.22
Serbia			0.19			0.15
Slovak Republic	0.38		0.23	0.32		0.20
Slovenia	0.36		0.19	0.30		0.14
Turkey			0.23			0.12
Ukraine			0.23			0.30

Source: EU KLEMS Database, United Nations Statistics Division, Input Output Matrices for ECA countries

The UNIDO Discussion

UNIDO: The United Nations Industrial Development Organization (UNIDO) is the specialized agency of the United Nations that promotes industrial development for poverty reduction, inclusive globalization and environmental sustainability. For the purposes of this paper, we only use this data to see how different branches of manufacturing may affect the vulnerability results in this Annex. We did not use this specific approach in the paper in order not to lose a number of countries that do not have UNIDO data in this specific breakdown. Please see the below figure for a reproduction of Figure 9, only for those branches of manufacturing that are the top four energy consuming branches, accounting more than half of

the total manufacturing energy use in ECA (Zhang, 2012). These are iron and steel, chemical and petrochemical, non-metallic minerals (such as glass, ceramic, cement etc.), and paper and pulp. As can be seen, the number of countries represented below is less in number, although the level of breakdown is more detailed.



Source: Authors' calculations using data shown in Annex 5, in addition to the UNIDO manufacturing data used only for this table.

Annex 2. International Standard Industrial Classification of All Economic Activities, Rev.3

- A - Agriculture, hunting and forestry
  - 01 - Agriculture, hunting and related service activities
  - 02 - Forestry, logging and related service activities
- B - Fishing
  - 05 - Fishing, operation of fish hatcheries and fish farms; service activities incidental to fishing
- C - Mining and quarrying
  - 10 - Mining of coal and lignite; extraction of peat
  - 11 - Extraction of crude petroleum and natural gas; service activities incidental to oil and gas extraction excluding surveying
  - 12 - Mining of uranium and thorium ores
  - 13 - Mining of metal ores
  - 14 - Other mining and quarrying
- D - Manufacturing
  - 15 - Manufacture of food products and beverages
  - 16 - Manufacture of tobacco products
  - 17 - Manufacture of textiles
  - 18 - Manufacture of wearing apparel; dressing and dyeing of fur
  - 19 - Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
  - 20 - Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
  - 21 - Manufacture of paper and paper products
  - 22 - Publishing, printing and reproduction of recorded media
  - 23 - Manufacture of coke, refined petroleum products and nuclear fuel
  - 24 - Manufacture of chemicals and chemical products
  - 25 - Manufacture of rubber and plastics products
  - 26 - Manufacture of other non-metallic mineral products
  - 27 - Manufacture of basic metals
  - 28 - Manufacture of fabricated metal products, except machinery and equipment
  - 29 - Manufacture of machinery and equipment n.e.c.
  - 30 - Manufacture of office, accounting and computing machinery
  - 31 - Manufacture of electrical machinery and apparatus n.e.c.
  - 32 - Manufacture of radio, television and communication equipment and apparatus
  - 33 - Manufacture of medical, precision and optical instruments, watches and clocks
  - 34 - Manufacture of motor vehicles, trailers and semi-trailers
  - 35 - Manufacture of other transport equipment
  - 36 - Manufacture of furniture; manufacturing n.e.c.
  - 37 - Recycling
- E - Electricity, gas and water supply
  - 40 - Electricity, gas, steam and hot water supply
  - 41 - Collection, purification and distribution of water
- F - Construction
  - 45 - Construction
- G - Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods
  - 50 - Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of automotive fuel
  - 51 - Wholesale trade and commission trade, except of motor vehicles and motorcycles
  - 52 - Retail trade, except of motor vehicles and motorcycles; repair of personal and household goods
- H - Hotels and restaurants
  - 55 - Hotels and restaurants
- I - Transport, storage and communications
  - 60 - Land transport; transport via pipelines
  - 61 - Water transport

    - 62 - Air transport
    - 63 - Supporting and auxiliary transport activities; activities of travel agencies
    - 64 - Post and telecommunications
- J - Financial intermediation
    - 65 - Financial intermediation, except insurance and pension funding
    - 66 - Insurance and pension funding, except compulsory social security
    - 67 - Activities auxiliary to financial intermediation
- K - Real estate, renting and business activities
    - 70 - Real estate activities
    - 71 - Renting of machinery and equipment without operator and of personal and household goods
    - 72 - Computer and related activities
    - 73 - Research and development
    - 74 - Other business activities
- L - Public administration and defence; compulsory social security
    - 75 - Public administration and defence; compulsory social security
- M - Education
    - 80 - Education
- N - Health and social work
    - 85 - Health and social work
- O - Other community, social and personal service activities
    - 90 - Sewage and refuse disposal, sanitation and similar activities
    - 91 - Activities of membership organizations n.e.c.
    - 92 - Recreational, cultural and sporting activities
    - 93 - Other service activities
- P - Private households with employed persons
    - 95 - Private households with employed persons
- Q - Extra-territorial organizations and bodies
    - 99 - Extra-territorial organizations and bodies

Annex 3 - Methodology

We use principal component analysis (PCA) as an integral part of our diagnostics. PCA is a mathematical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of uncorrelated variables— called principal components. The main advantage of PCA is that the entire data can be compressed by reducing the number of dimensions, without loss of much information. For PCA to work properly, the main criterion is to subtract the mean from each of the data dimensions. The mean subtracted is the average across each dimension.

We used the following indicators for our PCA: (i) share of value added in energy-intensive industries, (ii) share of employment in energy-intensive industries, (iii) the estimated energy price increase after regulation, (iv) spending per unemployed in active labor market policies (ALMPs), (v) tax wedge ratio, (vi) employment protection legislation index (EPL), (vii) ratio of minimum wage to value added, (viii) maximum duration of fixed contracts (in months), (ix) social assistance spending as a percentage of GDP, (x) unemployment benefit duration (in months), (xi) quality of last-resort social assistance (LRSA) and child allowance (CA) programs, (xii) ratio of unemployment benefit to average wage, (xiii) gross domestic expenditure on research and development (R&D), (xiv) share of the labor force with secondary education, (xv) ratio of vocational/technical secondary enrolment to general secondary enrolment, (xvi) average years of total schooling and (xvii) latest PISA math scores.

Among the above sixteen indicators, the first three are used to identify the degree of vulnerability while the rest are used to identify the degree of adaptability across countries. The indicators in the first group (vulnerability) are unidirectional, where higher values indicate more vulnerability. The indicators in the adaptability group are, however, not unidirectional. To make them unidirectional and making the higher value as represent a higher adaptability we took the negative of EPL, tax wage ratio, minimum wage to value added and ratio of vocational/technical secondary enrolment to general secondary enrolment. This transformation does not lead to loss of information since PCA is sensitive to relative scaling and not the linear transformation of vectors. Once we identify the groups representing vulnerability and adaptability, we perform PCA and take the predicted value of the first component (for both vulnerability and adaptability separately) as the representatives of vulnerability and adaptability. We take the first component since PCA is defined in such a way that the first principal component has as high a variance as possible.

Annex 4 – Adaptability Indicators

There are five main dimensions that will determine a country's capacity to adapt to an energy price change. For all these dimensions, we have identified certain indicators to include in our analysis:

a. Labor Market Flexibility: Consists of (i) tax wedge ratio, (ii) employment protection legislation index (EPL), (iii) ratio of minimum wage to value added, and (iv) maximum duration of fixed contracts (in months). For the first two indicators, we relied on Institute for the Study of Labor (IZA) labor market indicators database. The values are those of 2007 – the latest year that they were available. For the latter two indicators, we used the latest Doing Business Database (2012).

b. Skills, Training and Innovation: Consists of (i) gross domestic expenditure on research and development (R&D), (ii) share of the labor force with secondary education, (iii) ratio of vocational/technical secondary enrolment to general secondary enrolment, (iv) average years of total schooling and (v) latest PISA math scores. We took the first indicators from UNESCO, the second one from World Bank, third one from the UN Database, fourth one from Barro-Lee calculations (2010), and the last one from World Bank.

c. Active Labor Market Policies: Consists of (i) spending per unemployed in active labor market policies (ALMPs). We have first calculated the total ALMP spending in USD in 2007 - ALMP Spending as a % of GDP in 2007 (from IZA) / GDP in current US$ prices in 2007 (from WDI). We have divided the resulting number by the total number of unemployed people (from ILO) in the same year to reach the final indicator; spending per unemployed in active labor market policies.

d. Social Protection: Consists of (i) social assistance spending as a percentage of GDP, (ii) unemployment benefit duration (in months), (iii) quality of last-resort social assistance (LRSA) and child allowance (CA) programs, (iv) ratio of unemployment benefit to average wage. The first two indicators are taken from WDI, the third one is a scoring method developed by the ECA Social Protection team (See findings in World Bank, forthcoming) and the last one from IZA.

e. Incentives for Clean Industries: As discussed before, here we only perform a qualitative analysis of this dimension.

Annex 5 – Vulnerability and Adaptability Indicators, 2008

Collection of Data used in the Overall Analysis

		VULNERABILITY INDICATORS		ADAPTABILITY INDICATORS													
				LM Flexibility				Skills, Training and Innovation					ALMP	Social Protection Readiness			
	Potential electricity price hikes ($ cents/kWh)	Share of Employment in Energy-Intensive Industries	Share of Value Added in Energy-Intensive Industries	EPL (2007)	Tax Wedge (2007)	Minimum Wage/ Value Added	Maximum Length of Fixed Contracts	Gross Domestic Expenditure on R&D (% of GDP)	Labor Force w/ Secondary Education	Share of Enrollment in VTA in all Secondary Education	Average Years of Total Schooling (15+)	PISA Math Score (latest)	ALMP spending/ # of Unemployed	SA Expenditure (% of GDP)	Benefit Duration	Quality of LRSA and CA (average value of targeting, generosity and coverage)	Benefit Amount (average UB/average wage)
Armenia	4.67	0.18	0.34	-2.13	-38.5	-0.23	60	0.3	59.6	-0.01	10.4	456	45	1.46	12	4.0	14
Azerbaijan	11.76	0.13	0.66	-2.2	-29.8	-0.17	60	0.3	74.1	-0.16	10.2	431	1411	1.22	6	3.2	37.9
Bulgaria	7.83	0.18	0.29	-1.9	-31.5	-0.24	36	0.5	59.3	-0.30	9.8	428	137	1.18	12	3.7	40
Croatia	1.01	0.18	0.20	-2.7	-40.3	-0.31	36	0.8	63.3	-0.37	9.0	460	1247	3.79	13	3.7	25
Estonia	9.55	0.23	0.23	-2.29	-38.4	-0.23	120	1.4	55.8	-0.18	11.8	512	1703	1.89	12	3.3	8
Georgia	4.81	0.10	0.21	-0.38	-26.7	-0.08	360	0.2	60.4	-0.01	10.2	456	18	1.17	0	4.3	0
Hungary	-7.80	0.17	0.16	-1.85	-43.3	-0.25	60	1.1	65.2	-0.14	11.7	490	221	5.29	9	4.0	20
Kazakhstan	14.91	0.19	0.38	-1.5	-28.2	-0.14	360	0.2	59.6	-0.06	10.4	405	543	1.30	4	2.3	20
Latvia	-1.85	0.23	0.22	-2.6	-41.8	-0.24	36	0.5	61.8	-0.23	10.6	482	653	0.95	9	3.0	34
Lithuania	-2.61	0.20	0.24	-2.8	-40.6	-0.24	60	0.8	59.5	-0.10	10.9	477	1802	1.46	9	3.7	27
Macedonia, FYR	14.40	0.16	0.20	-3.1	-41.4	-0.32	60	0.2	59.6	-0.28	10.2	381	25	1.10	12	3.3	33
Moldova	6.11	0.14	0.21	-2.5	-32.4	-0.52	360	0.5	59.6	-0.12	9.6	456	53	1.36	12	2.7	27.9
Poland	3.77	0.16	0.21	-2.19	-42.5	-0.27	24	0.7	68.3	-0.28	9.9	495	985	1.97	18	3.3	20.3
Romania	3.10	0.16	0.25	-3	-42.2	-0.22	24	0.5	61.7	-0.33	10.5	427	1323	3.37	12	3.3	30
Russia	9.61	0.22	0.27	-1.9	-31	-0.14	60	1.2	41.1	-0.17	8.5	468	340	2.94	24	2.7	14
Serbia	14.17	0.15	0.19	-2.2	-42.2	-0.25	12	0.9	59.6	-0.36	9.1	442	53	1.93	24	3.0	60
Slovak Republic	3.33	0.20	0.23	-1.74	-35.5	-0.24	24	0.5	78.0	-0.35	11.2	497	635	2.63	6	3.2	20
Turkey	4.70	0.12	0.23	-3.49	-41.8	-0.47	360	0.8	21.9	-0.18	7.0	445	274	0.95	12	3.0	25.3
Ukraine	14.75	0.30	0.23	-2.3	-39.2	-0.38	360	0.9	43.1	-0.08	11.1	456	191	2.66	12	3.7	21.3
Source	IEA (2011) and ERRA tariff database	UN	UN	IZA	IZA	Doing Business	Doing Business	UNESCO	Ed Stats 2007 from HBS or LFS	UN	Barro-Lee 2010	EdStats	Own calculation based on ILO and IZA	WDI	WDI	ECA SP team calculations	IZA

Note: The highlighted cells correspond to figures not available for corresponding country. The numbers shown are unweighted averages of all other cells with available data for that indicator