EUROPE AND CENTRAL ASIA REPORTS

ENERGY EFFICIENCY

Lessons Learned from Success Stories

Gary Stuggins, Alexander Sharabaroff, and Yadviga Semikolenova

THE WORLD BANK

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Abbreviations

BER	Building Energy Ratings
CTF	Clean Technology Find
EBRD	European Bank for Reconstruction and Development
EC	European Community
ECA	Europe and Central Asia
ECCU2	Ukraine/Belarus/Moldova (World Bank group)
EE	Energy Efficiency
EEA	Energy Efficiency Agency
ESCO	Energy Service Company
EU	European Union
FEI	Final Energy Intensity
GDP	Gross domestic product
GEF	Global Environment Facility
GHG	Greenhouse gases
GWh	Gigawatt hour
IEA	International Energy Agency
kgoe/GDP	Kilogram oil equivalent/GDP
KSP	Knowledge Sharing Platform
NEEAP	National Energy Efficiency Action Plan
TJ	Terra joule

Executive Summary

This study is designed to analyze the energy efficiency policies in seven countries that were successful in achieving low energy intensities or in reducing their energy intensity considerably. The study analyzes the evolution of the energy intensity of these countries from 1990 to 2007, identifying points of inflection in the progress towards improvements. Changes to the policy agenda immediately upstream are explored in an effort to identify cause and affect relationships in energy efficiency improvements.

The energy intensity of Europe and Central Asia (ECA) region countries[1] and EU-15 countries[2] improved considerably from 1990-2007, decreasing by 32 percent overall. The average rate of improvement of the mature EU-15 countries (25 percent) was relatively high, especially since these countries were already more energy efficient in 1990 (0.17 kgoe/GDP). The energy intensity of EU-12 countries[3] improved a remarkable 40 percent during this period, closing the gap considerably with EU-15 countries.

Unfortunately, it's not all good news: the energy intensities of six ECA countries are still more than double the ECA average. Four ECA countries — Uzbekistan, Turkmenistan, Ukraine, and Kazakhstan — are among the eleven worst countries in the world in terms of energy intensity. Nearly all of the remaining seven high energy intensity countries are African countries with very low income levels. If one removes the low income Africa countries, ECA countries comprise half of the twelve worst performing countries in the world (as Russia and Moldova are added to the list of poor performers).

This study revolves around answering the following five questions:

How can market penetration be accelerated? The International Energy Agency's (IEA's) 2011 "World Energy Outlook[4]" states that energy efficiency is expected to meet half of the "greening" challenge facing the world to meet its global warming targets. Despite assigning a high priority to energy efficiency, there are few successful energy efficiency programs in World Bank client countries, although there is a good track record of successful projects. Projects typically meet, or exceed, their energy efficiency and rate of return targets, but market penetration remains lackluster.

What measures can be taken to foster acceleration in energy intensity improvements to enable others to approach EU standards? Many ECA countries were among the most energy intensive economies in the world in 1990. Most countries in Central Europe decreased their energy intensity considerably over the past twenty years: EU-12 countries were particularly successful, decreasing their energy intensity by about 50 percent. Other countries have languished, with many in Central Asia lingering among the most energy intensive countries in the world. However, progress is encouraging: as a group, Ukraine/Belarus/Moldova improved their energy intensity to the EU-12 countries' levels of twenty years ago, while EU-12 countries are now approaching the EU-15 countries' energy intensity levels of that time. This study explores the measures taken by the countries that have successfully decreased their energy intensity to help guide those whose energy intensity remains high.

Can the least successful countries benefit from the lessons learned in successful countries? The region has a wide range of energy intensities, thus providing an important opportunity for learning and knowledge transfer. EU countries have benefited from their collaboration as part of the EU processes. Preparing energy and other related Directives that are entered into countries' legal frameworks have helped accelerate energy efficiency in all countries. Non-EU countries don't have a similar process and could benefit from some alternative mechanism.

How did successful countries undertake their transition? I.e., how are policy reforms staged? Successful OECD countries experiences aren't always immediately relevant to the Bank's client countries as the economic and institutional conditions differ significantly. However, many client countries now find themselves in a position similar to that of the EU-12 countries in the early 1990s. The lessons learned from their transition and how to best sequence reforms could help client countries address their most urgent issues.

Can good energy efficiency policies help promote economic growth? The typical development path has been driven by countries that use energy to improve labor and capital productivity. As a result,

long-term elasticities of economic growth with respect to energy use have typically been close to 1.0. A few countries have delinked economic growth and energy use successfully. How is delinking achieved? How can it be applied to middle income countries? Is there a new paradigm for the role of energy in economic growth?

The primary lessons learned fall into five broad categories: Prices; Governance; Industries; Households; and, Communications (see Table 1 below). The country case studies indicate that policy implementation evolves over time, reflecting such issues as institutional capacity and affordability. For example, energy price increases were adjusted quickly to reflect full economic costs for all sectors except households. Household prices were generally kept below their economic cost of supply, but above the financial cost as utilities were able to reduce investment needs during the 1990s. EU-12 countries have avoided adding environmental taxes to energy costs. EU-15 countries implemented environmental taxes when it appeared to be politically viable to do so. In Sweden, this happened decades ago because of the strong support for environmental issues, while Germany didn't make major inroads in applying environmental taxes until the 1990s. Similarly for Governance issues, EU-12 countries have undertaken some of the first steps towards improving the governance of the energy efficiency agenda by establishing an entity responsible for energy efficiency policy and preparing National Energy Efficiency Action Plans. Monitoring and Evaluation of these programs is functioning to a limited extent in EU-12 countries while EU-15 countries take

TABLE 1
Priority Policy Energy Efficiency Reforms for EU Countries

	High to Medium Energy Intensity	Medium to Low Energy Intensity
Prices	Full Cost Recovery	Add Externalities
Governance	Establish an Effective EE Agency Establish EE Targets Create EE Action Plan Upgrade Laws/Regulations Monitor and Evaluate EE Program	Engage in International Fora Communicate Across Ministries Communicate to Regions/Cities Decentralize Decision-Making
Industry	Privatize Remove Trade Barriers Facilitate Competition	Facilitate Networking/Clusters EE Obligations for Energy Suppliers Enable ESCOs
Households	Implement Consumption-Based Billing Low Cost Financing for EE	Implement Buildings Certificates Establish Appliance Standards
Communications	Provide EE Information	Engage Social Networking Tools

these responsibilities more seriously as they are better able to afford the costs associated with such programs.

Top Lessons and Findings

The top five policy lessons drawn from this study are:

1. **Get the pricing right.** This comes as no surprise. However, there are interesting approaches to price adjustments. Successful countries increased energy prices rapidly: price shocks at politically expedient times, as experienced in Poland and Lithuania, have proven to be effective. Other countries — notably Denmark, Germany and Sweden — enabled price increases to become socially acceptable through outreach programs that actively engaged civil society in the decision making process. As incomes grow, energy prices are adjusted to reflect more than the simple direct cost of supply: indirect costs associated with the environmental impacts of energy use are reflected in environmental taxes that are added to energy prices in higher income countries.

2. **Good governance matters.** More specifically:

    a. **Get the enabling framework right:** Successful countries start by developing an energy efficiency policy, followed by an Action Plan to guide the implementation of the policy. They next set long- and medium-term energy efficiency targets, and ultimately pass laws, secondary legislation, and regulations to provide the incentives to enable implementation of the Action Plan.

    b. **Establish institutional arrangements:** Successful larger countries generally establish an Agency responsible for the energy efficiency program; in smaller countries, a department within a Ministry is typically established. Successful countries establish the budget needed to attract high quality professional staff. They are responsible for advising on policies, monitoring and evaluating the Action Plan to ensure that targets are met, reporting on progress to the government, and advising on adjustments to the policy framework as needed.

    c. **Develop coordination mechanisms:** Well-run energy efficiency programs work across sectors, coordinating programs among Ministries and sub-national entities (e.g., mayors' offices in large cities). Ministries of Energy (largely supply-side issues), Housing/Construction, Infrastructure (water supply and transport), Environment, Finance (to ensure funding), Economics,

Education (for schools), and Health (for hospitals and medical centers) are all actively engaged in successful energy efficiency programs. Careful coordination enables important energy efficiency gains through modest expenditures in health and education investment programs. Sweden also supports vertical coordination among the Federal, County and Municipal levels of government.

d. **Ensure that adequate, low-cost financing[5] is available to support investments:** It is critical to supplement commercial funds with low-cost financing to address environmental externalities and market rigidities. As incomes rise, low-cost financing can be replaced by environmental taxes to provide a similar set of incentives.

3. **Sustained monitoring and evaluation is needed to achieve results.** All successful countries actively review and update their energy efficiency programs, adjusting for changing conditions and learning from others.

4. **Quick wins happen in the industrial sector, while residential reforms take longer to implement.**

   a. **For the industrial sector:** The role of the government is limited, but important. It must create an enabling environment by setting energy prices right, including costs associated with environmental externalities. Trade, competition, and privatization policies facilitate competition, providing the incentive for industries to reduce costs so they can increase market share and profits. Private sector participation in industry is important as private companies tend to adjust faster than publicly owned companies. Low energy intensity economies have successfully worked with representatives of the industrial sector to facilitate energy savings programs in this sector.

   b. **For households and commercial buildings:** To address the energy efficiency of residential and commercial buildings, countries have taken a three-pronged approach: (1) short-term requirements in new, and to a lesser extent existing, buildings are addressed through building standards; (2) medium-term targets are addressed through the Buildings Certificates Programs in which the energy consumption of buildings is posted as a prerequisite for the sale or rental of properties; and (3) long-term concerns are addressed through the design of "nearly-zero energy" buildings. Successful governments have actively engaged in this sector to: set the prices to reflect the cost of supply; facilitate

Homeowners Associations; provide grants to fund part of the cost of energy efficiency investments; disseminate information on energy efficiency options; and facilitate low cost energy audits.

5. **It takes more than a market for energy efficiency to work.** It has been argued that energy efficiency should be driven by market forces in which the government ensures that the full cost of energy is reflected in the price and that the rest should be up to the market to respond. Successful countries have done more than rely on market principles. The incremental cost of making new buildings energy efficient is modest: in the order of 5 percent of the cost of the building. However, the cost of retrofitting existing buildings is much higher and difficult to justify. Hence the government has an important role to play in the regulation of building construction. Similarly, the application of appliance standards has proven to be an effective component of successful energy efficiency programs. Lastly, knowledge sharing programs, as a public good, are an important component of the government's responsibilities.

Four Interesting Findings for Future Consideration

Investing in energy efficiency appears to help sustain economic growth in higher income countries. Germany, Sweden, and Ireland all have managed to maintain robust levels of growth over the period under consideration. They have also aggressively addressed energy efficiency. A quick analysis of energy efficiency policy measures and economic growth in Germany and Sweden shows a high level of correlation. The possible impact of energy efficiency policies on economic growth could warrant a shift in approach to the development paradigm in which energy is used to fuel economic growth by introducing productivity gains. The new development paradigm could be one in which leaner, efficient enterprises gain increased market share, in a more competitive global economic market, by keeping their costs down. A cause and effect analysis could reveal a possibly interesting shift in attitudes towards energy use.

The energy intensity of EU-15 and EU-12 countries has converged significantly over the past twenty years. It is assumed that this is partly driven by: (1) the common need to follow EU Directives; (2) the application of a similar set of technologies due to more openness to trade; and (3) access to a common information base. Applying these lessons to non-EU member countries could facilitate an acceleration of energy efficiency programs elsewhere. However, it would be difficult to simulate the breadth and depth of mechanisms that the EU has available. It would be

useful to explore what options are available to simulate a similar system of incentives that non-EU countries could follow to enable the level of success achieved by EU-12 countries.

White Certificates Programs implemented in a few countries show promise. "White Certificates" are an important new instrument to help support the implementation of energy efficiency. These programs establish an obligation for energy operators (typically electricity and gas distribution companies) to reduce energy consumption by their customers. The operators are given a target level of energy reduction to achieve each year. White Certificates are issued against energy savings achieved. If the operator has not met his target level, he is obligated to either buy White Certificates from those who have over-achieved or pay a penalty. Typically, the targets are about a 1 percent per annum reduction in energy use. Operators establish programs with their clients, such as energy efficient lighting, motors, or building insulation programs. Operators will either implement these programs directly or engage Energy Service Companies (ESCOs) to implement them. The experience to date has been favorable: nearly all targets in five country programs have been met or exceeded. It would be instructive to see if similar programs could be implemented in Bank client countries and how they should be phased in. Denmark has a similar program in which energy suppliers have energy efficiency obligations on behalf of their customers, but does not include White Certificates. Their program has been successful as the additionality is estimated to be about a half of recorded energy savings.

It is recommended that an "Energy Efficiency Ladder" be established. The Energy Efficiency Ladder is a tool in which countries are ranked by their energy intensity levels. The ladder would be a vehicle to facilitate learning lessons of success cases by reporting on energy efficiency policies for all countries in the ladder. A quick review of the countries studied to date reveals that policies of successful countries are fairly similar, thus providing clearer guidance for others. Furthermore, the stratification of countries' energy intensities indicates a common set of issues and opportunities that can be learned from those higher up the ladder. The ladder approach also appears to reveal that there is no easy way of "leap-frogging" up the ladder: progress comes from sustained government commitment, attention to detail, and good governance.

Endnotes

1. ECA countries refer to countries in the World Bank's Europe and Central Asian region that borrowed from the Bank between 1990-2007, and include: Albania; Azerbaijan; Bosnia and Herzegovina; Croatia; Czech Republic; Estonia; Kazakhstan; Montenegro; Kyrgyzstan; Latvia; Macedonia; Mol-

dova; Poland; Russia; Turkey; Turkmenistan; Ukraine; Uzbekistan; Armenia; Bulgaria; Georgia; Kosovo; Lithuania; Romania; Serbia; Slovenia; Slovakia; and Tajikistan.

2. EU-15 countries include: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, and the United Kingdom.
3. EU-12 countries include: Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Romania, Slovakia, and Slovenia.
4. "World Energy Outlook",2011, www.iea.org.
5. "Low-cost financing could be any of a number of possibilities that result in a cost of capital that is below market rates. Typically, this is accomplished by blending grants with commercial loans.

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CHAPTER 1

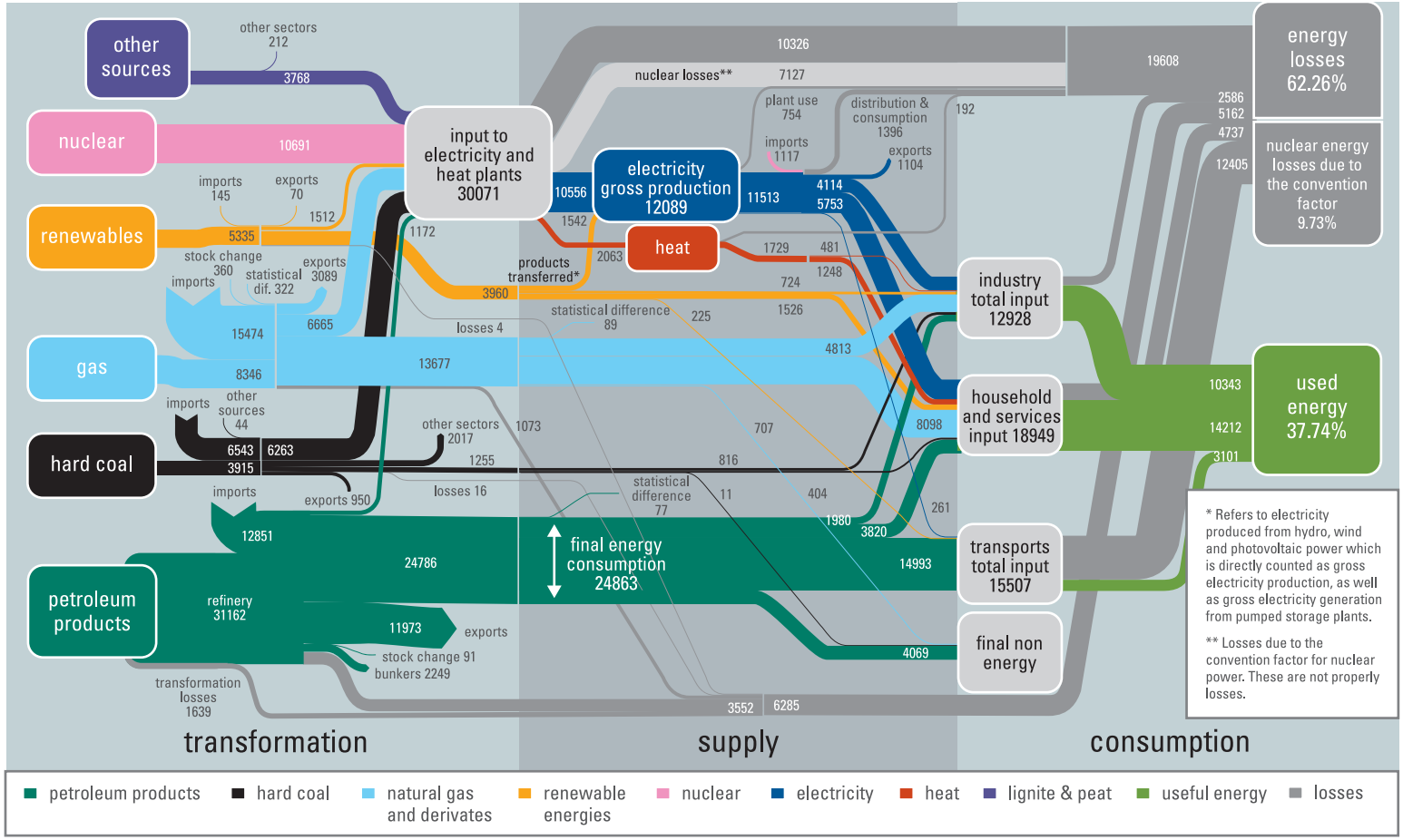
Why Is Energy Efficiency Important?

More than 60 percent of the primary energy mobilized to provide energy services is lost in processing or delivery systems. Figure 1.1 shows how energy in the EU-27 countries is transformed before it is delivered to customers. Although some of these losses are unavoidable, there is clearly considerable scope for utilizing wasted energy for productive uses and for reducing the amount of energy lost. Many of the potential energy efficiency gains are estimated to be commercially viable, yet they aren't being implemented for reasons that are addressed in the literature.[1]

The expected benefits from energy efficiency go well beyond simple commercial considerations. Energy efficiency investments would make industries more competitive, thus creating jobs by increasing their market share. IEA estimates that addressing an energy supply-demand gap costs US$ 1 for every US$ 2 spent on supply costs, thus reducing the "tax" burden of the energy sector on the broader economy. Energy efficiency is also the cheapest way of helping governments meet their energy security concerns by limiting their dependence on imported energy. And energy efficiency is the least-cost approach to reducing negative environmental impacts, such as local and regional air pollution, and emissions of greenhouse gases (GHG) that contribute to global warming.

The energy intensity of countries in ECA varies widely: Turkey and Albania's energy intensities are estimated to be about 0.1 kgoe/GDP[2], while Uzbekistan's (0.75) is estimated to be about the highest in the world. This broad range thus provides much fodder to analyze the successes that some countries have achieved, and to provide lessons learned. This study was designed to analyze the energy efficiency policies in seven countries that were successful in achieving low energy intensities or in

FIGURE 1.1
EU-27 Streamlined Energy Flow Trends, 2006



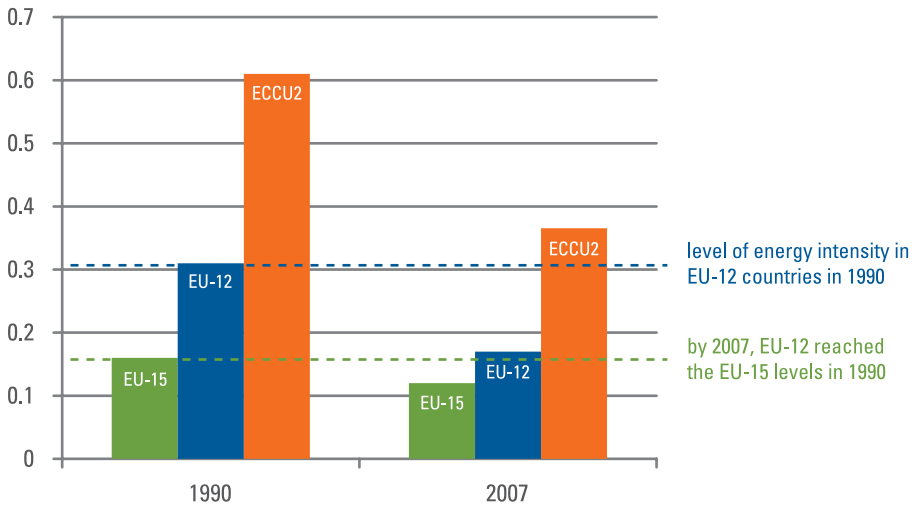
Source: http://www.sankey-diagrams.com/european-energy-flows-sankey/.

reducing their energy intensity considerably over the past twenty years. The study analyzes the evolution of the energy intensity of these countries from 1990 to 2007, identifying points of inflection in the progress towards improvements. Changes to the policy agenda immediately upstream are explored in an effort to identify cause and affect relationships in energy efficiency improvements. Although direct relationships are difficult to isolate, cross-country analyses that point to similar successes among a variety of countries give some confidence that these policies have contributed to reducing energy needs.

The Energy Intensity of ECA Countries

The energy intensity of ECA countries[3] and EU-15 countries improved considerably from 1990-2007, decreasing 32 percent (see Figure 1.2). The rate of improvement across the mature EU-15 countries (25 percent) was fairly high, especially since these countries were already relatively energy efficient in 1990 (0.17 kgoe/GDP). The energy intensity of EU-12 countries improved a remarkable 40 percent during this period, considerably closing the gap with EU-15 countries. Many countries outside of the EU zone improved their energy efficiency rapidly as well, but it is inappropriate to generalize as the rate of change of energy intensity varies considerably in this group.

FIGURE 1.2
Energy Intensity (kgoe/GDP) in EU-15, EU-12, and ECCU2 Countries, 1990 Versus 2007



Source: World Bank.

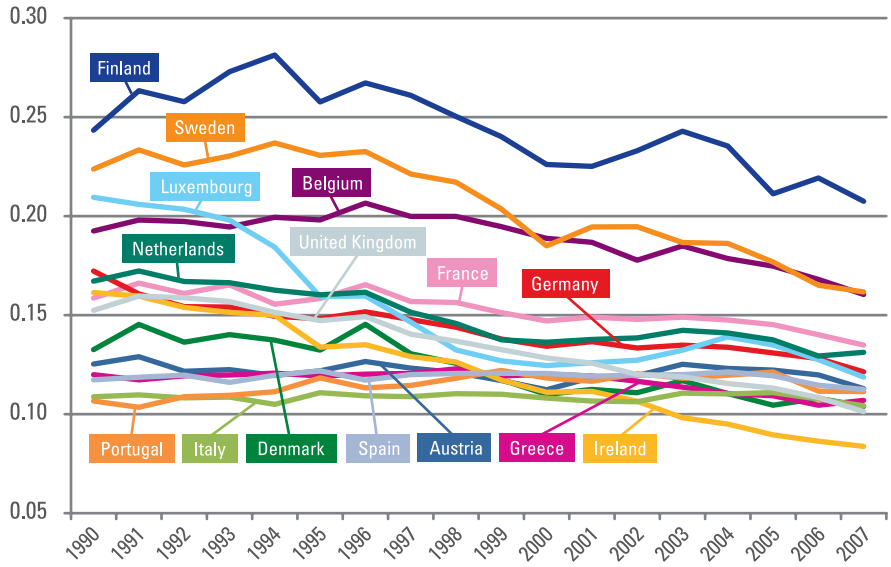
The energy intensity of the EU-15 countries was among the best in the world in 1990 and continued to improve. The 25 percent improvement in energy intensity from 1990-2007 is particularly impressive given their favorable starting point: their energy intensity in 1990 was roughly 30 percent better than in North American countries and 18 percent better than in high-income OECD countries. Attitudes about energy use in Western Europe are unique, affecting the fabric of attitudes of nearly all consumers. Policy reforms have enabled this change in consumer behavior, making energy use an important element of the decision making process at all levels of society.

The improvement in the energy intensity of EU-12 countries during this same period is, arguably, even more impressive: their energy intensity decreased by about 40 percent, from 0.3 kgoe/GDP to 0.17 kgoe/GDP. Over this seventeen year period, the average energy intensity of EU-12 countries went from below the world average to approximately that of the EU-15 in 1990 (see Figure 1.4). Many of the gains came at the expense of collapsing economies during the 1990s, with the closure of older, heavy industries no longer commercially viable. As a result, the structure of the economies changed considerably, with new industries and more efficient technologies, and a shift to more service-based economies.

Figures 1.3 and 1.4 demonstrate a notable characteristic of all EU countries: convergence in their energy intensity. After removing the outliers — i.e., countries that have to deal with the impact of cold winters (Sweden, Finland, and Estonia) and countries that benefit from the moderating effect of water (island states in the Mediterranean like Malta and Cyprus) — the remaining countries' energy intensities converge on a narrow range. The EU-15 countries' energy intensities range from 0.10-0.14, while those of EU-12 countries range from 0.14-0.18.[4] At the current rate of improvements, the energy intensity of EU-12 countries is expected to converge with those of the EU-15 within the next two decades.

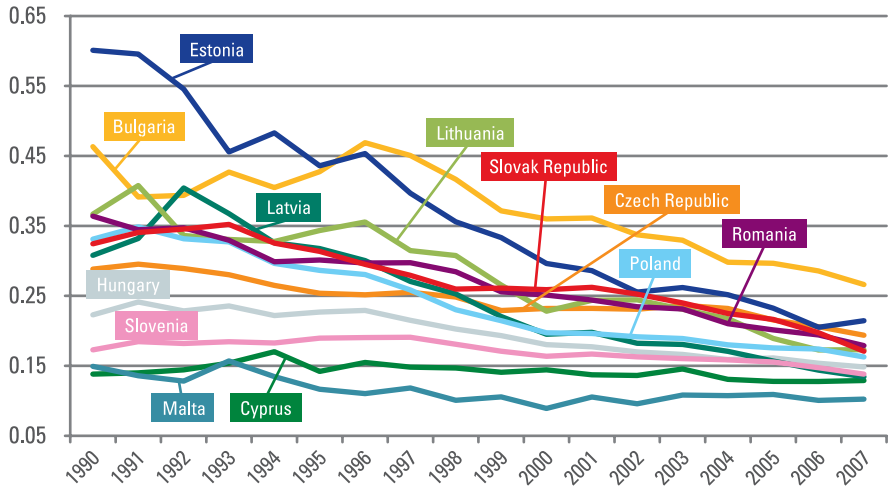
The primary reason for the expected convergence of energy intensities of EU-12 and EU-15 countries is the commonality of these countries' policies, many of which are driven by the need to meet EU Directives. EU-12 countries have, to a large part, been slower in implementing EU policies. However, EU-12 countries now appear to be accelerating their implementation of EU Directives, which will contribute to further convergence of energy intensities.

FIGURE 1.3
Energy Intensity (kgoe/GDP) in EU-15 Countries, 1990-2007



Source: World Bank.

FIGURE 1.4
Energy Intensity (kgoe/GDP) of EU-12 Countries, 1990-2007



Source: World Bank.

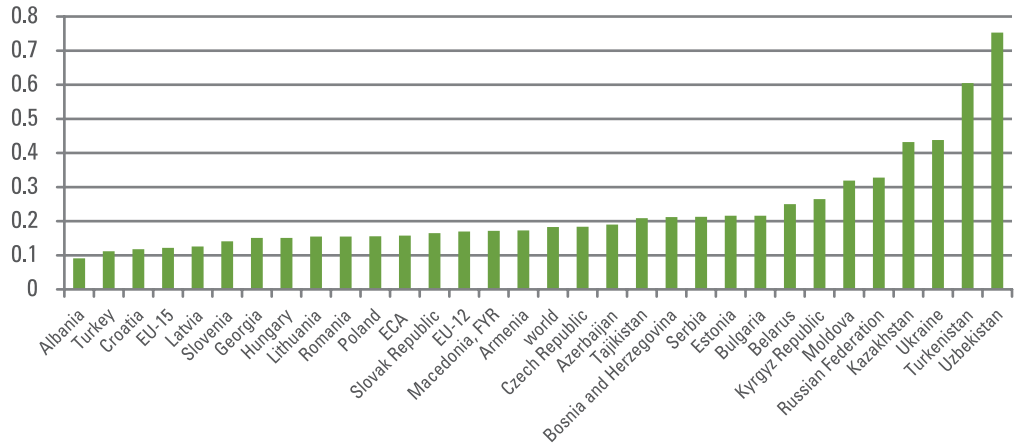
Similarly, ECCU2 countries reduced their energy intensity by 40 percent, approaching the level of energy intensity of EU-12 countries in 1990 (see Figure 1.2). However, detailed country assessments indicate broad variation in results: Belarus decreased its energy intensity by an impressive 64 percent, while Ukraine has achieved only a 28 percent improvement. The reasons for these differences are not necessarily consistent with traditional economic dogma. Belarus has achieved its results via strong sustained support from the government for energy efficiency investments, rather than relying on customers' responses to price signals. During this same period, the commitments of the Government of Ukraine on energy efficiency were weak, resulting in little improvement. Such results support the notion that achieving energy efficiency is complex, with no simple "silver bullet" to solve the problem. The energy intensities of ECCU2 and similar countries are expected to remain considerably behind the energy intensities of other EU countries unless their energy efficiency policy reforms accelerate.

Unfortunately, it's not all good news: the energy intensities of six ECA countries are more than double the ECA average (see Figure 1.5). Four ECA countries — Uzbekistan, Turkmenistan, Ukraine, and Kazakhstan — are among the eleven worst countries in the world in terms of energy intensity. Nearly all of the remaining seven high energy intensity countries are African countries with very low income levels. If one removes the low income African countries, ECA countries comprise half of the twelve worst performing countries in the world, as Russia and Moldova are added to the list of poor performers.

Much of the energy efficiency problem is a legacy from the Soviet era, caused by low energy prices, a secure level of primary energy, assets operated well past their design life, and barriers to trade. These circumstances have fostered perverse incentives, resulting in a negative value-added from parts of the industrial sector. As a result, it is not surprising that a large portion of the energy savings that took place in the EU-12 countries during the 1990s came from structural reforms. Once the energy subsidies were removed, and trade barriers lifted, industries had to compete with other suppliers for their markets, and many became insolvent. Thus, the "easy" part of energy efficiency was achieved through structural reforms in EU-12 countries. This phenomenon is expected to continue in those countries that become candidates for EU Accession.

Unfortunately, the clear lessons learned by successful countries have not yet been picked up by many other countries. Structural reforms and the impact on energy intensity have been evolving slowly in Ukraine, Russia, and most Central Asian countries. Technologies that have long

FIGURE 1.5
Energy Intensity (kgoe/GDP) of EU and ECA Countries, 2008



Source: World Bank.

since been abandoned in other countries remain operational in some of these countries. For example, open hearth steel making, still used in Ukraine, was abandoned in OECD countries decades ago because of its inefficiencies (both energy and labor), and has been replaced by use of Basic Oxygen Furnaces and Electric Arc Furnaces. Similarly, most cement plants in low energy intensity countries now use a dry process because it is cheaper and more energy efficient; in ECA countries with high energy intensities, many older plants still need to be upgraded to this process.

The issue that many client countries pose is how to prioritize actions needed to phase in energy efficiency improvements. Improvements in the efficiency of the building sector are much more difficult to implement than in the industrial sector. Successful transition economies tend to address industrial sector and structural issues first. Improvements in building standards for new buildings follow soon thereafter. Upgrading the existing building stock usually takes much longer.

The energy efficiency of new buildings is relatively easily and inexpensively addressed by setting standards: making a new building energy efficient typically adds only 5 percent to the total cost. Implementing and controlling the application of these standards is, however, a problem in many client countries, as the institutional capacity is weak and the incentives are distorted. Therefore, improved efficiency of new buildings is typically a second round agenda.

This study examines energy efficiency policies to identify actions that have enabled results, and asks:

- Why do countries with similar starting points diverge?
- How do policies applied in EU-15 countries differ from those used in EU-12 and ECCU2 countries?
- How did successful countries undertake their transition — i.e., how are policy reforms staged?
- What policies appear to have the biggest impact?

Box 1.1 explains methodology used to identify and analyze energy efficiency policies.

The approach taken in this study draws on questions asked of the Bank by its clients. They see neighbors with similar characteristics doing much better: EU-12 countries wish to converge with EU-15 countries, while former Soviet Union countries look to EU-12 countries that had similar starting points in 1990, but that are now well ahead of them in terms of economic efficiency — including energy use — and its impact on economic growth, income, and quality of life (Box 1.2 explains selection criteria for countries case studies). They want to know what their neighbors have done to enable such success. Thus, this study undertook an assessment of three categories of countries (see Annex 1 for a summary of the seven case studies):

- **Low Energy Intensity Countries:** The mature EU-15 countries that either achieved low energy intensity (Ireland) or decreased energy intensity rapidly in the past twenty years (Sweden) or both (Denmark, Germany).
- **Medium Energy Intensity Countries:** The quickly transitioning EU-12 countries who have undertaken their energy use transition well, nearly catching up to the energy intensity of EU-15 countries over the past twenty years. The analysis focuses on three countries that reduced their energy intensity by at least 50 percent between 1990-2007: Lithuania, Poland, and Romania.
- **High Energy Intensity Countries:** The Bank has been actively involved in supporting energy efficiency programs in Ukraine, Belarus, and Moldova (the ECCU2 country group). Each of these countries has an interesting, but quite different, story. Although they all three countries have energy intensities that are among the highest in the world, Belarus has cut its energy intensity by more than 60% in the past twenty years.

BOX 1.1

How Successful Energy Efficiency Policies Were Identified and Analyzed

The purpose of this study is to determine what policy changes make a difference in countries' energy intensity. The starting point for the analysis was the evolution of countries' energy intensity over time to identify inflection points when notable changes took place. Given that the inflection point could have been caused by external price shocks or structural changes, these causes were analyzed and removed from further consideration. Then changes to the policy agenda during identified periods were explored in an effort to identify cause and affect relationships in energy efficiency improvements.

To separate impacts of energy efficiency and economic structural changes on observed changes in energy intensity, the country case-studies drew on a methodology developed by the ODYSSEE MURE project*. ODYSSEE estimates the energy intensity at constant structure. It is a theoretical intensity that would result from all sectors growing at the same rate as GDP (i.e., constant GDP structure and constant structure of industry) and using the actual values of sectoral intensities. Separating the impact of structural changes on energy intensity allows one to assess the importance of energy efficiency policies in decreasing energy intensity.

The MURE database was used as a primary source of energy efficiency policies. MURE contains information on energy efficiency programs and cross-cutting measures; it is structured by energy end-use sector (households, transport, industry and tertiary) and enables identification of energy efficiency measures by sector. For each policy, MURE provides a detailed description and assigns an impact rating. For the time period studied, only high and medium impact energy efficiency interventions were selected for analysis.

The selected policy measures were analyzed, drawing on existing literature and evaluations performed by different agencies. Emphasis focused on implementation experience of the selected programs. For each intervention, the following areas of interest were explored: (i) rationale and objective (market failures addressed; targeted areas/agents; expected outcomes); (ii) design (expected cause-effect relationship between policies introduced and issues addressed); (iii) monitoring, evaluation and verification mechanisms; and (iv) results (was the expected cause-effect relationship achieved; what factors were essential for the intervention's success; cost of the program). Due to limited availability of detailed data, it was difficult to disaggregate the impact of each particular policy measure in cases when a number of policy measures were simultaneously introduced. However, the analysis benefited from the multi-country nature of the assessment: if a policy intervention consistently arose across countries, it was taken as a good indication of the relative success of this measure. Combining this analysis with a review of evaluations of the measures, it enabled the identification of the most effective energy efficiency policy interventions.

* The ODYSSEE MURE project is designed to monitor energy efficiency trends and policy measures in Europe. Energy agencies from the 27 EU Member States plus Norway and Croatia participate in the project. The MURE (Mesures d'Utilisation Rationnelle de l'Energie) database provides information on energy efficiency policies. ODYSSEE has defined a set of comparable energy efficiency indicators to monitor energy efficiency trends.

BOX 1.2

How the Countries Case Studies Were Selected

The report was designed to draw on country examples that had a proven track record of success in energy efficiency to provide evidence based solutions for Bank client countries. The study focused on countries that had made significant improvements in their energy intensity from 1990-2007. EU-12 countries that had made the biggest improvements had starting points that are similar to that of many of our client countries of today, making these examples particularly interesting as it helps guide a process rather than a final result. The EU-15 examples help guide client countries that are preparing to take on the second generation of reforms. The EU-15 case studies also provide guidance to countries taking on the first steps as some "leap-frogging" may be possible to accelerate implementation. In addition, the country selection tried to avoid duplication and focus on countries where more information was available.

Change in Energy Intensity in EU-15 Countries between 1990 and 2007

Country	1990	2007	% change
Ireland	0.16	0.08	-48
Luxembourg	0.21	0.12	-43
United Kingdom	0.15	0.1	-34
Germany	0.17	0.12	-30
Sweden	0.22	0.16	-28
Denmark	0.13	0.1	-22
Netherlands	0.17	0.13	-21
Belgium	0.19	0.16	-17
Finland	0.24	0.21	-15
France	0.16	0.13	-15
Greece	0.12	0.11	-11
Austria	0.13	0.11	-10
Italy	0.11	0.1	-4
Spain	0.12	0.11	-4
Portugal	0.11	0.11	0
Average	0.16	0.12	-22

Source: World Bank.

The decrease in the average energy intensity in EU-15 countries from 1990-2007 was 22%. The biggest improvement was achieved by Ireland (48%), Luxembourg (43%), UK (34%), Germany (30%), Sweden (28%) and Denmark (22%).

According to International Energy Agency report on "Implementing Energy Efficiency Policies 2009", Ireland, Germany and Sweden decreased their energy intensity primarily due to improving energy efficiency of their economies as structural changes contributed to less than half of the total reduction in energy intensity. In the UK, the decrease in energy intensity was mostly due to structural changes (e.g., decreasing share of heavy industries in GDP). Hence, among EU-15 countries the following were selected for the case-studies: Denmark, Germany, Sweden and Ireland. Denmark was added to the list of case studies based on its level of improvements, its low energy intensity and its focus on the difficult buildings sector.

Change in Energy Intensity in EU-12 Countries between 1990 and 2007

Country	1990	2007	% change
Estonia	0.6	0.21	-64
Latvia	0.31	0.13	-56
Lithuania	0.37	0.17	-53
Poland	0.33	0.16	-51
Romania	0.36	0.18	-51
Slovak Republic	0.32	0.17	-47
Bulgaria	0.46	0.27	-43
Czech Republic	0.29	0.19	-33
Hungary	0.22	0.15	-33
Malta	0.15	0.1	-31
Slovenia	0.17	0.14	-20
Cyprus	0.14	0.13	-7
Average	0.31	0.17	-46

Source: World Bank.

The decrease in the average energy intensity of the EU-12 countries from 1990-2007 was 46%. The biggest improvements were achieved by Estonia (64%), Latvia (56%), Lithuania (53%), Poland and Romania (51%). Much of the success in the EU-12 countries is attributable to their economic growth following the initial decline in the early 1990s. However, energy price shocks in the 1990s led to considerable market response after a lag in the adjustment phase. Among EU-12 countries-champions in decreasing their energy intensities, Lithuania was selected from its neighbors on the Baltic Sea (Estonia and Latvia) since their approaches were similar and more information was available on Lithuania's energy efficiency program. Poland and Romania were selected because of the high rate of improvements from 1990-2007.

Endnotes

1. Bottlenecks to energy efficiency identified in the literature include: (1) high transaction costs; (2) the "landlord-tenant problem"; (3) sub-optimal information sharing; (4) inadequate policies, such as energy price subsidies; and (5) availability of financing.
2. Unless otherwise stated, GDP is measured as 2005 US$ in Purchasing Power Parity terms.
3. ECA countries refer to those in the World Bank's Europe and Central Asian region that borrowed from the Bank between 1990-2007, and include: Albania; Azerbaijan; Bosnia and Herzegovina; Croatia; Czech Republic; Estonia; Kazakhstan; Montenegro; Kyrgyzstan; Latvia; Macedonia; Moldova; Poland; Russia; Turkey; Turkmenistan; Ukraine; Uzbekistan; Armenia; Bulgaria; Georgia; Kosovo; Lithuania; Romania; Serbia; Slovenia; Slovakia; and Tajikistan.
4. There is one additional outlier in the EU-12: Bulgaria, whose reforms appear to be lagging behind those of other EU-12 countries.

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CHAPTER 2

Low, Medium, and High Energy Intensity Country Characteristics[1]

Convergence of Energy Intensity

The energy intensities of EU countries generally show an interesting phenomenon: convergence (see Figures 1.3 and 1.4).[2] In 1990, twelve[3] of the EU-15 countries had energy intensities that differed by 0.11 kgoe/GDP (0.11-0.22 kgoe/GDP). By 2007 the energy intensity of these same countries converged nearly three-fold as they differed by only 0.4 kgoe/GDP (0.10-0.14 kgoe/GDP). Similarly, EU-12 countries had a wide range of energy intensities in 1990, differing by 0.56 kgoe/GDP,[4] dropping more than four-fold to 0.13 kgoe/GDP by 2007.

However, the energy intensities of the non-EU countries studied are not converging. As a group, the energy intensity of Ukraine, Belarus, and Moldova has improved by about 40 percent, similar to the EU-12 countries' improvement. However, the disaggregated data tell a dramatically different story: Belarus improved its energy intensity by 64 percent, Moldova by 55 percent, and Ukraine by 27 percent. Belarus provides an interesting example, as its success has been driven more by government fiat than market forces (see Box 2.1).

Is Convergence Desirable?

Convergence of EU countries' energy intensity is a result of a common desire to target excellence. The process of establishing EU Directives involves considerable dialogue among experts in many countries, all

BOX 2.1

Belarus Versus Ukraine: Commitment to Energy Efficiency Matters

In 1990, the energy intensities of Belarus and Ukraine — at 0.68 and 0.6 kgoe/GDP, respectively — were both more than double the world average. The high energy intensities in Belarus and Ukraine were attributable, in part, to historically low energy prices, which had biased the incentives in favor of inefficient and energy-intensive technologies.

By 2009, however, the picture changed: while Ukraine's energy intensity remained more than double the world average (0.45 kgoe/GDP), the energy intensity of Belarus had fallen to 0.24 kgoe/GDP, below the ECA average of 0.27 kgoe/GDP. The difference in energy intensity decline between Belarus and Ukraine is primarily explained by Belarus's strong systematic and political commitment to improving energy efficiency (EE). The Committee for Energy Efficiency was created in 1993 (currently the Department of Energy Efficiency under the Committee for Standardization) to develop and implement the EE strategy. The government prepared three National Programs for Energy Savings, the first in 1996, and updates in 2001 and 2006. The "Law on Energy Savings of the Republic of Belarus" was adopted in 1998. In addition, a State Program of Conversion of Heat-Only Boilers into Combined Heat-and-Power Plants for 2007-2010 was adopted in 2007. Also in 2007, the State Energy Generation Assets Modernization Program was launched to upgrade power supply systems.

From 1996-2008, about US$ 4.2 billion was invested in improving EE in Belarus; financing of EE measures increased from US$ 47.7 million in 1996 to US$ 1.2 billion in 2008. Roughly 50 percent of total EE financing came from state sources. As a result of the implementation of the three National EE Programs as well as State Conversion and Generation Asset Modernization programs, Belarus succeeded in improving the performance of its energy sector and decreasing the energy intensity of its economy.

The Government of Ukraine has made it a strategic priority to reduce energy intensity, but its approach to improving EE has been slow, piecemeal, and without strong financial commitment from the state. In 1994, the "Law on Energy Conservation" was adopted, followed by creation of the State Committee on Energy Conservation in 1995. In 1997, the Comprehensive State Energy Efficiency Program was approved, which outlined the strategy of decreasing energy consumption in industrial, energy, and housing sectors. In 2005, the National Agency of Ukraine for the Effective Use of Energy Resources, now the State Agency of Ukraine for Energy Efficiency and Energy Conservation (SAER), was established. In 2006, the Energy Strategy to 2030 was adopted, in which the government set a target of decreasing Ukraine's energy intensity by 50 percent by 2030. The Energy Strategy estimated that it would require about US$ 2.5 billion in EE investments annually to achieve this goal, but failed to identify sources of financing or a monitoring framework. As a result, the funds to EE measures were assigned on ad hoc basis and often fell below necessary levels to meet the established targets. For example, in 2009 and 2010, about US$ 0.6 billion was invested each year in EE improvements in Ukraine, most of which was financed by companies and households. In general, state sources have contributed about 10-15 percent of the total EE investment. Although Ukraine's population is roughly four times that of Belarus, its investment in EE is roughly half.

These contrasting examples indicate the importance of government commitment, good governance, and dedicated financing.

Source: World Bank.

striving for improvements. This framework enables cross-fertilization of ideas and draws on a diverse set of views in the interest of establishing a common good. The results speak for themselves. Both EU-15 and EU-12 countries made remarkable progress in reducing their energy intensity during the period under study. Convergence is likely the byproduct of a successful policy process.

Adoption of a common set of policies instituted through EU Directives is an important component of the road to convergence. EU-15 countries have a history of quickly adopting EU policies into their national legal frameworks. Rapidly implementing the enabling environment helps give early adopters a competitive advantage in implementing new technologies. Investors see less risk in these markets, as the legal basis is strong, as is the support for implementation. Denmark and Germany provide particularly good examples of this; the governments are not reactive to the establishment of EU policies, but rather proactive. By getting involved in the early stages of policy development, Denmark and Germany find themselves well-placed to implement the policies efficiently.

An increased openness to trade, moving away from favoring domestic suppliers, results in a common adoption of technologies. Breaking down the barriers to trade and ensuring that governments don't influence commercial practices results in industries implementing state-of-the-art, low cost technologies to gain market share and increase profits. As a result, most industries replace outdated technology with best available technology. Furthermore, industries are less hesitant to export to countries in which there is perceived to be a high respect for private property and intellectual property rights. This leads to the use of a relatively common set of technologies across countries, as equipment costs tend to be similar, thus also causing some of the convergence seen in EU countries' energy intensities.

Convergence and Good Governance

Higher income EU countries have increased the incentives for energy efficiency by internalizing environmental impacts through energy taxes. Sweden initiated environmental taxes as early as the 1950s. Germany introduced an environmental tax in 1999 after considerable public debate. The dialogue with civil society resulted in an interesting solution that achieved broad-based support. The tax was designed to be nearly (90 percent) revenue neutral and the revenues were used to support reduced pension payments by employers and employees. Careful design of environmental taxes, coupled with a patient outreach program, can deliver multiple benefits.

Top tier governments go beyond the dutiful implementation of EU Directives: they help set policies. The low energy intensity countries are actively engaged in developing new policies. They implement these policies into their legal and regulatory framework faster than medium energy intensity countries, which often take years to transpose EU Directives into law. Active engagement in the early stages of policy formulation helps accelerate implementation and achieve results.

The EU's Building Certificates Program is designed to help address two energy efficiency bottlenecks associated with the need to upgrade the existing building stock: the information gap and the landlord-tenant problem. This program is in its early stages of implementation, with the more aggressive countries showing success and the more passive countries failing. The program is designed to provide information about buildings' energy use to new owners or tenants at the time of either a sale or rental of property. The less successful programs — as in Poland — provide limited information, with unreliable data about building energy use; allow provisions to circumvent the system; and have inadequate outreach programs. Successful programs — as in Ireland — do the opposite: an outreach program is designed to address the information gaps; Buildings Certificates provide accurate, reliable information; and the program is viewed as a benefit to society, not a burden imposed by the EU. Although still in its early and quickly evolving stages, the Buildings Certificate Program shows promise in addressing some of the critical bottlenecks in achieving energy efficiency gains in buildings.

Piloting innovative programs helps push the frontier of energy efficiency programs, as was the case with the White Certificates programs developed in the U.K., France, and Italy. These programs obligated energy suppliers to enable their customers to reduce energy consumption by a target level of roughly 1 percent per annum. These programs were initiated before 2005, thus providing evidence that the proposed energy efficiency targets were feasible, as the White Certificates programs were all successful. This favorable experience was noted by the Government of Poland, which subsequently implemented a White Certificates Program based on the experience of others, and embedded it in its Energy Efficiency Law passed in May 2011.

Denmark has achieved similar energy efficiency results by establishing energy efficiency obligations for energy supply companies without White Certificates. The obligation scheme, introduced in 2005, involves energy supply companies in four supply sectors: electricity, district heating, gas and oil. They are to reduce final consumption of their consumers by 1.2 percent annually till 2012; and by 1.8 percent per year from 2012 onwards. The energy companies have freedom to choose which energy efficiency measures to implement and how they are implemented. Most typical measures include energy audits, targeted information campaigns

and subsidies; the companies could use their own energy efficiency service companies or outsource energy efficiency services. The "additionality effect" is high: about a half of the recorded savings at end-user level would not have been realized without interventions by energy companies.

The White Certificates and Denmark's obligations programs, help establish near- to medium-term targets. A good example is the EU's target to decrease energy consumption by about 1 percent per annum from 2008-2016. EU countries agreed to this target and prepared reports indicating interim results for the first three years (2008-2010). These reports are available in the public domain and indicate that most countries are on track to meet the target. However, the success in the first three years may be attributable to the economic slowdown during this period, and may not be as easy to sustain over the next five years. The success of the White Certificates programs showed that such goals were achievable.

Successful EU-15 countries set energy efficiency targets, both long-term and medium-term, and monitor and evaluate the Action Plans designed to achieve these targets. Germany set targets under its voluntary energy efficiency program for industries and later followed this with CO_2 reduction targets with policies and programs designed to meet these targets. Longer-term targets are also used to help drive Research and Development programs; e.g., the EU's "nearly-zero energy building by 2020" program. Each country will define what this standard means for its particular circumstances, taking into account local temperature effects, and will then design a program to achieve this target. Denmark's building efficiency program is a good example of a country's commitment to this goal.

All EU-15 countries analyzed in this study strongly support the institutional capacity needed to guide the implementation of their energy efficiency targets. A clear mandate for supporting the implementation of energy efficiency targets has been met through the establishment of an entity responsible for oversight of the program. This was followed up with adequate budget and staffing, but included responsibilities and accountability once the resources were in place. Sweden and Ireland are good examples of establishing institutional capacity and following it with adequate budgets. Furthermore, Sweden's Energy Agency has actively supported inter-Ministerial cooperation, recognizing that energy efficiency programs cut across nearly all aspects of the government: Economy to get the incentives right; Finance to ensure the financial support is adequate; Industry and Commerce to ensure that energy efficiency is taken on by businesses; infrastructure to make sure the supply-side and services are efficient; and buildings. Sweden also fostered vertical coordination among government entities from the Federal to County to Municipal levels.

Energy efficiency pilot programs must be designed well to achieve favorable results. Information dissemination is often not adequately addressed in energy efficiency pilot programs. Energy efficiency pilot programs tend to be small and ad hoc and thus have limited impacts, resulting in limited market penetration. The more successful programs are based on a more comprehensive design that improves institutional support, better governance, and adequate funding, all of which are incorporated at the design concept stage. For example, Lithuania undertook a broad-based program of energy efficiency pilots for building upgrades, coupled with the creation of institutional support and budget allocation. Its "poster example" is an apartment building with 60 m^2 apartments that reduced its energy consumption from 35 kWh/m^2/month before upgrading to 8 kWh/m^2/month, and reduced its heating cost from 510 Lt/month (147€/month) to only 115 Lt/month (33€/month) after upgrading.

Sequencing Convergence

Energy efficiency gains in the industrial and commercial sectors were the first targets for EU-12 countries. Market forces provided the incentives for commercial entities to decrease their cost of production to enable them to capture market share, particularly for commercial entities in which products have been commoditized, like steel and cement production. Opening markets to increased competitive pressures helped facilitate these gains. In addition to cost reduction, structural changes to the economy also took place as formerly protected industries were closed or their production scaled back when subsidies were eliminated.

Industrial sector reforms can be characterized by two separate sets of actions: reforms that did not focus on energy efficiency, but achieved energy efficiency results and reforms designed directly at energy efficiency. The indirect reforms occurred as a result of reforms that had a broader mandate of economic efficiency in the industrial sector. Governments implemented reforms that broke down barriers to competition, breaking up monopolies where feasible and decreasing barriers to trade. Coupling these reforms with privatization of the means of production enabled much economic efficiency to take place as nonviable industries were restructured or closed and new industries grew from new investments, responding to changing demands. Industries using outdated technologies were closed and replaced by more efficient processes, including a reduction in energy use in response to higher energy prices. New industries grew out of evolving customer demand, including energy efficiency products. For example, in Lithuania, soon after the building energy effi-

ciency program was started, local manufacturing of energy efficient windows started. As district heating companies focused on reducing losses, local manufacturing of pre-insulated pipe was initiated.

EU-15 countries, however, have focused their efforts on improving the energy efficiency of their industrial sectors through more direct interventions. For example, the Government of Sweden has played an important partnership role with the industrial sector to promote energy efficiency by establishing the Program for Energy Efficiency Improvement for Energy-Intensive Industries. This program was initiated in 2005 after the 2004 introduction of an energy tax on electricity. Participating companies are exempt from this tax if they enter into the program. In the first two years of this five year program, an Energy Management System must be introduced and an energy audit undertaken; in the second, three-year stage, after review by the Swedish Energy Agency, the energy efficiency investments are implemented. At the end of the five year period, a report on the results is delivered, enabling the company to enter into a second five year program. It is estimated that 1 TWh per year of energy is saved under this program, reducing GHG emissions by 0.5-1.0 million tons per year. Similarly, Denmark supported energy efficiency programs in industry by providing a refund on CO_2 taxes in return for implementing energy efficiency programs.

Soon after energy efficiency measures were implemented in the industrial sector, countries moved their focus to new buildings follow soon after industrial sector energy efficiency gains. These are relatively easy targets to meet by setting building standards and carefully monitoring their implementation. The additional cost of making new buildings energy efficient is modest, typically adding less than 5 percent to the cost of a new building to decrease energy use by 10-20 percent per annum. All EU countries aggressively support effective building standards and modify them over time as new technologies and techniques become available and as energy prices rise, increasing the affordability of energy efficiency measures.

How to implement energy efficiency interventions in existing buildings is possibly the least understood process, and is usually dealt with after the industrial sector and new buildings are addressed. The literature frequently identifies such investments as “low hanging fruit,” yet the market response indicates otherwise. Energy efficiency improvements in existing buildings are much more expensive and typically require some form of financial support to enable investments to take place. Much of this has to do with overly simplistic economic analysis as, for example, transaction costs, which can add 30-50 percent to the cost, are typically overlooked.

Financing Convergence

Financial support, either through subsidies or tax incentives, is needed to penetrate the more difficult markets to address bottlenecks. Germany's program in support of existing buildings provides a good model. Its program started in the early 1990s and focused on the former East Germany. The program initially employed 20 percent subsidies for individual energy efficiency investments. This program evolved into low interest loans (1.5 percent below market rates) and expanded coverage to all of Germany. In 2001, the program was replaced by a CO_2 reduction program, in which packages of measures ranging from insulation and window replacement to boiler equipment replacement were introduced. The 2001 program was designed to enable the building stock to meet the upgraded building standards introduced in 2002. The program has met with considerable success, with average dwelling energy consumption reduced by about 20 percent.

Poland's Thermo-modernization and Rehabilitation Fund (TMF) is a similar mechanism designed to support upgrades to upgrade existing buildings. The TMF provides a 15 percent grant, coupled with commercial loans to facilitate investments in reducing energy consumption in buildings. The program is also a good example of good governance: the program started slowly and was upgraded over time to better meet the needs of consumers. It is now supporting close to US$ 1 billion per year in funding for renovating the building stock, of which US$ 150 million comes from budget resources.

Low-cost financing alone isn't enough. Banks that have successfully penetrated energy efficiency markets have made it an important business line. This requires training of staff, outreach to potential customers and advice on investment options. They also ensure that the transaction costs associated with borrowing is low. A good example of this is a system in which a bank offers credit for standard energy efficiency products. This helps with the customer information problem as well as decreasing the transaction cost.

Endnotes

1. The study was initiated by undertaking desk studies of nine of the ten countries: four EU-15 countries, three EU-12 countries and two ECCU2 countries. The excluded country — Moldova — has not seen any significant Bank involvement in energy efficiency in the recent past. The studies resulted in separate 80-100 page reports for the EU countries and shorter papers for Ukraine and Belarus. The information base for the EU-15 countries was more robust than that of the EU-12 countries during the 1990s, as some EU-

12 countries were establishing new administrations and all were recovering from major upheavals — both political and economic.

2. The biggest variations in countries' energy intensities appear to be driven by climate considerations: cold countries like Sweden, Finland, and Estonia have high energy intensities, while island states like Malta, Cyprus, and Ireland have the lowest energy intensities. Countries that have long, cold winters need to make special efforts to reduce the energy consumption of buildings.
3. The three exceptions are: Finland and Sweden, which have high energy intensities caused by the impact of long, cold winters on heating needs in buildings; and Belgium.
4. Estonia was the highest, at 0.60 and Malta the lowest, at 0.14.

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CHAPTER 3

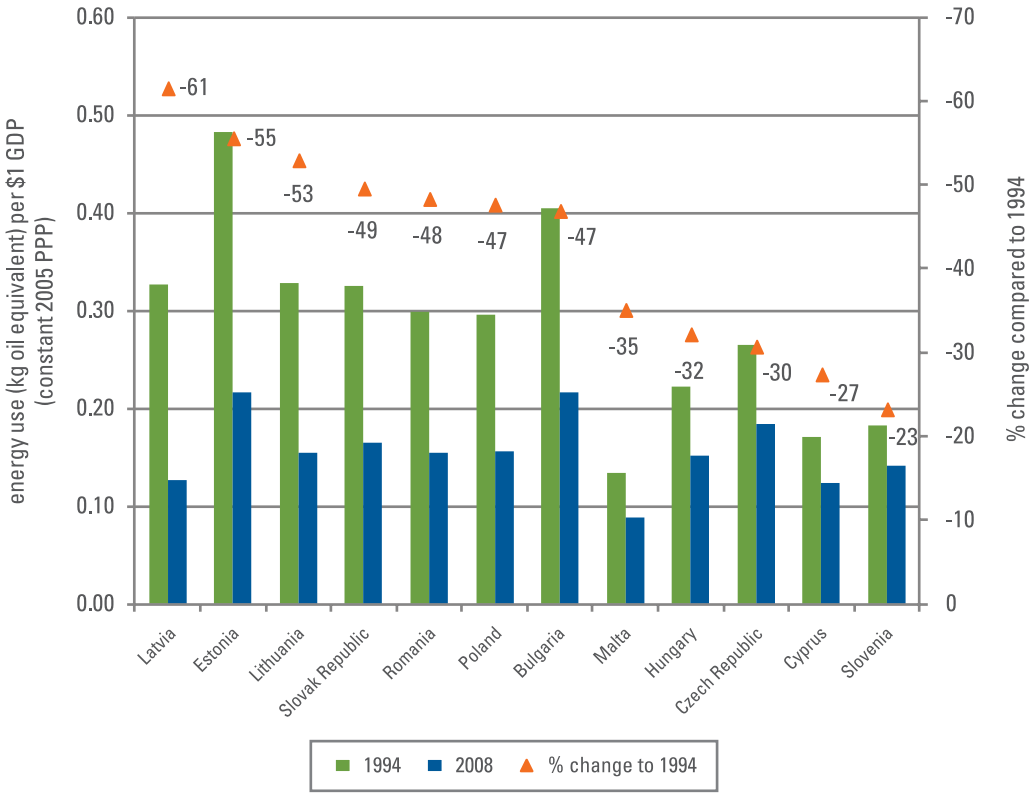
Moving from High to Medium Energy Intensity

Eleven Actions that Most Enable Countries to Move from High to Medium Energy Intensity

1. Quickly increase energy prices to fully cover the short-term cost of supply
2. Establish an entity responsible for guiding an energy efficiency program
3. Establish energy efficiency targets
4. Establish a National Energy Efficiency Action Plan
5. Upgrade the legal and regulatory framework to support energy efficiency
6. Create a monitoring and evaluation program to support implementation, and adjust the policy framework as needed to support meeting energy efficiency targets
7. Privatize the commercial sector to facilitate structural reforms
8. Remove trade barriers to facilitate competition
9. Implement consumption-based billing for households
10. Provide low cost financing for energy efficiency investments in buildings
11. Provide energy efficiency informational support to consumers

There have been impressive improvements in the energy intensity of all EU-12 countries from 1994-2008 (see Figure 3.1). The most successful examples are the three Baltic States: Latvia, Estonia, and Lithuania. Their starting points in 1994 were among the highest of this group, indicating considerable potential for improvement. In 1994, many EU-12 countries had energy intensities in the 0.30-0.48 range, while Estonia's was more than double the global average at that time. The energy intensities of the six highest countries all reduced by an incredible 47 to 61 percent. By 2008, the energy intensities of EU-12 countries were 22 percent lower than the global average.

FIGURE 3.1
EU-12 Comparison of Energy Intensity, 1994 Versus 2008



Source: World Bank.

Lithuania (as well as Latvia and Estonia) and Poland used a "Big Bang" approach to reforms, such that most prices were set to reflect the cost of supply. In addition, enterprises that were not financially viable were

closed and markets were opened to increase competition. The dislocation was massive, with the size of economies dropping by roughly 40 percent during the late 1980s (Poland) and the early 1990s (Estonia, Latvia, and Lithuania). Unemployment jumped to levels unheard of in the decades prior to the Big Bang.

Energy prices for industries were immediately adjusted to reflect the long-run economic cost of supply. By setting price signals that reflected a new norm, the governments provided incentives to get the capital/operating cost/labor cost mix right so that new investments would be sustainable and the necessary structural reforms would be clear. Closing commercially nonviable industries caused short-term problems, increasing both unemployment and poverty. However, new opportunities arose soon thereafter, particularly in service industries.

Privatization of industry was an important component of energy efficiency programs as it accelerated the impact of structural changes. Privately owned companies moved quickly to close non-viable production facilities, stripped out assets that were not viable or part of their core business, and invested in new assets to take advantage of market opportunities.

Countries with high levels of energy intensity often do not bill energy use based on consumption, but instead use a proxy: for example, the size of an apartment determines heating bills, rather than consumption levels. Billing for energy consumption by households should be based on consumption to provide an incentive to avoid wasting energy. Successful EU-12 countries quickly implemented building-level metering and temperature controls. Typical initial energy savings were in the range of 15-25 percent, with payback periods of roughly two years, simply by changing the incentive for households to control energy usage. This helped customers address affordability issues, changed behaviors, and motivated low-cost, short payback investments in energy savings. Over the longer term, energy savings in buildings have been greater than 50 percent.

Targeting a 50 percent decrease in energy consumption in buildings within ten years is reasonable and feasible. Lithuania's "poster example", in which energy consumption decreased more than four-fold, clearly demonstrates the energy savings potential in buildings. Although likely a "best case" example, it illustrates the size of the potential energy savings through building retrofits. Energy consumption statistics further substantiate this claim. Many buildings in Ukraine consume 270 kWh/m^2 per year or more, well above the average rate of energy consumption of buildings in Poland (150 kWh/m^2). Even this level is still not state-of-the-art: Denmark's building efficiencies are typically less than 100 kWh/m^2. By 2020, when the "nearly-zero energy" building targets are imple-

mented, the target for energy efficiency of buildings in the EU is expected to be about 40 kWh/m^2.

Nearly all successful countries used low cost financing to support building upgrades. In higher income countries, the source of funds largely came from the budget, as was the case in Germany and for Poland's TMF. During the transition period, donor support helped jumpstart these programs through funding for pilot schemes and capacity building. Low cost funds designed to support the reduction of greenhouse gases (e.g., Global Environment Facility and Clean Technology Fund were also used to decrease financing costs.

A good example of such financing is Poland's Thermo-modernization and Renovation Fund (TMF). This fund has been in place since 1998, and has evolved over time to better target a variety of markets. The initial uptake for this fund was slow, despite the fact that the grant element was as high as 30 percent of the project cost. However, since the grant element was not seen until after implementation was completed, customers faced affordability issues. Once this problem was addressed by making the grant element available to finance the investment costs, the uptake of the TMF accelerated and the grant element was reduced to 16 percent.

Good governance is an important component of successful energy efficiency programs, starting with the establishment of a responsible entity. All successful countries established a modestly sized entity, either within a ministry responsible for energy policy, or by creation of a separate government-owned agency. The Energy Efficiency Agency (EEA) is given a clear mandate by the government, and is made responsible for designing an energy efficiency program and achieving its results.

Governments, with the advice of their EEA, should set short- and medium-term targets. EU countries committed to decrease energy use by 9 percent from 2008-2016 (1 percent per annum) and targeted a 20 percent decrease in energy use by 2020. Although these are not legally binding commitments, countries have put the infrastructure and programs in place to achieve these targets and monitor the implementation of their programs to ensure they are on track. Romania, Lithuania, and Poland all prepared National Energy Efficiency Action Plans (NEEAPs) in 2007 to meet the EU Directive requirement, identified specific targets, and assigned an agency to establish an Action Plan to meet the targets and monitor and evaluate the program during implementation. All EU countries reported their progress after the first three years of implementation, with reasonably successful results reported in 2011. Poland has established notable achievements, reporting energy efficiency improvements of 5.9 percent in the first two years of its 2008-2016 energy efficiency improvement program.

To meet their energy efficiency targets, EEAs established NEEAPs outlining the measures that would be taken to meet their targets. However, the success of a NEEAP depends on how seriously it is taken by the government. In some countries, it appears that the government has prepared a NEEAP to "check off boxes" for the sake of EU commitments. Countries that have been successful in reducing their energy consumption took their NEEAPs more seriously.

Once a NEEAP is established, a government can modify or update its legal and regulatory environment by amending or creating primary and secondary legislation. The more successful countries implemented these changes faster than others, depending on their institutional capacity or political rigidities. Since the creation of such laws tends to be time consuming, a knowledge base should be established in which relevant legislative packages are made available to guide other countries.

After legal and regulatory changes take place, the EEA is responsible for monitoring and evaluation of the program. Active monitoring and evaluation programs are characteristic of all successful countries. Given that the EEA is responsible for the success of the NEEAP, successful countries closely monitor results and adjust the design of the program and, if needed, update the legal environment. Even the best-designed programs require modifications as experience evolves: program design is not a one shot effort. The top performing countries treat their legal and regulatory framework as dynamic (e.g., Sweden and Germany); they constantly monitor results, evaluate the impacts, and modify the framework to improve results over time.

EEAs actively provide information to the population at large to inform them of opportunities to save energy. Typically, EEAs use traditional media to encourage households to reduce their energy use (e.g., by using efficient lighting, improving insulation in homes, and installing energy efficient windows). Even more aggressive outreach programs are implemented by the low energy intensity economies: a considerable effort at outreach is required to change consumer behavior. Once behavioral changes have taken place and a "tipping point" established, the resources needed to maintain this impact are reduced.

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CHAPTER 4

Moving from Medium to Low Energy Intensity

Eleven Actions that Most Enable Countries to Move from Medium to Low Energy Intensity

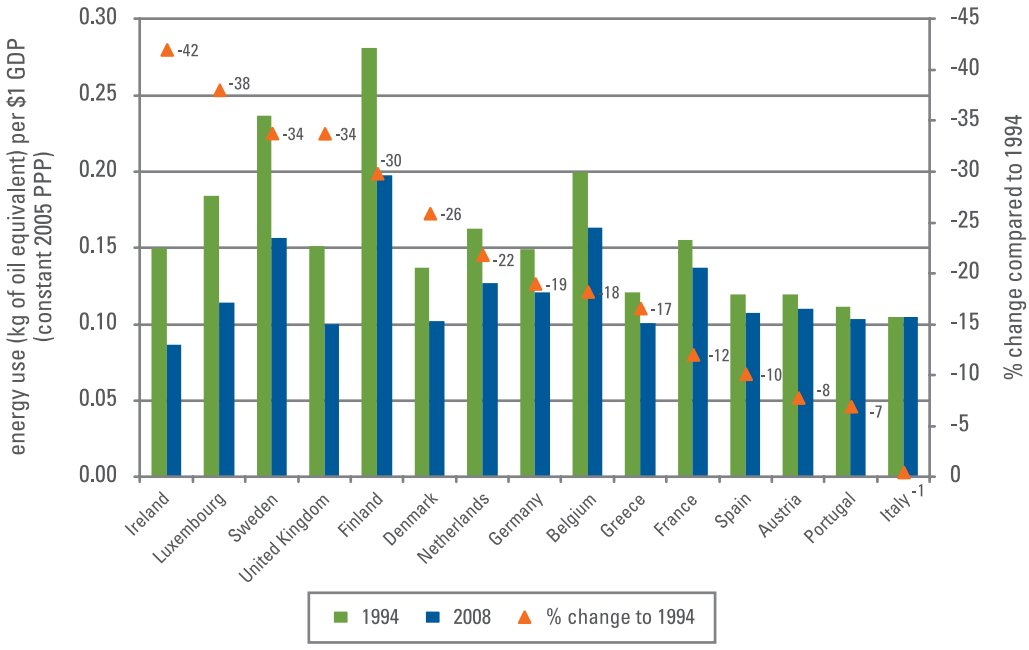
1. Add the cost of environmental externalities to energy prices
2. Actively engage in policy setting in international for a
3. Improve communications links among ministries
4. Promote good vertical coordination among different levels of government
5. Decentralize decision making
6. Facilitate networking/clustering among industries
7. Establish energy efficiency obligations for energy suppliers
8. Encourage the use of ESCOs
9. Encourage Building Certificates programs, which show promise
10. Establish appliance standards
11. Implement social networking tools

The energy efficiency improvements of EU-15 countries from 1994-2008 has been impressive (see Figure 4.1). This has been accomplished by deepening the energy efficiency policy agenda to support the transition from medium to low energy intensity levels.Fewer structural changes take place in this phase and there is a shift in emphasis from the industrial sector to households. Increased affordability enables an increase in market penetration and results in less push-back for higher energy prices.

Environmental taxes are added to energy prices so that the cost of the associated environmental impacts of energy use is also included in the price. Price increases designed to include an environmental component appear to have differing levels of acceptability by civil society, depending on the country. In Sweden, environmental taxes were included in energy prices during the 1950s, reflecting a long-standing respect for environmental concerns. Denmark introduced energy taxes in 1977. In Germany, environmental taxes were added in the 1990s after considerable debate within civil society.

Interesting tactics were employed by governments to ensure that environmental taxes were politically acceptable. Revenue neutrality was an important component of adding these taxes: other tax burdens were reduced to compensate. The governments' purpose in establishing envi-

FIGURE 4.1
EU-15 Comparison of Energy Intensity, 1994 Versus 2008



Source: World Bank.

ronmental taxes was not to increase revenue but to shift the incentives regarding the environmental impact of the type of energy used. By explicitly reducing other taxes, the governments made environmental taxation more palatable. In the 1990s, after considerable debate, the Government of Germany made environmental taxes acceptable by applying the increased revenue to pensions, reducing the pension cost burden for employers and employees.

Low energy intensity economies are more proactive in policy setting in international fora, unlike medium-level countries which tend to be more reactive. By becoming actively engaged in policy setting in international fora (e.g., within the European Community), countries are better prepared to implement energy efficiency policies. A better understanding of the rationale behind policy changes makes it easier for countries to implement them as part of their legal and regulatory framework. Rapid implementation enables countries to achieve direct benefits sooner than in countries that take a longer period of time to implement reforms. In addition, indirect benefits are also achieved, as early adopters are better positioned to provide advisory services to others. Poland has implemented EU Energy Directives more slowly than is the case for low energy intensity EU-15 countries as a result of playing a more passive role in EU policy formulation.

Low energy intensity economies (e.g., Germany) actively support networking among industries to achieve energy targets. Germany's government worked closely with industry associations to get their agreement on voluntary emissions reduction programs in the mid-1990s. The program was estimated to cost about €1 billion per year, with the costs split between the government and industry. The results were laudable for a voluntary program, with sub-sectoral achievements ranging between 60-160 percent of their targets.

Once solid legal and regulatory frameworks that provide for fair competition and facilitate networking are established, governments with low energy intensities play a light hand in the functioning of the industrial sector. Successful industries undertake research and development with a commercial focus, often in cooperation with their customers and their equipment suppliers. Privately owned companies are nimble and best placed with regard to the idiosyncrasies of their markets and the characteristics of new technologies in their industry. Good governments monitor the competitive framework and ensure that incentives are in line with the public's best interest, and then let industry meet the needs of the market.

Successful low energy intensity countries strengthen horizontal communication links among ministries. For medium-level countries, the

coordination among sectors is not as strong as in low energy intensity countries, as their ministries typically operate largely within their independently of one another. Sweden provides a good example in addressing this issue. The Ministry of Enterprise, Energy and Communications takes the lead in coordinating energy efficiency tasks, with active participation by the Environmental Protection Agency, the National Board of Housing, Building and Planning, and the National Tax Board, as well as other government agencies, industrial and construction associations, and real estate owners. Its energy efficiency program is actively supported by the Swedish Energy Agency, which plays an important role in the day-to-day tasks associated with coordination.

As governments evolve, effective decentralization of decision making is enabled. Some countries have run into problems by decentralizing decision making prematurely, before the institutional capacity is established or before capacity-building is supported. Without this capacity, decisions tend to be based more on political expediency than on sound economics. Improving institutional capacity takes time and money, but is clearly worthy of investment. However, the process can be constrained by civil service salaries: many highly qualified staff spend a short time in civil service jobs, as salaries elsewhere are more attractive. This creates two problems: it is difficult to retain highly qualified staff, negatively impacting the corporate culture; and frequent staff turnover makes it difficult to build institutional knowledge.

Good horizontal communication is complemented by good vertical communication among the different levels of government. In Sweden's "Sustainable Municipal Program," the Federal Government coordinates its energy programs, with partnerships in 62 out of 290 municipalities. However, in some countries, the institutional capacity at the lower levels of government may be limited. The Federal Government should help facilitate capacity building in other parts of the broader governmental structure.

One of the chief differences between low and medium energy intensive countries is the success in achieving greater building efficiency. The EU's Building Certificates programs show promise in aiding this improvement; Building Certificates are designed to address a number of problems associated with getting the incentives right for building efficiency: (i) they address the landlord-tenant problem by making building/apartment energy use explicitly available at the time of a housing transaction; (ii) they establish benchmarks so others will have reasonable expectations regarding building energy efficiency; and (iii) they make information available about which building energy efficiency measures are prudent. Some countries take this a step further by establishing an online database of accredited, reliable energy efficiency auditors.

A limited number of countries have implemented White Certificates programs to accelerate their energy efficiency programs; all are reported to be successful. The White Certificates programs are designed to create obligations by energy suppliers to reduce energy consumption by their customers. These programs started in the U.K. in 2005 and have since been implemented in Italy, France, Denmark, Flanders (Belgium), and Australia. Poland introduced a White Certificates program in an Energy Efficiency Law passed in May 2011. Targets are set for energy supply companies (typically electricity and gas supply companies, but also for district heating in Poland). If they don't meet their targets, they are obligated to pay a penalty or to buy a tradable "White Certificate" from a company that has exceeded its targets. Targeted energy savings are typically 1 percent per annum. These programs impose a responsibility on energy suppliers to help their customers use energy prudently, thus moving towards an energy service operation instead of an energy supply entity. Energy utilities work closely with their customers, providing information and helping arrange financing. These programs also help facilitate a market for Energy Service Companies (ESCOs) that actively help energy suppliers meet their targets and help customers rationalize their energy use. The success of these programs is noteworthy and worth consideration by middle energy intensity countries.

Experience in implementing ESCOs has generally been less successful than hoped. Industries tend to use their own staff, working directly with their equipment suppliers to design industrial processes. Part of this is due to the fact that markets have become very competitive and margins on commodities are fairly low. As a result, decreasing costs are an important component of establishing competitive advantages in the market and most companies prefer that these advantages remain proprietary. However, ESCOs are reported to have become an important component of both "White Certificates" programs and similar programs in countries that impose energy efficiency targets on energy supply companies without certificates. Germany has made good use of ESCOs to help decrease energy use and may provide a good example for others.

Governments in low energy intensity economies played an important leadership role to set an example for others to follow. In 2005-8, Sweden provided financial support to reduce energy use in public buildings. This program included: (i) energy mapping; (ii) conversion of heating systems; (iii) implementation of district cooling; (iv) installation of energy efficient lighting; (v) implementation of energy efficiency ventilation in buildings; and (vi) improving the energy efficiency of building envelopes. Sweden followed this up with support for energy efficiency in public buildings program in 2006.

Adopting appliance standards has been an important component of energy efficiency policies in all successful countries. Germany's energy intensity made notable improvements in the 1990s when their energy appliance standards were upgraded. It is a relatively easy policy to implement as energy standards are commonly used in many countries. EU appliance standards, Energy Star standards or LEED building standards are good examples of successful programs. Denmark notes its energy efficiency standards for appliances as one of its top five energy efficiency measures.

Countries with low energy intensities are increasingly making use of non-traditional media sources as part of their outreach programs. Ireland has been identified by IEA as a best practice example for implementation of its Buildings Certificates program. Its reporting and certification program is highly automated and accessible, making good use of a website. Although expensive to set up, the website provides information efficiently and reduces administrative and users' transaction costs. In addition to website applications, Ireland has developed Smartphone applications to support energy efficiency programs.

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CHAPTER 5

The Way Forward

It is reasonable to target a 50 percent reduction in energy intensity of World Bank client countries in the ECA region by 2030. Experience over the past seventeen years shows that this target is feasible if countries are willing to make energy efficiency a priority and to draw on lessons learned from neighboring countries.

The EU provides an important platform for cooperation and learning among EU countries. How can these lessons learned be transferred to countries outside of the EU? It is recommended that the following steps be taken to leverage this experience:

1. Establish energy efficiency as "The 50 percent Solution" by targeting energy efficiency as a cornerstone of lending and technical assistance: Lending institutions and other international support organizations could benefit from the ECA country case studies and improve their approach to energy efficiency. Working with clients and partners, energy efficiency targets should be established, Action Plans developed, and lending for energy efficiency increased.

2. Learn from the good governance examples of others: Ensure that staffing and related resources are adequate, and that budgets and monitoring and evaluation systems are in place to evaluate the energy efficiency program over time. Periodic reviews of the program and follow-up to enable improvements would help ensure that the targets are met.

3. Prepare an "Energy Efficiency Ladder," ranking countries' energy intensity (see Annex 2): An energy efficiency ladder would rank countries by their energy intensity, recognizing the impact of climate

on energy use. It is proposed that this information be established on a World Bank-maintained Knowledge Sharing Platform (KSP). In addition to providing rankings, the ladder would outline the key energy efficiency characteristics of each country, addressing pricing, governance, targets, institutions, laws, and regulations. It is also recommended that the KSP would disaggregate energy efficiency statistics by sector (steel, cement, fertilizer plants, etc.) to improve specificity of energy information to help guide implementation. Four categories of energy intensities are proposed: the low intensity countries (less than 0.15 kgoe/GDP), the transitional countries (0.15-0.20 kgoe/GDP), the medium intensity countries (0.20-0.30 kgoe/GDP), and the high intensity countries (greater than 0.30 kgoe/GDP).

4. Establish an "Energy Efficiency KSP": The purpose of such a website would be to disseminate information on energy efficiency issues, outlining best practices and tailored advice that would be helpful for lower income countries. This KSP would build on the energy efficiency ladder outlined above. The site would initially be an extension of the EU practices, drawing on the EU knowledge base. The KSP would be designed to provide practical advice, primarily targeting countries in the former Soviet Union and countries planning to join the EU. Although it is proposed that this site start with ECA countries, the design should allow other regions/countries to join as it evolves.

5. Outline energy efficiency policy options and provide links to good practice legislation: Drawing on the database of policy options implemented by countries studied, the pros and cons of each approach can be outlined. For each policy option, a brief description of how it has been applied should be presented. Good practices should be identified on the KSP, including information that would be relevant to the Bank's clients, such as links to primary and secondary legislation and NEEAPs in countries that have achieved notable success. The list of policy options would provide a template for reviews of client countries' energy efficiency policy environment so that policy gaps and opportunities can be identified.

6. Add more country case studies and deepen the analysis: The initial analysis focused on six country case studies. During the study, interesting additional examples arose: e.g., Denmark's building efficiency program, the U.K.'s White Certificates program, and the emergence of Belgium and Bulgaria as outliers. Limited analyses were undertaken of countries with high levels of energy intensity as it was assumed they would not provide much, if any, useful information on

good practices. However, once the KSP is established, it would be helpful to undertake pilots in three to six countries in which the lessons learned could be applied. Furthermore, the studies undertaken to date have been limited to desk studies because of budget limitations; more detailed analysis would be helpful, budget permitting.

7. Partner with the EC, European Investment Bank, International Energy Agency, European Bank for Reconstruction and Development, and bilateral donors: Since the starting point for these "good practices" are all in EU countries, it is proposed that the Bank explore a working relationship with the EC to develop the proposed KSP. The primary audience, from the perspective of the EU, would be countries that are considering EU Accession. It is proposed that the tool be used to help these countries make a successful transition by drawing on EU good practices. This approach would be extended to countries in the EU neighborhood as well. It is also proposed that the KSP draw on the energy efficiency chapters of IEA country reviews.

8. Develop the KSP to assist the development of products: The KSP would lend itself well to providing Technical Assistance. If Technical Assistance evolves well, and there is a demand for it, the studies could be used to develop a program of policy reforms that could be supported through Bank loans. Once the policies have been put in place, support for energy efficiency could follow with Program for Results Loans and/or Investment Loans, including loans to financial intermediaries.

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ANNEX 1

Summary of Lessons Learned from the Country Case Studies

Denmark

Energy intensity of Denmark's GDP is among the lowest in the EU. Denmark's final energy intensity declined by 22 percent from 1990-2009. Overall, the evolution in Denmark's primary and final energy demand and primary and final energy intensity is in line with the average of EU-15 countries. The main elements of Denmark's energy efficiency programs and main lessons learned include:

1. **Broad political consensus involving Government and opposition parties is essential for successful implementation of energy efficiency policies.** The political agreement of February 2008 set a target to reduce total final consumption (excluding transport) by 1.5 percent annually through 2013 by improving energy efficiency.

2. **Evaluating impacts and efficiency of energy efficiency interventions through the entire portfolio of policies (as opposed to only selected measures) gave way to findings that would otherwise not have been captured.** Danish Energy Agency reviewed portfolio of Danish energy efficiency measures in 2008. It ranked their socio-economic cost-efficiency from most efficient to least efficient as follows: (i) energy audits and tax rebates for industry, (ii) energy efficiency obligation scheme on energy suppliers, (iii) energy savings in the public sector, (iv) energy labeling of appliances, (v) Electricity Saving Trust (consumer information), (vi) building codes, (vii) energy labeling of buildings. The cost efficiency ratio of energy labeling of buildings was found to be substantially higher than 1.

3. **Energy taxes are used in all sectors; without them Danish energy consumption would be at least 10 percent higher.** Compared to other EU countries, Denmark stands out as making little use of public finance instruments and subsidies in its energy efficiency policies; whereas fuel and electricity taxation is among the highest in the EU. In 1977, energy tax was introduced to residential sector; in 1996, CO_2 tax was introduced to all sectors. There are taxes on all fossil fuels and high tax on residential and public electricity consumption.

4. **EE-Agreements with Industry on CO_2 reductions, combined with CO_2-tax, have been effective.** Energy efficiency agreements between industry and Danish Energy Agency provide energy intensive industries with an opportunity for a refund in their CO_2 tax in return for implementing measures such as energy management, etc.

5. **The Danish energy efficiency obligation scheme for energy supply companies provides a half of all annual savings in Denmark.** The obligation scheme, introduced in 2005, involves energy supply companies in four supply sectors: electricity, district heating, gas and oil. They are to reduce final consumption of their consumers by 1.2 percent annually till 2012; and by 1.8 percent per year from 2012 onwards. The energy companies have freedom to choose which energy efficiency measures to implement and how they are implemented. Most typical measures include energy audits, targeted information campaigns and subsidies; the companies could use their own energy efficiency service companies or outsource energy efficiency services. The "additionality effect" is high: about a half of the recorded savings at end-user level would not have been realized without interventions by energy companies.

6. **High quality statistical information can be used effectively for energy management.** Information from the energy efficiency building certificates assists energy supply companies in targeting their public service obligations for promoting end-user efficiency. The Danish Building Register has detailed information on all individual buildings in Denmark (including characteristics of individual heating systems); a new law requires energy suppliers to report annual sales to each individual building.

7. **The building code**, one of the strictest in the world, has been important in reducing the energy consumption of new buildings.

8. **Targeted technical information to consumers and training-programs for the supply side in energy efficiency construction is cost-effective.** A tax on every kWh sold finances various information and certification schemes aimed at consumers and supply companies.

Germany

Germany's energy intensity dropped 28 percent from 1990-2008: 20 percent of this was due to structural changes in the economy — largely after the merger of East and West Germany in the 1990s — while the remaining 80 percent came from energy efficiency gains. The main elements of Germany's reform program enabling these gains include:

1. **Germany quickly adopted EU Directives.** The government was actively involved in the debates associated with EU Directives and thus had a good understanding of how to implement them to maximize their benefits. Active engagement in the EU policy process appears to be helpful in both formulation and implementation.

2. **The government closely linked GHG reduction and energy efficiency targets in its National Climate Protection Program.** Targets were set, a package of policy measures prepared, and actions taken on regulation, the incentive framework, and information dissemination. Relevant existing programs were integrated into this plan. Constant monitoring and evaluation was used to amend the program to support the achievement of the targets. The costs were high (€2-3 billion per year) but the benefits were commensurate with the costs. Bundling of programs was considered to be particularly effective as energy efficiency rates nearly doubled.

3. **Germany established a public-private Energy Agency (DENA) with a mandate to help improve cooperation on energy policies among government agencies and the private sector.** As a commercial entity, DENA provides services to the government and private companies in energy, including energy efficiency. As energy efficiency is a pillar of the government's energy program, DENA spends considerable time and effort on this issue. Since DENA receives both public and private funding, its exposure to a broad constituency enhances its effectiveness.

4. **An environmental tax introduced in 1999 resulted in about a 7 percent reduction in total fuel consumption.** Public acceptance of the tax was enabled by ensuring (near) revenue neutrality, with 90 percent of the revenues going to reduce pension payments by employers and employees. Publicly open discussions about the tax options also facilitated its passage. Exemptions were introduced at the outset, but were gradually reduced until 2003, when they were eliminated.

5. **Despite considerable criticism, Germany's Voluntary Agreements with Industry on CO_2 reductions have been effective.** At the outset, industries balked at meeting GHG reduction targets, expecting this would infringe on their competitiveness: hence, the voluntary nature of the program. The program was designed to be self-policing, but the government played an active role in following up on a bilateral basis. The program met its targets due to good governance and cooperation by industry.

6. **Building regulations focused on new buildings and soft loans/grants focused on the existing building stock resulted in a decrease in energy use by buildings of 11 percent from 2002-2009.** The program was comprehensive, with KfW taking the lead and aggressively pushing the program. An aggressive set of buildings standards has evolved over the past 30 years, moving from 300 kWh/m^2 in the 1970s, to 170 kWh/m^2 in the 1980s, to 120 kWh/m^2 in the 1990s, and to 80 kWh/m^2 post-2000.

7. **Appliance labeling and disclosure of energy use information were effective in decreasing energy use by citizens.** Germany moved quickly to approve primary and secondary legislation and followed it up with an active information dissemination campaign.

8. **Fuel efficiency of cars improved dramatically starting in 1999 due to tax incentives: both level and structure.** Considerably lower excise taxes on diesel fuel helped support increased use of diesel cars, improving fuel efficiency despite an increase in engine sizes.

9. **A GPS-based, on-board unit that taxes heavy trucks' mileage, coupled with an incentive-based tax system, has provided incentives supporting a considerable shift to energy efficient trucks.**

Ireland

Ireland's energy intensity declined by 34 percent over 1990-2008. About half of the energy intensity decline in Ireland could be attributed to structural changes in the country's economy, while the other half could be explained by improvements in energy efficiency. The major elements of Ireland's reforms associated with these improvements are:

1. **A comprehensive approach to energy policy was one of the cornerstone implementation factors.** The Energy Policy Green Paper in 2006 was the first comprehensive government consultation paper on energy policy since the mid-1970s. The Energy White Paper, adopted in 2007, was informed by the Green Paper and set the Energy Policy Framework for 2007-2020. The Energy White Paper set targets for energy efficiency and renewable energy, gave mandates to institutions, clarified reporting linkages, and introduced smart metering and demand-side management. It is expected that implementation of the measures specified in the Energy White Paper will reduce energy consumption by 20 percent by 2020 (compared to 1990).

2. **A strong basis for monitoring and evaluation of energy policies' implementation has been formed by regular Implementation Reports.** Departmental Annual Reports are produced to monitor progress toward achieving energy policy aims outlined in the Energy White Paper, using benchmarks. In addition, in consultation with stakeholders, a bi-annual review of the energy policy framework 2007-2020, reporting on implementation and progress towards targets, is prepared (the first such report was planned to be released in 2009). Informed by results of the bi-annual review, corrections/adjustments to framework implementations are made. A fundamental review of the energy policy framework, in consultation with stakeholders, is to be conducted every five years; the first fundamental review is planned for 2012.

3. **Sustainable Energy Authority of Ireland (SEI) has been very effective in promoting energy efficiency.** SEI administers a number of energy efficiency grant programs, both residential and non-residential. It was estimated that every EUR 1 spent on business programs administrated by SEI resulted in energy savings worth EUR 10 for businesses. Similarly, every EUR 1 spent on residential programs, when combined with homeowners' own investments, resulted in energy savings worth EUR 4.5 for homeowners. SEI has 43 staff costing €26 million per year.

4. **Ireland has a large number of modest-sized industrial energy efficiency programs (awards programs, CHP grants, least-cost power system planning, etc.) with modest positive individual impacts, but considerable aggregate impact.** The key is to keep the administrative costs of such programs low.

5. **Regulations were found to have the biggest impact on reducing energy consumption in buildings: space heating needs in households dropped 33 percent over 15 years.** Good communication programs, including analytical tools on the internet and Smartphone applications, helped achieve these results. The government updates building regulations every five years or so, taking into account new technologies, changes in costs, and expected benefits.

6. **Building Energy Ratings (BER) are used as a market-based instrument to promote behavioral change.** BER assessments are produced by BER assessors, who must be accredited (i.e., successfully complete and pass a competency test) and registered with SEI. SEI conducts monitoring and evaluation of BER programs by preparing periodic status reports. As of February 2011, 186,922 residential BER certificates and 6,036 non-residential BER certificates had been produced. A number of consumer awareness and attitude surveys found a high level of recognition of the concept of energy certification for buildings among the general public.

7. **Gains in the efficiency of car engines were muted by the tendency for consumers to buy cars with bigger engines.**

8. **Significant investments in rail (roughly €1 billion over ten years) resulted in an increase in passengers of about 30 percent.** This program is planned to be accelerated over the next ten years.

Sweden

During 1990-2008, Sweden's energy intensity declined by 29 percent. About half of this drop could be explained by structural changes in the country's economy, while the other half could be attributed to improvements in energy efficiency. The key elements of Sweden's reform program contributing to these improvements include:

1. **Strong political commitment and consensus among major stakeholders gave the support needed for the success of energy efficiency reforms.** This support allowed establishment of effective institutional arrangements with clear mandates, division of responsibilities, and accountability, coupled with adequate and stable funding.

2. **An effective coordination mechanism was developed through strong intra-governmental (horizontal) and inter-governmental (vertical) cooperation, ensuring that the energy efficiency agenda was incorporated across various levels of government.** Thirteen regional offices of the Swedish Energy Agency were set up. Strong cooperation with non-governmental stakeholders was established. The coordination mechanism was significantly enhanced by monitoring and evaluation of the results of major energy efficiency programs.

3. **Carbon and energy taxes contributed to improving energy efficiency and decreasing emissions.** Since 1991, the Swedish tax system has included both a carbon tax and an energy tax on fuels (not connected to carbon content); biofuels are not taxed. Between 1991-2008, the share of fossil fuels in total final energy consumption fell from 42 percent to 37 percent and the share of biofuels increased from 15 percent to 18.5 percent. It is expected that by 2016, carbon and energy taxes will result in 38.5 TJ (or 10.7 GWh) of energy savings in the residential and transport sectors alone.

4. **For energy-intensive enterprises, financial incentives have played an important role in improving energy efficiency.** The Program for Energy Efficiency Improvement in Energy-Intensive Industry (PFE) is a voluntary program that promotes efficiency of energy use among companies that consume large amounts of electricity. The companies that choose to participate in the program are exempt from energy tax on electricity use, but need to take actions to improve their energy efficiency. In 2009, 111 energy-intensive industrial companies, responsible for over 20 percent of Sweden's

total electricity consumption, participated in the program. The participating companies indicated total energy savings of about 1 TWh per year, corresponding to CO_2 emissions reductions of about 0.5-1 million tons annually.

5. **Building regulations, with straightforward and transparent requirements, have had a strong impact on buildings' energy efficiency performance.** Sweden has a long history of building regulations that have been frequently revised. In 1995, specific requirements for the energy performance of buildings, including maximum energy use, were set. The regulations also set specific requirements for the energy performance of separate building components (e.g., doors, windows). It is estimated that in 1995-2005, tightening of building regulations resulted in a roughly 7 percent reduction of energy use in buildings. Currently, Sweden has a fully integrated building standards approach, with a single specific energy consumption criterion for buildings (kWh/m^2/year).

6. **Mandatory labeling of domestic electric appliances proved to be very effective in improving energy efficiency.** This measure is more effectively enforced by the Swedish Energy Agency (SEA) than is done in other countries. SEA performs systematic inspections of stores that sell domestic appliances to ensure that appliances are properly labeled. An administrative fine of about US$ 25,000 per store is issued to stores that do not follow the labeling requirements. It was estimated that since 1995, labeling has resulted in a 25-35 percent reduction in the average electricity consumption of domestic appliances.

Lithuania

Lithuania's energy efficiency program has met with considerable success, cutting the country's energy intensity roughly in half from 1994-2007, making it a leader among the EU-12 countries. The key elements of the government's reform program enabling this success include:

1. **Lithuania quickly adjusted prices to reflect the full cost of energy supply.** The energy price increases were largely a "big bang." Soon after independence, Russia increased the price of oil and gas to Lithuania. As Lithuania has limited domestic energy resources and a limited ability to pay, it passed on these costs to customers, who quickly rationalized consumption to address affordability issues, compromising comfort for the first few years. As incomes grew and energy efficiency measures took hold, most consumers gradually returned to reasonable comfort levels.

2. **Right after independence, the government established the Energy Agency (1993) and has maintained it continuously ever since.** The Energy Agency has adequate staffing (27 staff) and funding (€ 0.44 million annually). The Energy Agency has been the cornerstone of the government's Energy Efficiency program design and is responsible for the full agenda on energy efficiency, including: preparing and updating energy efficiency strategies; assisting with the preparation of laws and regulations related to energy efficiency; organizing the implementation of energy efficiency programs; disseminating information, and monitoring and evaluating results.

3. **Lithuania moved quickly to implement EU Directives into its legal and regulatory framework (EU Energy Performance of Buildings Directive, for example).** Given that the EU undertook considerable analytical work before the Directives were enacted, quick action enabled realization of the benefits to be accelerated.

4. **One of the key differences between Lithuania's program and those in countries that have been less successful is its comprehensive nature.** For example, to improve residential energy efficiency, Lithuania's program included: establishing building regulations, introducing energy audits, implementing energy efficiency pilots, introducing building certificates, and promoting information dissemination campaigns, as well as closely monitoring and evaluating each program (by Energy Agency, Ministry of Environment, Certification Center of Building Products, etc.). As a result of this comprehensive approach, specific heat energy consumption in

Lithuanian buildings decreased from about 200 kWh/m^2 in 1995 to about 140 kWh/m^2 in 2007.

5. **Establishing building regulations ("Thermal Techniques for Building Envelops") and upgrading them regularly resulted in a decline of buildings' energy consumption.** Implementation of the 1992 building regulations resulted in a decrease in energy consumption by newly constructed buildings of 40-45 percent compared to buildings constructed according to the Soviet norms. The 1999 building regulations resulted in a further 3-5 percent energy efficiency improvement of new buildings. Subsequently, the 2005 building regulations improved the energy performance of newly constructed buildings by another 15-20 percent.

6. **Lithuania made important changes to its Homeowner Association legislation in 2000, which helped unblock the implementation of energy efficiency programs in apartment buildings.**

7. **Grant funding was needed to support energy efficiency investments by Lithuanian households to get the market started.** Initially, no or only modest grants were available, resulting in limited uptake. When 30 percent grants, funded by the government using budget and EU funding, were made available, uptake by households took off.

8. **Modest pilot programs did not make much of an impact, as few people saw the impact or heard of the results.** When the pilots did have an impact, they were assumed to be outliers — not mainstream examples. However, when a large number of pilot schemes were undertaken as a part of a coordinated pilot program, the results were impressive. There seems to be a need to reach a "tipping point" before impacts become meaningful.

Poland

In the period from 1990-2009, Poland's energy intensity was nearly cut in half, about twice as good as the EU average reduction. Since 1994, the decrease in energy intensity has been the result of energy efficiency gains, not structural changes. The main elements of Poland's energy efficiency reform include:

1. **The "big bang" in energy price increases in the 1990s was a key component for putting in place an enabling environment for improving energy efficiency.** With the fall of communism in the late 1980s, Poland began a program of rapid economic reform—dubbed "shock therapy"—that included adjustments to correct distortions in heat and electricity tariffs. Between 1990 and 1995, electricity and gas prices increased six- and thirteen-fold, respectively. Although it is not possible to estimate the direct energy savings arising from cost-reflective energy pricing, this policy measure has been a major element of an enabling environment for investments in energy efficiency measures.

2. **The energy sector was unbundled to enable competition to determine electricity prices for all consumers except households (which will be also included in the near-term).** Network prices are regulated as natural monopolies; gas supply is regulated as a de facto monopoly. The establishment of an independent regulator in 1998 enabled energy price reforms to be sustainable.

3. **Poland introduced a Thermo-Modernization and Renovation Fund (TMRF) in 1998 to address the financing needs for energy efficiency investments in existing buildings to mitigate rapidly increasing prices.** The TMRF provides a Thermo-Modernization Bonus (subsidy) for eligible energy efficiency projects in buildings and heating networks, financed on commercial terms by 16 selected commercial banks. The bonus corresponds to up to 20 percent of the loan amount and is paid once projects are fully implemented. The first five years were unsuccessful, so the government streamlined the application process and made the grant resources available earlier, resulting in a rapid uptake. Between 1998 and 2009, it is estimated that 16,700 applications were granted, for a total investment value of EUR 1.3 billion, of which EUR 0.9 billion was financed by credits from commercial banks. Expected energy savings from TMRF-financed projects are 30-40 percent of the average cost of energy used for heating purposes in households.

4. **Construction regulations that establish energy performance requirements for buildings in Poland have been effective at significantly reducing energy consumption in the residential sector and have ensured convergence with EU levels.** Poland has a long-standing (since 1982) tradition of complementing market forces with regulations (through its Construction Law and later through secondary legislation). Regulations became increasingly more stringent during the early 1990s. The impact of these measures is considered significant, as a sizeable reduction in energy consumption by the residential sector followed their implementation. For example, between 1990 and 2002, energy consumption per m^2 in dwellings declined by 25 percent, compared with a reduction of only 7 percent in the EU.

5. **The Building Certificates program introduced in 2007 has not been as successful as expected as energy consumption since then has not decreased.** The program should be amended to draw on lessons learned elsewhere (e.g., Ireland).

Romania

Romania's energy intensity declined 52 percent during 1992-2008 (a 4.3 percent average decrease per year). Since 1994, most of the decrease in energy intensity came as a result of improvements in energy efficiency. The key elements of Romanian reforms contributing to this result include:

1. **Many EU directives were quickly transposed into the Romanian legal framework, including the Energy Performance of Buildings Directive and various directives on energy labeling of household appliances.** Combined with domestic legislation (e.g., The Law on Efficient Use of Energy), they have created a comprehensive enabling framework for improving energy efficiency.

2. **Romania established the Agency for Energy Conservation in 1990, which contributed significantly to effective institutional arrangements.**

3. **Monitoring and evaluation of energy efficiency programs has been essential for tracking progress.** Romania has developed a substantial energy efficiency statistical database. However, this database could be improved further. For instance, lack of data on energy efficiency indicators for domestic (household) electric appliances represents a significant obstacle in analyzing the effectiveness of mandatory minimum energy efficiency standards and energy labeling programs which proved to be effective in other countries (e.g., Sweden).

4. **The most often used financial support mechanism for energy efficiency improvements in Romania has been grants (e.g., grants for energy audits and feasibility studies for energy efficiency projects, partial grants to finance works).** Most of the energy efficiency funding in Romania has been provided by international organizations (e.g., the World Bank, GEF, UNDP, etc.). Domestic financing for energy efficiency has been limited.

5. **A good example of an effective domestic financing mechanism is FREE — Romanian Energy Efficiency Fund — a revolving trust fund established under the World Bank-administered GEF "Romania: Energy Efficiency Project."** The objective of the project was to enable companies in the industrial sector and other energy consumers to adopt and utilize energy-efficient technologies. During 2002-2008, a total of US$ 8 million was invested in energy efficiency projects; 12 projects were completed with an average pay-

back period of 3.5 years, and saved about 123,458 cumulative tons of CO_2. Cost-effectiveness of FREE seed financing constituted 0.08 US¢/kWh, which ranks among the best-practice international benchmarks. Lessons learned from the FREE experience are:

- For small demonstration projects such as this one, the institutional design of FREE is overly complex. At the same time, the fiduciary controls and checks and balances are attractive features for scaling up with both public and private capital;
- A strong and reliable pipeline of initial projects is essential to ensure early success of this type of project;
- The original Fund Manager contract structure should have been weighted more towards performance instead of the retainer part; adding flexibility in the contract structure to adjust the fixed and performance fee would be desirable and would avoid costly repeated procurement. Knowledge of local industry and market is also very important to ensure success;
- The project level transaction costs are still high and clients require considerable pre-investment TA support (e.g., grants for feasibility studies; structuring finance; finding attractive financing, etc.) before large scale energy efficiency implementation is possible. Local knowledge and skills contribute to success more cost effectively.

6. **Building regulations, including Energy Performance Certificates of buildings, are expected to be an effective tool for improving energy efficiency of the building stock.** Although the Energy Performance of Buildings Directive was transposed into Romanian legal framework fairly recently (effective from January 2007), initial measures taken demonstrate visible progress in implementing the directive. A system of certification of energy auditors has been established and is functioning. By November 2010, there were over 1,000 certified energy auditors in Romania. In addition, Quality Assurance and Quality Control schemes have been established.

ANNEX 2

The Energy Efficiency Ladder

The purpose of an "Energy Efficiency Ladder" would be to identify countries that have successfully managed to reduce their energy intensity so that other countries may benefit from their example. At the top of the ladder would be the "Low" (<0.15 kgoe/GDP in 2005 $) energy intensity countries, followed by the "Medium" (0.20-0.30) and the "High" (>0.30) energy intensity countries. Between the Low and Medium countries would be the "Transitional" countries (0.15-0.20). The 2007 results yield the following groupings for ECA and EU-15 countries:

Low Energy Intensity Countries (<0.15)

Ireland, Malta, Albania, Switzerland, United Kingdom, Greece, Denmark, Portugal, Italy, Spain, Austria, Turkey, Luxemburg, Croatia, Germany, and Cyprus.

Transitional Countries (0.15-0.20)

Latvia, Netherlands, Norway, France, Slovenia, Hungary, Lithuania, Romania, Poland, Sweden, Belgium, Slovak Republic, FYR Macedonia, Armenia, Azerbaijan, and Finland.

Medium Energy Intensity Countries (0.20-0.30)

Tajikistan, Bosnia/Herzegovina, Serbia, Estonia, Bulgaria, Belarus, and Kyrgyz Republic.

High Energy Intensity Countries (>0.30)

Moldova, Russia, Kazakhstan, Ukraine, Turkmenistan, and Uzbekistan.

The grouping of countries broadly fits with expectations. One thing that is clear from the grouping is the impact of climate on energy use: it is not just energy policies that matter.

Drawing on the information available from the country case studies, the following table of key characteristics is assembled. Table A2.1 primar-

TABLE A2.1
Energy Efficiency Ladder, Key Characteristics

		Germany	Sweden	Poland	Lithuania	Ukraine	Kazakhstan
Prices	Energy prices	Full cost + Eco tax	Full cost + Eco tax	Full Cost	Full Cost	<Full Cost	<Full Cost
Governance	EE Law	Yes	Yes *	Yes	Yes	No	No
	EE Co-ord.	Yes	Yes	No	[No] *	No	No
	EE Agency	Yes	Yes	No	Yes	Yes	Yes
	EE Budget	High	High	Low	Medium	Low	Low
	EE Targets	High	High	High	High	Medium	Low
	EE M&E	Yes	Yes	Sort of	Sort of	No	No
	Industry Competition	High	High	Medium	Medium	Low	Low
	Building Standards (x kWh/m^2)	High	High	Medium	Medium	Low	Low
Industry	Building Certificates	Yes	Yes	Sort of	Sort of	No	No
	Appliance Standards	High	High	High	High	Low	Low
	White Certificates	Sort of	Sort of	Yes	No	No	No
Households	Smart Grids	Yes	Yes	Yes	No	No	No
	Centralized Decision-Making	No	No	Medium	No	Yes	Yes
	Stable Civil Service	Yes	Yes	Somewhat	Somewhat	No	No
Communications	Public awareness campaigns, access to information, etc.	Strong	Strong	Somewhat	Good	None	None

*Sweden's energy efficiency legal framework is addressed under a number of laws and regulations, not one comprehensive law.

ily focuses on energy policies, but there are a few other notable characteristics, namely centralized decision making and the stability of the civil service.

A few observations emerging from this table are:

For a country to move from High or Medium to Transitional Energy Intensity, it should:

- Set prices to reflect the cost of supply
- Ensure that energy efficiency is embedded in the legal framework
- Establish an adequate budget for energy efficiency
- Establish energy efficiency targets that are monitored and evaluated
- Enable competition for the industrial sector
- Create reasonable building standards and ensure implementation
- Establish appliance standards

For a country to move from Transitional to Low Energy Intensity, it should:

- Include environmental externalities in energy prices
- Ensure good coordination among government ministries and agencies
- Ensure an adequate budget for energy efficiency
- Establish a well-functioning Buildings Certificate Program
- Decentralize decision making
- Ensure a stable civil service

Country specific information should include data about the structure of the economy to help separate structural shifts. In addition, energy use should be normalized for climate impacts, drawing on Eurostat's approach.

As the Knowledge Sharing platform evolves, it should also include information about energy use by sector, where it is available, recognizing that some of this information may be difficult to obtain because of its proprietary nature.

This report is a part of a series of 3 regional reports. The series includes *Growing Green: The Economic Benefits of Climate Action*, *Balancing Act: Cutting Energy Subsidies While Protecting Affordability* and *Energy Efficiency: Lessons Learned from Success Stories*.

Growing Green: The Economic Benefits of Climate Action

Besides growth and social inclusion, the third strategic priority for the ECA Region is addressing the problem of climate change. Adaptation to a changing climate is already a concern in several ECA countries that have experienced severe droughts affecting crops and hydropower generation. A regional study on adapting to climate change and several national adaptation pilots have analyzed these issues. This report is a complementary study which explores options for reducing the region's greenhouse gas emissions. It focuses on the three main ways to do so: use less energy, use cleaner energy, and better manage natural systems that store vast amounts of carbon. The study discusses policy priorities across sectors — in power generation, production, mobility, the built environment and natural environment. Making climate sustainability a higher priority will involve trade-offs. A low carbon energy transition imposes costs on firms and households, but it also generates new economic activities. The study proposes strategies how countries can reduce harmful impacts from climate action policies and get the most out of emerging opportunities.

Balancing Act: Cutting Energy Subsidies While Protecting Affordability

In Eastern Europe and Central Asia there are significant pressures for residential energy tariffs to rise, as government budgets are increasingly stretched and cannot afford to pay large energy subsidies. Further pressures for tariffs to rise come from environmental concerns, as the tariff levels that households now face do not cover the social costs of energy production. Because reforms that would increase energy tariffs are likely to affect significantly the poor and the middle class, their political feasibility may be questioned unless appropriate ways of cushioning the impacts

can be devised. Balancing these competing claims—fiscal and environmental concerns on the one hand, affordability and political economy concerns on the other—is a task that policy makers in the region are increasingly unable to put off. While challenging, the reforms needed for this balancing act can build on much that has been learned in the last decade in terms of improving the effectiveness of social assistance systems and increasing energy efficiency. The report suggests that a policy agenda that focuses on cutting subsidies to the energy sector, while investing in energy efficiency and supporting households at the bottom of the distribution, amounts to a new wave of policy reforms for the energy sector in transition countries. The feasibility of such an integrated policy agenda and the ability of these policies to balance the competing claims of fiscal responsibility and social concerns are explored through different policy scenarios, which, in their simplicity, help clarify the parameters of the policy choices many countries ECA are facing.

ECO-AUDIT

Environmental Benefits Statement

The World Bank is committed to preserving endangered forests and natural resources. The Office of the Publisher follows the recommended standards for paper usage set by the Green Press Initiative, a nonprofit program supporting publishers in using fiber that is not from endangered forests.

In the printing of *Energy Efficiency: Lessons Learned from Success Stories*, we took the following measures to reduce our carbon footprint:

- We used paper containing 30-percent recycled fiber made from post-consumer waste; each pound of postconsumer recycled fiber that replaces a ton of virgin fiber prevents the release of 2,108 pounds of greenhouse gas emissions and lessens the burden on landfills.
- We used paper that is chlorine-free and acid-free.
- We printed with vegetable-based inks made from renewable sources and easier to remove in the recycling process.

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Energy Efficiency: Lessons Learned from Success Stories is designed to identify energy efficiency policies that were implemented in countries that successfully decreased their energy intensity. The study analyzes the energy efficiency policies in seven successful European Union (EU) countries, namely: Denmark, Germany, Ireland, Lithuania, Poland, Romania, and Sweden. Over the past 20 years, these seven countries have achieved low energy intensities or have reduced their energy intensity considerably.

The report analyzes the evolution of the energy intensity of these countries from 1990 to 2007, identifying points of inflection in the progress toward improvements. The authors explore changes to the policy agenda immediately upstream to identify cause and effect relationships in energy use.

The country case studies indicate that policy implementation evolves, reflecting such issues as institutional capacity and affordability. For example, energy price increases were adjusted quickly to reflect full economic costs for all sectors except households in EU-12 countries. EU-15 countries have added environmental taxes to energy costs, providing deeper incentives to constrain energy use. Implementing environmental taxes was difficult and generally took place when it appeared to be politically viable to do so.

Similarly for governance issues, EU-12 countries have undertaken some of the first steps toward improving the governance of the energy efficiency agenda by establishing an entity responsible for energy efficiency policy and preparing National Energy Efficiency Action Plans. Monitoring and evaluation of these programs is functioning to a limited extent in EU-12 countries, while EU-15 countries take these responsibilities more seriously as they are better able to afford the costs associated with such programs.

Energy Efficiency: Lessons Learned from Success Stories is a part of a series of three regional reports that also includes *Balancing Act: Cutting Energy Subsidies While Protecting Affordability* and *Growing Green: The Economic Benefits of Climate Action*. These reports will be of interest to policy makers, government officials in finance and line ministries, nongovernmental organizations, and development practitioners.

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