The European Union: World Leader and Standard Setter on Carbon Emissions Reductions

Major Economies and Climate Change Research Group

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EXECUTIVE SUMMARY

This report examines the barriers to greenhouse gas (GHG) emissions reductions within the European Union. While the EU has historically been a world leader in pursuing environmentally friendly policies, it faces a difficult path moving forward. Responsible for just over 11% of global annual CO_2 emissions, the EU is the third largest GHG emitter after the U.S. and China. The EU has seen a slight uptick in emissions following the financial crisis of 2008 and is grappling with both EU-level and member country-level obstacles.

BARRIERS

This report outlines the following barriers to further climate mitigation action.

At the EU level, these include:

- Individual member disagreements, roughly between richer and poorer states.
- Failings in the Emissions Trading System (ETS).
- Conflicts with the imperatives of achieving energy security for some member states.

At the member country level, these include:

- Strong economic and political opposition in Eastern Europe, particularly in Poland, to ambitious climate measures.
- Persistent subsidy and incentive programs.
- A knowledge gap between utilities and oil and gas companies on CCS techniques.

The key sectors analyzed in this report include energy production and transportation due to their large contributions to current and future emissions trajectories. On the demand side, energy efficiency in buildings and industries is also examined.

POLICY RECOMMENDATIONS

A number of different policies could be deployed to overcome these barriers. Some of these should be deployed at the EU-level while others are more relevant to particular states. Policy recommendations are summarized below.

Energy Production - Carbon Capture and Storage (CCS)

In the energy production space and CCS, policy recommendations at both the EU- and country-level are worth pursuing, including:

- *Fund CCS in coal-rich countries such as Poland.* Ensure funding for CCS projects in Poland; this will mitigate the financial barriers to CCS deployment.

The UK should:

- *Reduce risk aversion of utilities over CCS.* Work toward reducing the risk aversion of utilities to invest in CCS. This could take the form of increasing funding to CCS R and D activities in utilities, or providing some sort of insurance mechanism to utility companies should their CCS projects fail.
- *Foster knowledge.* Foster knowledge transfer about CCS projects from the oil and gas industry to the utility industry. This will mitigate some of the technical barriers to CCS

deployment in the UK. Moreover, because production is fairly concentrated (6 utility companies), training and knowledge diffusion should not be as problematic.

Germany should:

- *Educate the public.* Begin an educational public information campaign about the benefits and costs of CCS technology. Doing so might sway public opinion to a more favorable opinion on CCS, especially given Germany's reliance on coal.
- *Engage stakeholders.* Continue to foster an inclusive process of CCS deployment by engaging stakeholders early in the CCS exploration process.

The Emissions Trading System

For the ETS, the EU should enact two key policies:

- *Reduce permits or harmonize national policies.* The EU should either aggressively reduce permits on market, or consider harmonizing national level policies with EU level policies.
- *Stop exemptions.* The EU should stop granting exemptions to some countries and industries. This is politically contentious, but a step toward removing market distortions.

Energy Production – Renewables

In the renewables space, two policies are worthwhile:

- *The UK should step up offshore wind and pursue other renewables.* The UK should continue to pursue renewables and nuclear energy development. It should seek to scale up its burgeoning offshore wind industry.
- *Assist Eastern Europe.* Wealthy EU countries should more aggressively assist Eastern European countries (Poland, in particular) to embrace renewables in lieu of coal-based power. Eastern European countries in particular have enormous potential for scaling up renewable technologies. If economic barriers can be overcome, renewable technologies could make a large contribution toward securing Eastern Europe's energy security.

Transportation

Several policies in the transport space are viable:

- *Continue support for public transport.* Continue to pursue public transport as a primary option in local, intra-state personal travel and freight.
- *Support stricter fuel efficiency standards for vehicles.* Continue policies that incentivize fuel-efficient low-carbon LDV, MDV, and HDV technologies.
- *Share information on demand management.* Disseminate information about success in TDM through outreach and development projects.

Energy Efficiency in Industries and Buildings

Three policy recommendations in energy efficiency are:

- *Eliminate exemption for older buildings.* Eliminate grandfather clauses in EU Building Codes that allow older buildings to exempt themselves from energy efficiency standards.
- *Require mandatory upgrades.* Close the mandatory retrofit and upgrade cycle and require all buildings to make improvements every ten years.
- *Include biofuel minimums for cement production.* Institute mandatory biofuel minimums for cement production, starting at 10% and then scaling up.

THE EUROPEAN UNION IN THE GLOBAL CONTEXT

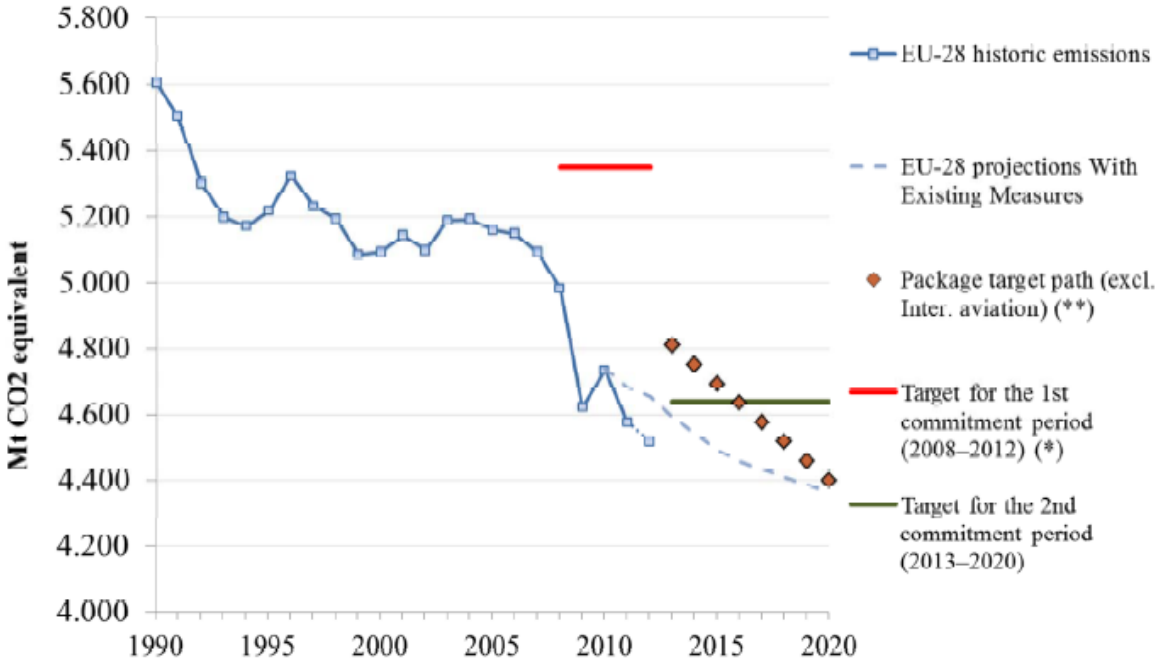
Responsible for over 11% of annual global CO_2 emissions, the European Union (28) is the third largest emitter in the world after the U.S. and China.[1] Relative to its population of 500 million people (which is less than 7% of the world's population) the EU, like the United States, accounts for a disproportionately high share of global emissions. In 2011 it emitted around twice the amount of CO_2 as India (3790000 kilo tons CO_2, as compared to India's 1970000 kilo tons CO_2) yet had less than half the population size.[2] The picture is diverse within the EU, with most Western European countries being very sensitive to their emissions contributions. The countries of Eastern Europe, on the other hand, are poorer and tend to have much more energy-intensive economies.

Although accounting for a large share of the world's annual emissions, the EU has made significant steps toward reducing its emissions. This reduction is due, at least in part, to a series of climate change policies, including an emissions trading system, directives aimed at increasing the share of renewable energy in electricity production, and emissions targets for automobiles.[3] Other factors, such as the financial crisis of 2008 and ensuing reduction in economic output, may account for some of the variation (see right side of figure below) and may obscure the true impact of these policies. The financial crisis significantly reduced economic growth in the EU, which led to less industrial and energy production. Additionally, many EU citizens have viewed emissions reductions strategies as a luxury and may not see the benefits to them when forced to tighten their belts.

By 2011, the EU had reduced its overall emissions by 18.3% below 1990 levels, excluding emissions from international aviation. This means that it overachieved its target for the first Kyoto commitment period (2008-2012, see figure below), and it also means that the EU is well placed to meet its target for the second Kyoto commitment period from 2013-2020.[4] Even with existing measures in place, the EU is likely to meet its target; however, that does not obviate the necessity for further emissions reductions, given that EU emissions account for such a high proportion of world GHG emissions. Despite these accomplishments, the EU has continued to place increasingly stringent standards on itself, and these are manifest in the EU 2020 and 2030 goals.

[1] Gerdes, 2013
[2] The European Commission, 2013b, 3-4.
[3] Ibid.
[4] Ibid.

Figure 1: EU Emissions over time as compared to Kyoto Targets



Note: (*) defined as the sum of EU-15's collective target and EU-13 national individual targets (average 2008-2012 (proxy data) emissions for Malta and Cyprus)
(**) defined as the sum of Member States' annual emission allocations under the ESD and ETS cap excluding international aviation.
Source: European Commission, EEA

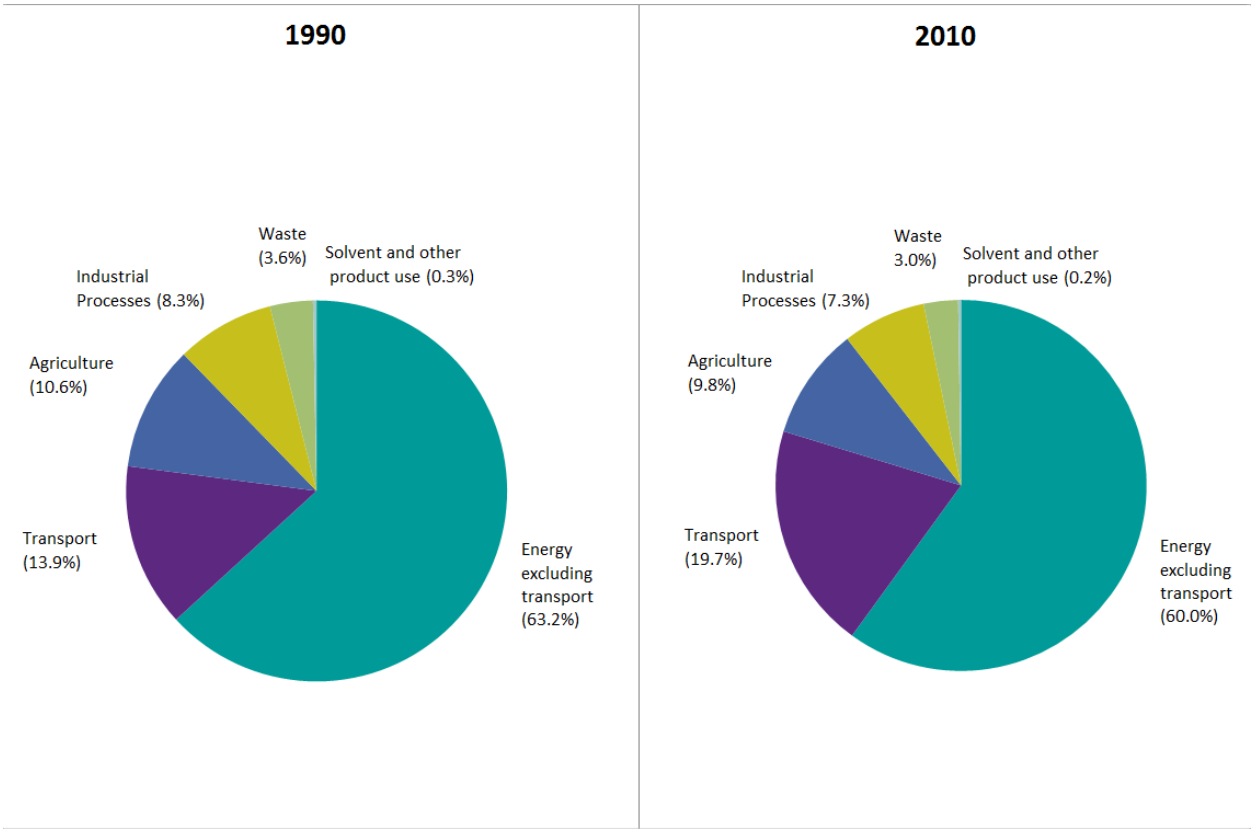
Source: European Commission, EEA

RATIONALE

When looking within the EU, there are three important facts to keep in mind when examining emissions reductions potentials. Within the EU, two sectors dominate the emissions scene: energy and transport. In 1990, the two sectors accounted for 77.1% of total emissions; in 2010, they accounted for 79.7% of total emissions (figure 2). While energy, as a share of emissions marginally decreased, transport increased roughly 6% over the same time period. Because they account for such a large portion of emissions totals, they provide the greatest areas where emissions reductions are needed. The interesting question, however, is to what extent emission reductions within these sectors are possible.[5]

[5] Excerpt from Stephenson-Reynolds, 2013a.

Figure 2: Sectoral Composition of EU Emissions



Source: Eurostat

Twenty-eight countries make up the EU, but the top six emitters in 2010 accounted for roughly 70% of annual CO_2 emissions. In order, they are: Germany, accounting for 19.84% of emissions; the United Kingdom (12.5%); France (11.07%); Italy (10.62%); Poland (8.49%); and Spain (7.54%). The remaining 21 countries — with the exception of the Netherlands (4.45%) — only contribute on the order of 1-2% to the total annual emissions (table 1). For this reason, this study primarily focuses on the largest emitting countries, while briefly looking at some success stories from smaller emitters to see if their strategies can be applied to the larger economies.

Table 1: Emissions Contributions of EU Countries

	Total greenhouse gas emissions (Kyoto base year=100) (1)				Weighted emissions of greenhouse gases (thousands of tonnes of CO_2 equivalent)			
GEO/TIME	2000	2005	2010	Targets 2008-2012	2000	2005	2010	Share of EU-27* (%)
EU-27	:	:	:	:	5 078 135	5 148 712	4 720 878	
Belgium	100	99	91	92,5	146 154	143 623	132 459	2,81
Bulgaria	47	50	46	92,0	62 892	66 361	61 427	1,30
Czech Republic	75	75	72	92,0	145 775	146 326	139 158	2,95
Denmark	98	92	88	79,0	68 090	63 740	61 065	1,29
Germany	84	81	76	79,0	1 038 999	997 277	936 544	19,84
Estonia	40	44	48	92,0	17 220	18 565	20 517	0,43
Ireland	122	125	110	113,0	68 103	69 315	61 314	1,30
Greece	119	127	111	125,0	127 054	135 661	118 287	2,51
Spain	131	150	123	115,0	380 831	435 428	355 898	7,54
France	100	101	93	100,0	564 800	567 109	522 373	11,07
Italy	107	111	97	93,5	551 570	574 749	501 318	10,62
Cyprus	:	:	:	:	10 108	11 081	10 838	0,23
Latvia	40	43	47	92,0	10 238	11 247	12 077	0,26
Lithuania	39	46	42	92,0	19 364	22 919	20 810	0,44
Luxembourg	73	98	92	72,0	9 596	12 950	12 075	0,26
Hungary	67	69	59	94,0	77 270	79 486	67 679	1,43
Malta	:	:	:	:	2 602	3 027	3 035	0,06
Netherlands	100	99	99	94,0	213 201	210 964	210 053	4,45
Austria	102	118	107	87,0	80 470	92 880	84 594	1,79
Poland	68	69	71	94,0	384 745	388 917	400 865	8,49
Portugal	137	144	117	127,0	82 293	86 540	70 599	1,50
Romania	51	54	44	92,0	140 520	148 889	121 355	2,57
Slovenia	92	100	96	92,0	18 823	20 344	19 522	0,41
Slovakia	68	71	64	92,0	49 339	51 213	45 982	0,97
Finland	98	97	105	100,0	69 239	68 623	74 556	1,58
Sweden	96	93	92	104,0	68 959	67 384	66 232	1,40
United Kingdom	86	84	76	87,5	669 879	654 094	590 247	12,50
Iceland	114	113	135	110,0	3 845	3 819	4 542	
Liechtenstein	111	119	102	92,0	256	272	233	
Norway	108	108	109	101,0	53 443	53 765	53 896	
Switzerland	98	103	103	92,0	51 884	54 398	54 247	
Turkey	:	:	:	:	:	:	:	

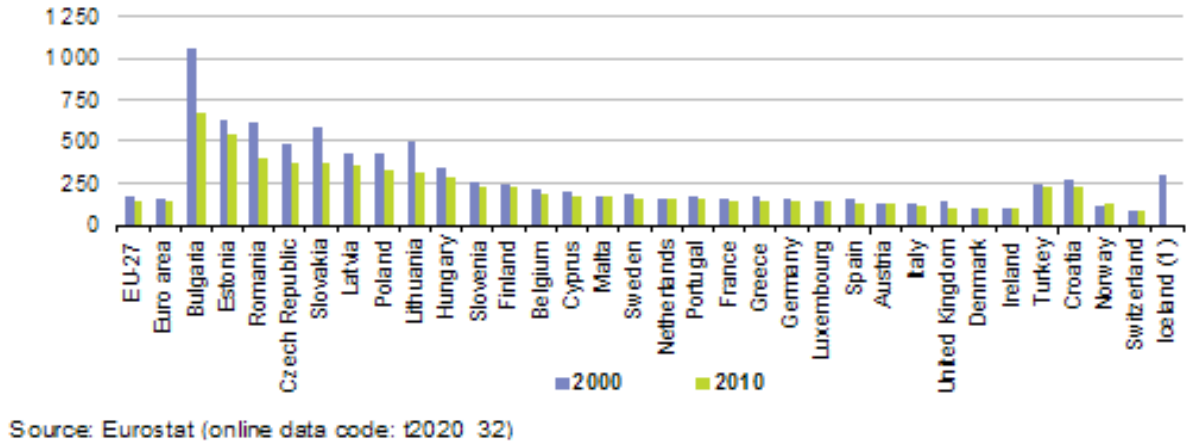
(1) EU-27, Cyprus, Malta and Turkey have no target and thus no base year under the Kyoto Protocol
*Share in EU27 total (in percentage) for the year 2010
Source: Eurostat (env_air_ind and env_air_gge), European Energy Agency, European Topic Centre on Air and Climate Change

Source: Eurostat

However, average emissions do not capture diversity within the EU, nor do they capture the extent to which energy is important to the total Gross Domestic Product (GDP) of a country within the EU. Figure 3 provides a visual representation of how diverse European countries are in terms of their energy intensity. Eastern European countries have dramatically reduced the amount of energy required to produce a unit of GDP; however, it is clear that their economies, relative to Western and Northern Europe, are still widely dependent on energy for economic output. This explains, in part, their resistance to adopting more rigorous standards. Poland is of particular importance in this regard; not only is it one of the major emitters within the EU, but also it has a very energy intensive economy. It has proved to be a formidable veto-player within the EU on climate change issues.[6]

[6] Torello and Kruk, 2014.

Figure 3: Energy Intensity of European Economies (kgoe per EUR 1000 of GDP)



Source: Eurostat

Germany, France, and the UK are the three largest emitters in the EU, while Poland is both a top emitter and a country with an extremely energy intense economy. Additionally, Poland is the largest economy in Eastern Europe, and it is emblematic of many of the challenges faced by the smaller nations in the region. Therefore, this report focuses on the obstacles to emissions reductions in each of these countries and provides recommendations to overcoming these barriers. It also attempts to draw lessons from several smaller scale success stories, and provide policy recommendations for how to scale these successes up in larger economies.

Socio-economic divide between Eastern and Western Europe

The European Union as a whole has a GDP per capita of $25,500 across its 28 member states. This single figure conceals major economic disparities across the region, from Luxembourg's $80,700 per person to Bulgaria's $5,500 per person levels.[7] One of the greatest challenges is gaining the same amount of support for EU emissions reduction initiatives from countries that have a fraction of the living standards of the richer, western countries. Both in income and in support for these initiatives, the greatest divide is between east and west. There is a high correlation between income and environmental awareness, with the richer countries generally pushing for stronger climate action.

[7] Eurostat, 2011.

EU EMISSIONS REDUCTION POTENTIAL BY SECTOR AND TECHNOLOGY

Emissions Reductions Potentials within the EU-28:

Looking across the major sectors (energy production, transport, housing/industry, and agriculture), the International Energy Agency (IEA) has identified emissions reductions potentials within the EU-27. Because energy production, transport, and housing/industry have the greatest potential for emissions reductions going out to 2030 and 2050, this report focuses on these areas.

Table 2: Projected Sectoral Emissions of EU Countries in 2030 and 2050

Year	Energy Production	Transport	Housing/ Industry	Agriculture
2030	800 Mt CO_2 (4.2 to 3.4)	300 Mt CO_2 (4.2 to 3.9)	300 Mt CO_2 (4.2 to 3.9)	Negligible
2050	1100 Mt CO_2 (4.1 to 3)	600 Mt CO_2 (4.1 to 3.5)	500 Mt CO_2 (4.1 to 3.6)	Negligible

Source: IEA ETP Data Visualization Tool

Table 3: Emissions Reduction Potential by Technology

Year	CCS	Renewables	End-use Efficiency	Fuel Switching	Nuclear
2030	300 $MtCO_2$ (4.2 to 3.9)	400 $MtCO_2$ (4.2 to 3.8)	700 $MtCO_2$ (4.2 to 3.5)	200 $MtCO_2$ (4.2 to 4)	100 $MtCO_2$ (4.2 to 4.1)
2050	.5 Gt CO_2 (4.1 to 3.6)	700 $MtCO_2$ (4.1 to 3.4)	800 $MtCO_2$ (4.1 to 3.3)	200 $MtCO_2$ (4.1 to 3.9)	100 $MtCO_2$ (4.1 to 4)

Source: IEA ETP Data Visualization Tool

The IEA breaks down emissions reductions potential by technology. For each intervention, the IEA identifies reductions potentials in 2030 and 2050. The most favorable interventions in terms of reductions potential are in end-use efficiency, renewables, and CCS. Fuel switching and nuclear power lag behind, but given the enormity of the EU's GHG emissions on an annual basis, even comparably smaller reductions are still important on a global scale.

In sum, a combination of CCS, renewables, end-use efficiency, fuel switching, and nuclear energy could contribute 4000 Mt CO_2 emissions reductions in 2050, assuming full implementation. Given the EU's good track record to date on carbon emissions reduction, it is more realistic to assume full implementation than in other major economies.

ENERGY PRODUCTION

Energy production and supply make up the bulk of emissions in Germany, France, the UK, and Poland. There is, however, significant variation in terms of the relative weight of the two sectors compared to each other. For example, France's emissions from energy supply only account for 12.7% of its annual emissions due to its extensive reliance on nuclear power,[8] whereas 47.6% of Poland's emissions come from energy supply – and 88% of its energy production comes from coal.[9] The following table illustrates the relative weight of energy supply and energy use as a percentage of annual GHG emissions and lists the number of utility companies operating in each respective country. Germany, with only 3 major utilities, has the most concentrated energy production sector, while France, with nine major companies, has the most diffuse energy production sector.

However, given that France's energy supply sector contributes such a small amount to its annual GHG emissions, the diffuse nature of production is not a great concern for implementing interventions in the energy production sector because there are not many gains to be had. Energy efficiency and transport are better candidates for making a dent in France's emissions. Germany, the UK, and Poland, could all benefit from a combination of interventions in the energy production sector to mitigate their GHG emissions. A combination of CCS, renewables, nuclear, or fuel switching is the best way to do this.

Table 4: Emissions from Energy Production & Energy Use in select EU countries

Country	Energy Supply (as a % of annual GHG emissions)	Energy Use (excluding transport)	Utility Providers
Germany	38.7%	27.3%	3 companies
France	12.7%	31.8%	9 companies
UK	34.3%	29.5%	6 companies
Poland	47.6% (*88% of energy production from coal*)	22.1%	4 companies

Source: European Environment Agency, 2011

[8] European Environmental Agency, 2011.
[9] Polish Information and Foreign Investment Agency, 2012. 2.

The following section outlines the barriers to emissions reduction in the EU and select countries with respect to CCS, the ETS, renewable technologies, nuclear energy, and fuel switching.

BARRIERS

CCS

Poland

CCS could have a large impact on GHG emissions from Poland. Poland has a very high energy intensity of economy (see figure 3), and coal makes up a disproportionately large part of the energy production mix. According to the IEA, coal generated 92% of Poland's electricity in 2008.[10] Poland could capture 36-72 Mt CO_2 per year if CCS technology develops rapidly.

However, Poland has been a vociferous opponent of CCS directives at the EU level, even though it could greatly benefit from deploying the technology. The probable reason for this opposition is that any CCS directive would most likely require disproportionate investment in Polish power plants, as well as Polish iron, steel, and chemical plants. The contention lies in who bears the cost of specific interventions; although Poland has two small-scale CCS projects funded by the EU and two other operated by the Polish gas group PCNiG, it is unlikely they will scale up CCS projects barring some large influx of external funding.[11]

Because Poland's economy lags behind Western Europe on many indicators, it is likely that in the short to medium term, Poland will continue to oppose costly policy measures targeted at reducing GHG emissions. Poland has played the role of a veto player on numerous occasions, most recently at the negotiations over the EU's 2030 climate change goals.[12]

The UK

The UK began to shift away from coal in 1990. This trend has continued to play out in recent years, to the point that in 2008 natural gas produced 45 percent of the UK's electricity, while coal produced about 33 percent. Although there has been a significant decline of coal vis-à-vis natural gas in the UK's energy production mix, it is unlikely that coal will drop significantly further in the short to medium term.[13]

There are two main reasons for why coal will continue to play an important part in the UK's energy mix. First, coal will remain a large part of the UK's energy strategy because the country still enjoys large domestic reserves. In 2012, the UK produced 16.8 million tons of coal, 6.2 million tons coming from deep mines, and 10.2 million tons coming from surface mines. Moreover, the UK has significant coal reserves. According to Energy Minister Charles Hendry, in an assessment he gave in 2011, the UK has 2,344 million tons of underground coal reserves,

[10] Global CCS Institute, 2013.
[11] Ibid.
[12] Global CCS Institute, 2014.
[13] Global CCS Institute, 2013.

and a further 852 million tons of surface reserves, giving a total coal reserve of 3,196 million tons.

Second, coal has historically had greater price stability and requires less capital expenditure than gas. The six major utility companies in the UK have preferred to use coal because an infrastructure already exists for coal burning and because coal prices are very low. While it is true that the UK's domestic coal industry has declined in recent years, due to rock bottom coal prices and increasing levels of imports, particularly from Russia (45% of coal imports) and Colombia (26% of imports), were coal prices to rise again the domestic UK coal production industry could pick up at least some of the slack.[14]

Because coal will continue to play an important part of the UK's energy portfolio, the government has expressed interest in scaling up CCS projects. In an effort to create a new cost-competitive CCS industry by 2030, the UK has enacted several policies to stimulate CCS technology deployment. This includes: a 1 billion pound commercialization competition to support design, construction, and operation of commercial-scale CCS; a 125 million pound research, development, and innovation program, and reform in the UK electricity market so that CCS will be able to compete with low-carbon energy sources.[15]

However, barriers to deploying CCS remain. Chief among these are the absence of market value on avoided carbon emissions. Were carbon emissions valued at a higher level, the incentives for developing CCS would increase. Furthermore, the six chief power producers in the UK—British gas, EDF energy, E.ON UK, npower, Scottish power, and SSE—who provide 90% of the energy consumed in the UK, are risk averse, and barring significant government intervention to mitigate this risk aversion, they will be unlikely to further invest in CCS. Finally, the majority of the limited expertise in CCS storage lies in the oil and gas industry, not the power utilities. It is unclear who will fill the gap between producers and storers of CO_2 and how CCS knowledge will diffuse from oil and gas companies to the utilities.

Germany

Germany could greatly reduce CO_2 emissions with the deployment of CCS technology. Coal is Germany's most abundant natural energy resource. In 2012, Germany was the 8th largest coal producer in the world and the fifth largest consumer of coal. Nearly all coal production serves the power and industrial sectors, and coal accounted for 24% of Germany's total primary energy consumption. Because Germany is also one of the EU's largest GHG emitters, it could potentially dramatically reduce its emissions with CCS technology.

However, CCS faces significant political barriers in Germany. While Germany has enacted a national level CO_2 storage act, as per EU requirements, the process was very contentious. In 2009, a draft law envisaged commercial deployment of CCS. The legislative process coincided with CCS exploration activities in Schleswig-Holstein by the utility company RWE. However, public opposition to the exploration for storage sites, concerns

[14] Government of UK, 2014,15.
[15] Ibid.

about pollution of drinking water and the risks of leakage, and fears about the infringement of property rights drove the government to postpone the legislation until 2011. In the interim, RWE suspended its CCS project, while another utility, Vattenfall, committed to a small exploration project despite strong public opposition in Brandenberg.[16]

A significantly weakened piece of CCS legislation passed in 2011. One particularly important compromise surrounded the right of German states to exclude parts of their territory if based on reasonable grounds. It is unlikely that public opinion will shift in favor of CCS in the near term. The status of CCS is perhaps best summed up in a presentation on CCS from the German Federal Ministry of Economics and Technology: "Overall, public pressure and opposition had a substantial impact on the legislative process. Open approval of demonstration of CCS technology is rare."[17]

Emissions Trading System (ETS)

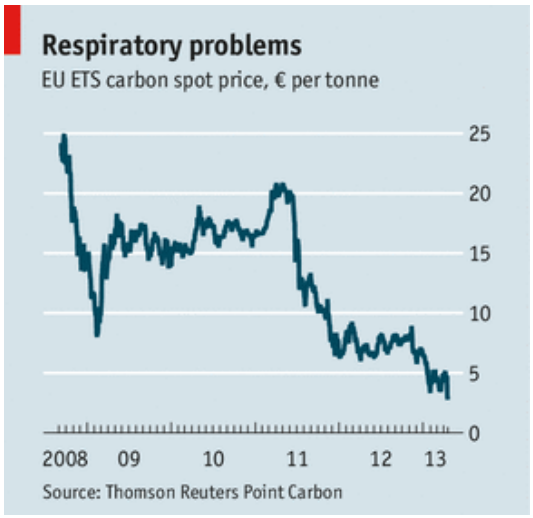
One reason the ETS is not functioning properly is because the EU issued too many carbon permits at the time of the creation of the market. Domestic lobbying groups successfully convinced EU decision makers to allocate a high number of permits to soften the initial blow of levying a tax on carbon emissions. Even now, there is a strong constituency of interest groups and politicians who have little interest in making the ETS function as it should, specifically lobbying groups in energy intensive industries and utility companies. It is unlikely that lobbying groups in energy intensive industries will support their EU representatives in enacting a robust reform to the ETS system.[18]

But this is not the only problem. While the EU has tried to remedy the problem of excess permits by broadly ending the practice of providing free permits to industries directly impacted by the ETS, the EU still grants a significant amount of free allowances to energy intensive industries, particularly in Eastern Europe. From 2013, the EU required power companies to purchase permits, but grants exemptions to countries that have entered the Union in 2004. To illustrate this point, an EU commission paper states: "Eight of the member states which have joined the EU since 2004 - Bulgaria, Cyprus, Czech Republic, Estonia, Hungary, Lithuania, Poland and Romania - have made use of a provision allowing them to continue granting limited numbers of free allowances to existing power plants until 2019. In return they will invest at least as much as the value of the free allowances in modernizing their power sector."[19]

The consequence of the initial surplus of permits plus the granting of exemptions has been that at the end of 2013, there was a surplus of almost 2 billion allowances -- this amounts to the equivalent of one year of emissions. Moreover, there has been a sharp fall in the price of permits (figure 4). From a record high of 32 euro in April 2006, the price fell to a record low of 2.81 Euro in January 2013; recently, prices have stabilized to around 5-6 euro per metric ton of CO_2. Many experts suggest that prices need to stabilize at prices over 20 Euros per metric ton in order to create strong incentives for utilities to improve efficiency and reduce dependence on cheap fossil fuel sources such as coal. This is an example of a market failure that urgently needs corrective action.

Figure 4: The Collapse of Carbon Price in the EU ETS

[16] German Federal Ministry of Economics and Technology, 2011.
[17] German Federal Ministry of Economics and Technology, 2011.
[18] The Economist. 2013b.
[19] The European Commission, 2013b. 3-4.



Source: The Economist

The EU's current policy to remedy the problems of the carbon market is a back loading program. The back loading program (table 5), most recently amended in February 2014, will reduce the allowance of permits in a stepwise fashion for the next three years and then release withheld permits on the market in 2019 and 2020. In aggregate, the program will reduce the market by 900 million permits in the 2014-2016 time period and then put up 900 million permits for sale in the 2019-2020 time period. Given that there is currently a 2 billion allowance surplus, it remains unclear what impact that the back loading program will have. As the program was enacted as a directive, it did not require widespread political support from members of the EU parliament, further calling its sustainability and efficacy into question.

Table 5: The EU's Backloading Program to Remedy ETS Market

'ANNEX IV

Adjustments to the volumes of allowances (in million) to be auctioned in 2013-20 referred to in Article 10(2)

Year	Volume of reduction	Volume of increase
2013		
2014	400	
2015	300	
2016	200	
2017		
2018		
2019		300
2020		600'

Source: EU Commission Regulation No 176/2014

Renewables[20]

Countries within the EU, such as Germany, Italy, and Spain have some of the highest levels of renewable capacity in the world.[21] The IEA identifies a 0.7 $GtCO_2$ reductions potential moving out to 2050 for the entire EU. While the EU has set rigorous standards and targets for its member states, it is unclear to what extent reductions will continue or if a domestic political backlash will slow down the process of expanding the supply of renewable technologies.

The problem in the EU is twofold: first, the European Trading System, the EU's tradable permits scheme for putting a price on carbon emissions has not succeeded in its stated goal, and second, both utilities and electricity consumers are increasingly opposing the direction various renewable subsidy incentives programs have taken.

Under the ETS, carbon prices are extremely low – currently around 5 Euros a ton; part of this is due to the fact that the EU issued too many preliminary permits, and part of it is due to the unintended consequences of generous renewable energy subsidy programs such as feed-in tariffs (FiT).[22] When utilities reduce emissions by using more renewable energy sources in their energy portfolio, they end up with a surplus of permits, and so are able to sell them on the market. Due to the high increase in the supply of permits on the market, carbon prices have consequently dropped to extremely low levels.

This is a case where national level incentives are undermining the broader EU market-based approach. When countries create an artificially low carbon price cost for renewable energies, they stimulate investment in those very cheap renewables, but this also has the perverse effect of creating an incentive to not engage in slightly more expensive -- yet extremely valuable -- energy efficiency investments.

[20] Stephenson-Reynolds, 2013a.
[21] See Table 1.2.
[22] The Economist, 2014c.

It does not help that some industries, even pollution intensive industries such as coal-burning power plants, are granted exemptions or free permits. As noted previously, many Eastern European countries have made use of a provision allowing them to continue granting limited numbers of free allowances to existing power plants until 2019.[23] Manufacturing industry in general will receive 80% of its allowances free of charge in 2013 but this will decrease annually to 30% in 2020.

In addition, utility companies and consumers have come to oppose subsidy programs. Increased supply of intermittent renewable energy has caused a steady decline in wholesale electricity prices, creating large losses for utility companies. Since 2008, the major European utility companies have lost over 500 billion Euros in market capitalization.[24] Utilities have been very vocal about criticizing subsidy programs for renewable technologies which have driven down their market shares; for example, E.ON, Germany's largest utility, in 2013 to relocate to Turkey if the German government continued to implement policies which undercut the profitability of its nuclear and fossil fuel powered plants.[25] German consumers also face some of the highest residential electricity prices in the world, even though the wholesale price has declined. Subsidies have distorted the market such that the residential electricity prices are around 285 Euros per MWh, while the wholesale price languishes at a mere 38 Euro per MWh.[26]

The German government has released a plan to reduce these subsidies, but even though utilities and many consumers support this decision, a powerful constituency consisting of both rural farmers and urban green party members have voiced a strong preference for maintaining incentives programs. A political storm is brewing, and the future of these programs remains unclear.

Hydraulic Fracturing and Fuel Switching[27]

The issue of hydraulic fracturing or "fracking," involving the extraction of natural gas from deep shale formations, has divided the European Union. While many of the wealthier nations of Western Europe have opposed the practice, poorer countries of Eastern Europe have generally expressed strong support. The debate is revealing deep rifts in the power structure of the EU, as well as how it relates to Russia, its energy-exporting rival to the east. The technology of hydraulic fracturing will pose a significant challenge to the speedy implementation of non-hydrocarbon alternatives. The energy debate of the next twenty years in Europe may very well switch from whether or not oil and natural gas will be part of the energy strategy, to how much of a part it will continue to play.

France became the most recent country in Western Europe to uphold a ban on hydraulic fracturing in late October of 2013. With this decision, it remains one of the main

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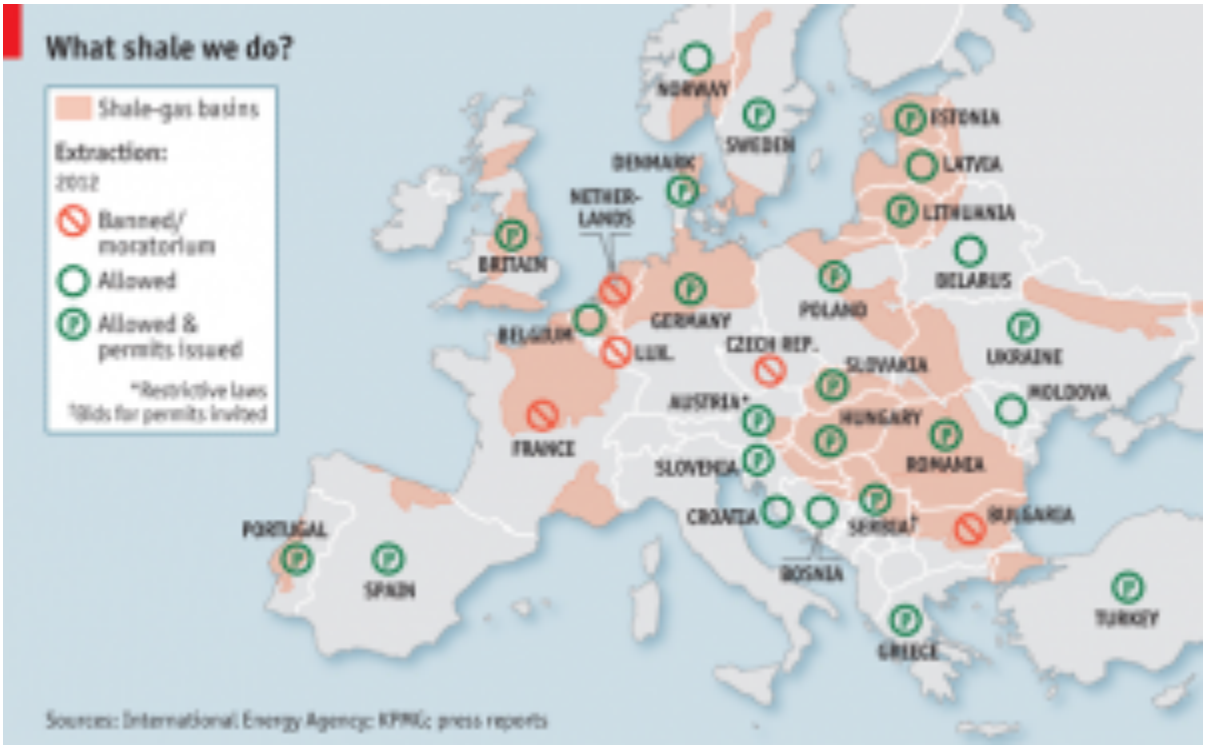
[23] European Union, 2014.
[24] The Economist, 2013c.
[25] Pentland, 2013.
[26] The Economist, 2013c.
[27] Excerpt from Bartlett 2014.

opponents of fracking in Europe, alongside Belgium, Luxembourg, and Bulgaria. This was of no surprise to most, as 39% of France's energy production is from nuclear power, giving France significantly more energy independence than most nations of the EU.[28] Additionally, France is less dependent on Russia for its energy than the nations of Eastern Europe.

Figure 5: Opposition to Hydraulic Fracturing in Europe



Source: The Economist

While some have argued that hydraulic fracturing would not be commercially viable in France, this argument does not hold up when its potential reserves are taken into account. The United States Energy Information Agency estimates that there are 137 trillion cubic feet of "technically recoverable" gas reserves in France, equivalent to a decade's worth of national consumption.[29] This issue spans beyond which nations have the greatest recoverable reserves, to which nations feel that the technology is important enough to their energy security to sacrifice some of their environmental values. Countries like Britain and Germany, which have similar income levels and smaller shale gas reserves than France, have gone ahead with allowing fracking and issuing permits.

Hydraulic fracturing is especially appealing to the nations of Eastern Europe as there is less aversion to fossil fuels along with a strong desire to reduce energy dependence on Russia. Bulgaria is the only Eastern European country that has banned hydraulic fracturing. Poland and

[28] Jolly, 2013.
[29] Ibid.

Ukraine have been some of the most eager in Europe to sign fracking contracts. Poland has consistently vetoed and delayed EU attempts to tighten fossil fuel emissions due to its extensive coal reserves, so adding oil and natural gas (which burn cleaner than coal) would not be against its national preferences.

Additionally, eastern EU nations are keen for foreign direct investment of any kind, which has created a lightly regulated business environment. This has led to what many have dubbed a "race to the bottom" in the regulating environment of countries like Poland, Hungary, and Romania. They are generally not in favor of environmental regulations that are seen to drive away foreign direct investment.

Overall, to the extent that fracking gains support in Europe, it will delay the expansion of renewable energy. However curbs on fracking also have a negative impact on mitigation by giving coal a new lease of life that few foresaw a decade ago. Most emissions reduction scenarios for Europe still need to be revised in order to factor in the impact of fracking. Additionally, increased domestic energy security may make EU emissions regulations less popular, as energy efficiency will shift from a matter of national security to a matter of national preference.

The on-going crisis in Ukraine has increased the risk to Europe of a reduction or cut-off of natural gas supplies from Russia. Sources of LNG from the U.S. are often cited as an alternative to Russian gas exports. However, this is a mid-term strategy at best, as the U.S.'s first LNG export terminal, the Sabine Pass on the Texas-Louisiana border, with a capacity of up to 2bcm, will start pumping LNG only in 2015. Two dozen export applications are pending, though, and IHS anticipates that a burst of projects coming online in 2018–20 will bring America's total LNG export capacity to 66 BCM by early in the next decade.[30]

Nuclear Energy

While many nations in Europe are curtailing their nuclear ambitions, the prospects for nuclear energy are positive in several countries, particularly in Eastern Europe. While there has been some speculation about the death of nuclear energy following the Fukushima Daiichi power plant catastrophe, it has become clear that aside from Germany, a number of countries are in fact pursuing nuclear power as a means of diversifying their respective energy portfolios.

There are currently only two nuclear reactors under construction in Western Europe, including France and the UK. However, in Central and Eastern Europe, 15 nuclear power plants are currently under construction.[31] For example, Poland plans to build two new nuclear power plants over the next decade. By 2016 the sites of the two plants will be picked. Three years later construction is to begin and, by 2024, the first plant should be producing power.[32] Energy security concerns and greenhouse constraints on coal have combined to put nuclear power

[30] The Economist, 2014a.
[31] International Atomic Energy Agency, 2014.
[32] The Economist, 2013c.

back on the agenda for projected new capacity in many countries.[33] On the whole, the prospects for nuclear are not great in Europe, but there is some space for expansion, which could displace coal consumption.

Germany is clearly the strongest major opponent of nuclear power in Europe. The German nuclear debate goes back several decades, but the decision to slowly phase out nuclear dates back to the early 2000s. In 2000-2001, Environment Minister Juergen Tritten, with backing from Chancellor Gerhard Schroeder, led negotiations with Germany's utility giants, with the goal of securing an agreement to phase out nuclear power. Although the negotiations were contentious, Tritten succeeded in signing an accord; a piece of legislation, Germany's Nuclear Exit Law, soon followed, and mandated that utility companies close down their oldest reactors as part of a plan to phase out nuclear by 2020.

But policies are not the only indicator of widespread support of phasing out nuclear; public opinion polls in the late 2000s (pre-Fukushima) reflect this change in preferences for nuclear energy. The major political parties agreed that Germany should phase out nuclear – the differences are mainly over its timing. Policies of the German government pre-March 2011 indicate that nuclear was in a difficult political position even before the Fukushima disaster. In 2009, Chancellor Merkel managed to pass legislation extending the nuclear phase out in spite of public opposition, but reversed her decision after Fukushima. The government response – to shut down eight nuclear reactors in August 2011 – gained press attention and led many to believe that irrational fear was the main driver of the German state's response. However the decision to close several nuclear reactors and to phase out nuclear by 2022 only expedited a phase out process that German voters had consistently and strongly supported. The prospects for Germany reversing course on phasing out nuclear energy appear dim.[34]

EU Success stories: The challenges of scaling up

This section examines some EU emissions reduction success stories that are often ignored because they aren't occurring in the largest economies of the region. It explores whether or not there is opportunity for the strategies of smaller nations like Portugal and regions within larger countries – such as Bavaria -- to be applied to major economies.

Portugal

In Portugal, 70% of energy production in the first quarter of 2013 came from renewable technologies. The country has been one of the most successful countries in the world at integrating renewable power into its energy production portfolio. One of the key lessons from Portugal's success story is that countries seeking to scale up and incorporate renewable technologies need to incorporate a diverse renewables portfolio. Hydropower provided a solid baseline at 37% of energy production and wind provided 27% of the production power. Portugal even managed to export 6% of its electricity. This has allowed Portugal to sell off a

[33] World Nuclear Association, 2013.
[34] Stephenson-Reynolds, 2013b.

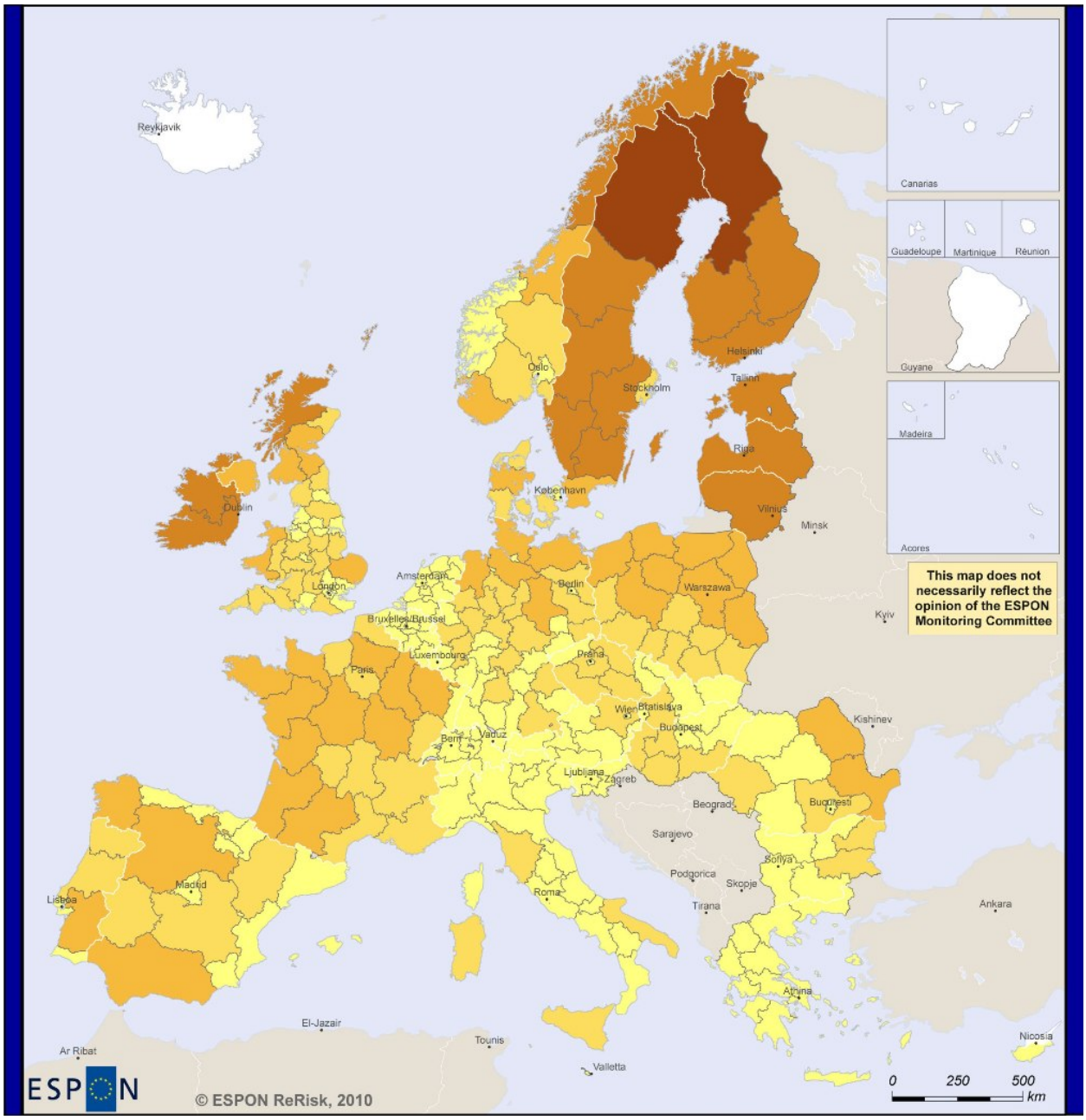
large portion of its emissions allocation credits and ensure long term energy security by decreasing its dependence on imported fossil fuels.[35]

Bavaria

Germany is facing many problems with its renewables programs; however, it is still amazing in the sense that Germany, a country not particularly well-endowed for solar and wind energy (figures 6 and 7), has managed to build up a huge renewable energy capacity in just a few years. Moreover, rural and traditionally conservative areas, such as Bavaria, in Southern Germany, have come to embrace renewable technologies because they benefit generously from subsidy programs. This is a case where incentives have in some sense been able to overcome a rural and conservative backlash against government intervention promoting the deployment of renewables. The case of Bavaria could offer instructive lessons for transforming Eastern European countries into renewable energy success stories.

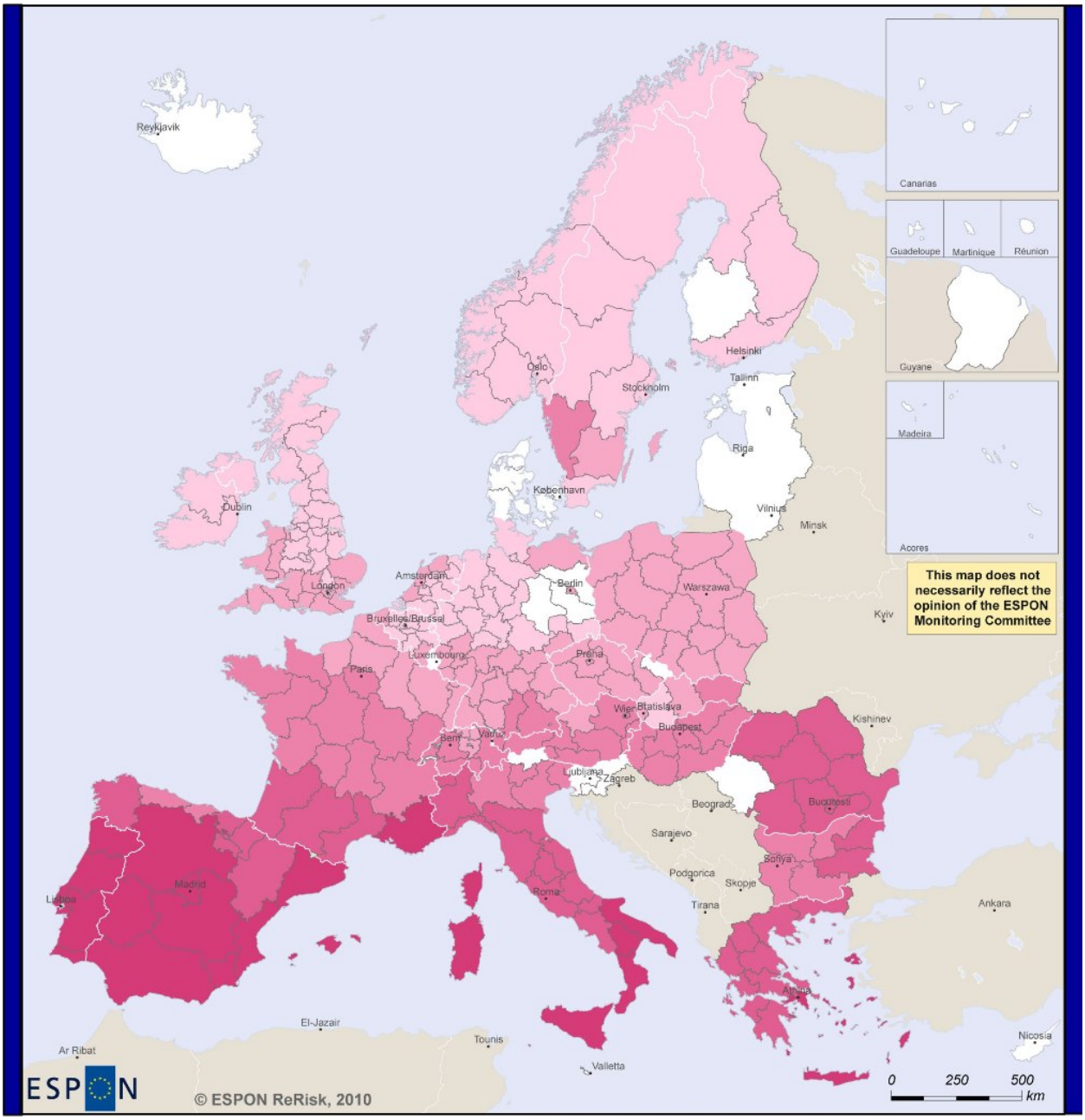
[35] The Energy Collective, 2013.

Figure 6: Wind Power Potential in Europe



Darker shades indicate higher potential. Source: ESPON, 2011

Figure 7: Solar PV potential in Europe



Darker shades indicate a higher potential. Source: ESPON, 2011

RECOMMENDATIONS

For CCS

In the energy production space and CCS, policy recommendations at both the EU and country-level are worth pursuing, including:

- *Fund CCS in coal-rich countries such as Poland.* The EU should ensure funding for CCS projects in coal-rich countries such as Poland; this will mitigate the financial barriers to CCS deployment.

The UK should:

- *Reduce risk aversion of utilities over CCS.* Work toward reducing the risk aversion of utilities to invest in CCS. This could take the form of increasing funding to CCS R and D activities in utilities, or providing some sort of insurance mechanism to utility companies should their CCS projects fail.
- *Foster knowledge.* Foster knowledge transfer about CCS projects from the oil and gas industry to the utility industry. This will mitigate some of the technical barriers to CCS deployment in the UK. Moreover, because production is fairly concentrated (6 utility companies), training and knowledge diffusion is a tractable challenge.

Germany should:

- *Educate the public.* Begin an educational public information campaign about the benefits and costs of CCS technology. Doing so might sway public opinion to a more favorable opinion on CCS, especially given Germany's reliance on coal for energy production.
- *Engage stakeholders.* Continue to foster an inclusive process of CCS deployment by engaging stakeholders early in the CCS exploration process.

The ETS

For the ETS, the EU should enact two key policies:

- *Reduce permits or harmonize national policies.* The EU should either aggressively reduce permits on market, or consider harmonizing national level policies with EU level policies.
- *Stop exemptions.* The EU should stop granting exemptions to some countries and industries. This is politically contentious, but a step toward removing market distortions. The withdrawal of these exemptions could be facilitated by offering concessions in other, non-climate areas.

Renewables

In the renewables space, two policies are worthwhile:

- *The UK should step up offshore wind and pursue other renewables.* The UK should continue to pursue renewables and nuclear energy development. It should seek to scale up its burgeoning offshore wind industry.
- *Assist Eastern Europe.* Wealthy EU countries should more aggressively assist Eastern European countries (Poland, in particular) to embrace renewables in lieu of coal-based power. Eastern European countries in particular have enormous potential for scaling up

renewable technologies. If economic barriers can be overcome, renewable technologies could make a large contribution toward securing Eastern Europe's energy security.

TRANSPORTATION

Background

The European Union accounted for 22% of overall transportation sector emissions, placing it second behind the United States which has a 29% share.[36] Transport emissions reductions are a challenge in Europe, as they have been a proven leader in emissions reduction strategies across the board. Ridership on public transportation is high, both in the poor and rich countries of the region. Additionally, more Europeans live within biking and walking distance of work, which keeps cities less congested. European emissions standards have been replicated around the world, and they continue to be the standard setter in the transportation space.

This regional paper uses the same Avoid, Shift, and Improve framework as outlined in the transportation sector paper and explores the opportunities for reduction accordingly. Essentially, this breaks up transport mitigation strategies into ones that *avoid* transportation whenever possible, *shift* passengers from highly carbon-intensive to less intensive methods, and *improve* the energy efficiency of carbon-intensive transportation methods when they cannot be avoided. In Europe, as in other regions, improve strategies form the bulk of the mitigation potential, but avoid and shift strategies are essential to realizing the 2DS scenario.

Avoid

The EU has many advantages over other developed regions of the world in the avoid space. One of the major reasons for this is the general compact layout of most of Europe's major cities. This is not mainly due to recent efforts but is actually a general legacy of Europe's pre-automobile development. This makes zero carbon transportation methods like walking and bicycling practical for a much greater percentage of commuters in many European cities.

Shift

One of the greatest challenges of the shift strategy in the EU is the already great numbers of riders, both within cities and between them. EU rail potential is saturated to the point where there would need to be a great expansion of capacity. The European Union, on the other hand, already possesses an extensive passenger rail system that connects almost every city. Since this infrastructure is present, and is already widely utilized, there is much less space for gains to be made by shifting to rail. By comparison, Americans drive for 85 percent of their daily trips, while Europeans opted for cars only 50-65 percent of the time.

In addition to physical infrastructure investments, the EU has also outperformed the United States in marketing and promotion of its public transportation options. While not as high as in the U.S., personal passenger vehicle usage remains high and contributes significantly to carbon emissions and congestion. As the European Union reaches a saturation point in terms of

[36] Ibid.,14, 99-100.

urban and highway congestion, public awareness campaigns regarding the benefits of reducing personal passenger transport in dirty combustion LDVs increased.[37]

Improve

The EU has been a proven leader in energy efficiency standards in all road vehicles, and this is exemplified by existing legislation. The Euro V emissions standards went into effect in 2009 and will be superseded by Euro VI standards in 2014. These standards do not limit CO_2 emissions directly but other exhaust emissions such as CO and particulate matter (Regulation (EC) No 582/2011). By reducing these other harmful vehicle emissions local air quality is improved, and the higher efficiency of the vehicles engineered to meet these standards in turn reduces the CO_2 emissions of European LDVs. Euro and CAFE equivalent standards are also increasingly being adopted in developing countries, due to the benefits for local air quality, which reduces the CO_2 emissions of LDVs, MDVs, and HDVs globally.

In addition to emissions standards for internal combustion vehicles, the EU is proving to be a valuable lab for testing the viability of alternative fuel options. Many of these new technologies are front-heavy in terms of infrastructure investment. Despite these high upfront costs, the EU is continuing to push forward with low carbon infrastructure investment. Since the European Union is already replete with diverse low carbon transport options and high speed linkages between cities, increasing the emphasis on providing fiscal incentives for electric vehicle (EV) infrastructure could increase demand for EV and hybrid vehicles in EU member states where market penetration has not reached its full potential.

In addition, the EU has been a leader in pushing for increased air and sea energy efficiency. Aviation emissions have been an ongoing bone of contention between the EU and many of its major trading partners. As part of its climate action plan, the European Union advocates a monitoring, results, and verification (MRV) approach to reporting emissions from maritime bunker fuels and also has an emissions trading system (ETS) in place to hold state actors accountable for their GHG emissions over EU airspace, though the ETS system is currently stalled.[38]

Aviation sector regulation has proven to be a controversial issue both within the EU and without. While the EU has advocated for a carbon tax on all flights originating or heading to EU airspace, American and Chinese airlines and governments have vehemently opposed this plan. This has led EU lawmakers to propose a compromise, in which EU airlines will only be taxed during their stay in EU airspace. This compromise is intended to stay in place until 2017, as the EU hopes that there will be a global air emissions regime in place by this time.[39]

EU as a Purveyor of Best Practices

While efforts to reduce carbon emissions within the EU will prove important for reaching global targets, some of the bloc's most important contributions will occur beyond its

[37] United States Department of Transportation, 2014.
[38] European Union, 2014.
[39] BBC, 2014.

borders. Many around the world see the EU as the standard setter for emissions reduction policy.

This is clearly seen in the transportation space, with the Euro IV standards serving as a guide for a number of developing countries. For example, China is currently active in employing emissions standards, especially in cities, which are required to abide by different regulations. The regulations in cities tend to be more stringent, but both sets of emissions are based on iterations of EU standards. China's urban emissions standards mirror those of the Euro IV, however most of the country is covered by China III standards (which mirror Euro III) while Beijing is subject to China V regulations.

Meeting emissions standards is of some concern to China, which primarily results from a need to appeal to the European Union due to strong economic ties. Thus, China could be persuaded to reduce its emissions out of a desire to keep its cities livable and its maintain strong relations with the European Union, who thus far have been the greatest champions of stricter emissions standards. Since the EU is China's largest trading partner, with $567 billion in annual trade, the opinions of the EU on environmental issues could prove to be highly influential in Chinese decision-making.

India too has adopted the Euro IV emissions standards for light duty vehicles and heavy-duty diesel vehicles.[40] Emissions standards for LDVs have been introduced in other countries as well, and usually follow the Euro V model. The Bharat III and China IV emissions and particulate standards emulate the effect of the Euro V and VI standards in regulating fuel efficiency, and continuing to encourage the spread of these and similar standards should remain a priority of global and country-level decision makers.

Transportation Success Story: Denmark/Copenhagen

Denmark has distinguished itself by taking some of the boldest measures toward carbon neutrality in the world. This is exemplified by its Carbon-Neutral Copenhagen 2025 strategy. This is a multifaceted strategy that includes avoid and shift transportation strategies, as well as investments in energy efficiency and renewable energy investment.[41] Copenhagen is working toward this goal despite the old age of most of its building, especially in its city center. It is currently expanding its metro capacity, with the goal that every resident will be within 500 meters of a station when the system expansions are completed.

Given that Denmark is itself a small country, there are concerns about how its strategy could be employed in the larger countries of the European Union. That said, despite the small size of the country, the city of Copenhagen is a major metropolitan area, ranking 33rd in size on the European continent.[42] Due to this large size, many of the strategies being employed there are applicable to most of Europe's major metropolitan areas.

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[40] Dieselnet, 2014.
[41] Gerdes, 2013.
[42] Danmarks Statistikbank, 2014.

BARRIERS

Avoid

The barriers to avoid technologies are significantly less in the EU as compared to the U.S., as congestion and distance-based fees are more common and have been used extensively to shape behavior. Additionally, the EU has been a leader in using biofuels in concrete mixes, which allow for less-carbon intensive transportation infrastructure investment. This will be discussed in greater detail in the energy efficiency section. In general, there are few barriers to avoid strategies in Europe.

Shift

The EU is already effective at encouraging low-carbon approaches to transportation such as subways, light rail, and bus rapid transit (BRT) systems. Most of its countries subsidize public transportation ridership, which leads to high usage both within and between major metropolitan areas. The major challenge in the future is likely to be market saturation, as crowdedness and non-availability of tickets may cause some to turn to personal passenger vehicles for a greater share of their passenger kilometers.

Improve

While the rich nations of Western Europe are very receptive to increasingly stringent emissions standards, there is much greater opposition to these standards in the eastern flank of the EU. While more energy efficient personal passenger vehicles will save drivers money on fuel in the long run, the high upfront cost of hybrid and electric vehicles renders them unaffordable to many EU citizens. Additionally, the high cost of alternative fuel infrastructure will prove to be a challenge, as EV charging stations will need to be installed both in city centers and between cities.

RECOMMENDATIONS

Avoid Recommendations

To support options in the avoid transport space, the European Union should:

- *Conduct case studies.* Conduct case studies on cap and trade policies' effect on member nations at the national level.
- *Continue smart growth policies.* Continue to pursue smart growth and Transportation Demand Management (TDM) policies like congestion pricing in local jurisdictions.

Shift Recommendations

To shift transport to more fuel-efficient options, the EU should:

- *Continue support for public transport.* Continue to pursue public transport as a primary option in local, intra-state personal travel and freight.
- *Expand incentives for electric vehicles.* Look to expand fiscal incentives for EV infrastructure and vehicle purchases.

Improve Recommendations

To improve existing transport options to foster efficiency, the EU should:

- *Support stricter fuel efficiency standards for vehicles.* Continue policies that incentivize fuel-efficient low-carbon LDV, MDV, and HDV technologies.
- *Expand infrastructure.* Expand electric vehicle charging infrastructure.

- *Scale up alternative fuels.* Continue to scale up alternative fuel use.
- *Internalize emissions costs.* Internalize cost of emissions from international air and sea transport

ENERGY EFFICIENCY IN BUILDINGS AND INDUSTRIES[43]

Background

While Europe's compact city design bodes well for transportation emissions mitigation, the aging buildings that comprise these cities poses a completely different set of challenges. The buildings of the EU are responsible for 1.5 $GtCO_2e$/year. This comes to 16% of global emissions in this sector, and 3% of global GHG emissions across all sectors. In total, the building sector offers a 2030 emissions abatement potential of 3.0 $GtCO_2e$. The E.U. can provide 15%. The makes energy efficiency the third largest potential area for emissions reduction in the EU.

EU Policy & Building Codes

The EU member states have mandatory Building Energy Codes (BECs) that apply to their entire building stock. This is the most unique aspect of the EU's codes, that there are no exemptions from them. In an attempt to find "low hanging fruit", the BEC offers several creative financing mechanisms to improve on building efficiency. Low hanging fruit is a term "used to designate energy efficiency measures that are the most cost-effective, least invasive and that tend to have quick payback periods and yield energy savings of up to 20-25% in some cases. This can include measures such as operation and maintenance, behavior change, and lighting upgrades."[44]

Retrofitting

The average age for most types of buildings in the EU is high. For example, the average age of chemical plants in Europe and North America are more than 20 years, compared to just 10 years in China.[45] On the other hand, many of the buildings that will be operating in 2050 in regions such as the U.S. and E.U. have already been constructed, meaning that retrofits could be a more viable option for potential emissions reductions.[46]

Recycling

Europe has less retired steel due to its aged infrastructure. This recycling could prove to be a large boon to emissions reduction in the EU, as many of its first generation steel buildings are reaching the end of their operational lives. Many of the EU's buildings are not steel based, so this will not produce the same dramatic potential that would be available in the U.S. Despite many of the older pre-steel buildings, this provides a chance for the EU to create at least some new energy efficient buildings.

There are also potential fringe benefits from fuel switching for the energy efficiency sector. In addition to switching to cleaner natural gas, biofuels can be easily adapted for cement

[43] The following is based on excerpts from companion paper in energy efficiency from Hulsey et al., 2014.
[44] The European Commission, 2013a.
[45] IEA, 2009.
[46] United Nations Environment Program, 2009,15.

production. Biofuel options include waste tires, plastics, chemical waste, waste pellets, wood waste, and sewage sludge. Currently, cement producers in Europe have been able to achieve substitution rates between 7% and 43% from these alternative fuels.[47] If these practices can be standardized, this would allow for much less carbon intensive construction methods to be employed in Europe.

BARRIERS

Many of the barriers in the energy efficiency sector in the EU are physical in nature. While there is great potential for retrofitting old buildings in Europe, these buildings will never be as efficient as newly constructed buildings that use new materials and construction methods. In order to protect many older historical structures, EU cities have allowed for the existence of "grandfather" clauses that exempt historical buildings from new building codes. Closing this gap could prove to be a boon for energy efficiency in city centers, but it will also meet great resistance from city residents and governments.

Additionally, biofuels are becoming increasingly important in EU building construction, but these alternatives are also increasingly controversial. Research has called into question whether many biofuels are actually "greener" due to the land use demands that they place. This debate will most likely rage in the EU for some time, at least until the mitigation potential behind biofuels becomes clearer.

RECOMMENDATIONS

- *Eliminate exemptions.* Eliminate grandfather clauses in EU Building Codes that allow older buildings to exempt themselves from energy efficiency standards.
- *Promote building codes internationally.* Continue to promote EU Building Energy Codes in large emerging economies, like China, India, and Brazil.
- *Require mandatory upgrades.* Close the mandatory retrofit and upgrade cycle and require all buildings to make improvements every ten years.
- *Include biofuel minimums for cement production.* Institute mandatory biofuel minimums for cement production, starting at 10% and then scaling up.

[47] IEA 2009.

CONCLUSIONS

This report has summarized some of the key obstacles to reducing greenhouse gas emissions within the European Union. As one of the largest emitters in the world, just behind the U.S. and China, the EU's climate policies matter greatly for the future of emissions reductions on the global scale. While the EU has been on the cutting edge of climate change policy for many years, it must not backslide on previous gains.

The report has identified key obstacles to further action including: member state disagreements at the EU parliamentary level, pressures for energy security in the areas of coal and natural gas (fracking), and the currently dysfunctional ETS system. It has also identified key policy recommendations with respect to important sectors.

At the general level, these include:

- *Push for stricter fuel efficiency standards.* Continue to push for stricter fuel efficiency standards on MDV's & LDV's, as well as investing in infrastructure for electric vehicles.
- *Repair the ETS.* Repair the serious market failure in the carbon ETS with country level incentive programs and exercising more forceful leadership to limit the actions of recalcitrant lobbies.
- *Resolve differences.* Resolve the sharp differences between the richer and poorer members of the EU on fossil fuel policies and renewables.
- *Aid developing countries.* Aid developing countries, especially China and India, in sharing best practices and technologies for climate mitigation.

At the sector-specific level, the EU should focus on the following:

- *Support CCS deployment in coal-rich countries.* Aid for scaling up CCS technologies especially in coal-intensive countries like Poland.
- *Foster knowledge transfer between industries.* Foster knowledge transfer about CCS projects from the oil and gas industry to the utility industry.
- *Provide support for electric vehicles*, including an expanded charging infrastructure.
- *Continue support for public transport,* including infrastructure and measures such as congestion pricing.
- *Apply energy efficient standards to old buildings*, bringing older buildings under energy efficiency requirements currently applicable only to new buildings.
- *Include biofuel minimums for cement production.*

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