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Enabling Renewable Energy and Energy Efficiency Technologies

Opportunities in Eastern Europe, Caucasus, Central Asia, Southern and Eastern Mediterranean

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INTERNATIONAL ENERGY AGENCY

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[1] The GEF is a partnership for international cooperation where 183 countries work together with international institutions, civil society organisations and the private sector, to address global environmental issues. Since its establishment in 1991, the GEF has provided $13.5 billion in grants and leveraged $65 billion in co-financing for 3,900 projects in more than 165 developing countries.

[2] Under FINTECC, the Early Transition Countries (ETC) are: Armenia, Azerbaijan, Belarus, Georgia, Kyrgyz Republic, Moldova, Mongolia, Tajikistan, Turkmenistan and Uzbekistan. The IEA-EBRD collaboration also considers Kazakhstan as a reference country within this grouping.

[3] For the EBRD, and for the purposes of the IEA-EBRD collaboration, SEMED refers to: Egypt, Jordan, Morocco and Tunisia.

Executive summary

IEA analyses have consistently pointed to the opportunity for renewable energy and energy efficiency to contribute to energy security, economic development and environmental protection goals, as well as to the crucial role of sound policy for supporting their maximisation.

This publication considers policy options for supporting the deployment of renewable energy and energy efficiency technologies (RE&EET), as well as the surrounding factors that can support – or indeed impede – the successful implementation of such support policies. Consistent with the IEA's current collaboration with the EBRD, and given the high potential for further RE&EE deployment in these regions, the paper gives particular consideration to the Southern and Eastern Mediterranean (SEMED) region and the Early Transition Countries (ETC), while drawing on energy policy experiences globally.

Given their extensive natural resource bases and projected growth in energy demand, the ETC and SEMED countries represent high priority energy regions. **In spite of considerable variations in characteristics such as size, geopolitical circumstances, energy endowment and economic outlook, on the whole, the countries in these regions possess great unexploited potential for both enhanced renewables deployment and for improvements in energy efficiency.** It is also notable that, for the most part, these regions are not accessing international climate and clean energy financing to the same degree as some other countries with similar levels of development. Well-designed government support for RE&EE may pave the way for increased access to such financing.

Creating an enabling environment

The opportunity to enhance RE&EE is not unique to countries in the SEMED and ETC regions. Globally, there exists huge potential for RE&EE to further support sustainable development. Yet, many countries struggle with setting – and implementing – policy mechanisms that support the uptake of these technologies. **Sound policy for RE&EE is dependent not only on the policy design itself but also on a wide range of underlying factors that may support, or hinder, the successful implementation of policy measures and the creation of an attractive investment climate.**

The constituting factors within a country that jointly support the deployment of RE&EE technology can together be described as the "enabling environment". **Given common barriers to RE&EET deployment, an enabling environment is crucial for low-carbon development in any phase of energy system or market maturity.** This paper describes cross-cutting enablers that can support RE&EET development based on five categories: technical factors, infrastructure and innovation factors; financial and market factors; social factors; regulatory and institutional factors; and environmental factors. Annex 1 provides a more detailed checklist of elements for assessing the overarching enabling environment and policy framework within a country.

Renewable energy

For renewable energy specifically, it is up to any single country to determine the most appropriate domestic policy mix based on national circumstances. At the same time, there is now considerable experience globally on effective policy tools for fostering enhanced renewable energy technology deployment.

A crucial overarching message is that policy frameworks should be suited to the level of market development, provide an adequate degree of stability for investment and project development, and yet also be capable of adapting as the market evolves. The paper sets out guidance based on three principal phases of deployment – Inception, Take-off and Consolidation or Mainstreaming, focusing principally on the first two given the status of RE deployment in the target regions. The paper looks specifically at policy measures for renewable heat, electricity and transport.

Policy plays a key role for renewable electricity because policies establish the level of confidence in the market, the market rules that govern the way electricity is sold, and the associated risk perception. This influences the pace of deployment and costs of generation. The policy and regulatory framework also determines the extent to which non-economic barriers – such as lack of market access, difficulties in gaining the necessary permits, and skills shortages – inhibit or push up the cost of deployment. Finally, the regulatory framework also determines how easily renewables can be integrated into grid operations, given technical as well as institutional considerations. Despite the importance of local context, existing experience suggests a basic set of policy principles for renewable electricity, as set out in the paper.

For renewable heat, the opportunities and the barriers to deployment are highly market and technology dependent. **Successful policy therefore depends on well-founded identification of the technology options that can best assist national energy aims, and an in-depth review of economic and non-economic barriers to progress.** A carefully designed and balanced policy portfolio is likely to be more successful and cost-effective than an approach which simply offers high financial incentives.

With regard to transport, biofuels are the principal renewable energy option in transport today, and deployment of biofuel technologies is also highly policy dependent. Policy measures to introduce biofuels need to focus on establishing targets accompanied by blending mandates, often complemented with financial support tools such as tax exemptions. It is crucial that efforts to develop biofuels are complemented by a strategy that takes into account potential land use and sustainability impacts. While biofuels are unlikely to play a large role in SEMED and ETC countries in the near term, they should certainly be borne in mind for the medium- to long-term policy mix.

Renewable energy in SEMED and ETC

In recent years, the SEMED countries under study in this paper have made considerable strides in the area of RE policy. Morocco in particular has developed a range of policy tools and institutions that could serve as examples for others in seeking to increase the market penetration of RE technologies. The SEMED countries could benefit from continuing to augment and adapt their RE policy support portfolio and to ensure consistent enabling conditions, such as the removal of fiscal support measures for fossil fuels.

The potential for RE in ETCs, such as wind and solar in Mongolia to name but one example, is significant—and largely untapped. Policy developments in Kazakhstan, Azerbaijan, Georgia and Moldova are notable, in terms of primary legislation for overall RE targets and licensing/permitting to encourage investment. The same cannot be said for secondary, supporting legislation or for concrete evidence of the emergence of RE technology deployment domestically beyond isolated instances. **On the whole, the renewable energy market in the region remains nascent, with small hydro and biofuels having had the most success, due largely to inability to attract investors given competitive pricing from other energy sources and an absence of clear and enforceable rules for grid modernisation and integration.** Further government effort will be required to address these barriers. Target actions could include:

strengthening national RE strategies with quantitative targets; fair market and grid access and predictable remuneration for renewable generators; clear and transparent permitting procedures and a supporting institution for implementing and monitoring; consistent and comprehensive primary and secondary legislation; a minimisation of contradictory support policies for fossil fuels; and modernisation of network and transmission systems to allow for grid integration of renewables.

Energy efficiency

In the case of energy efficiency, IEA analyses suggests that a cross-cutting national energy efficiency plan, that takes account of wider energy and economic objectives, includes measurable energy savings targets, and is accompanied by political support and an adequately resourced agency responsible for implementation and monitoring, can provide a solid foundation for supporting EE improvements. Sound methods and institutions for energy data collection and analysis are related key components for rolling out EE programmes and measuring energy savings.

Concerning transport, a host of complementary policy tools can help to realise strong efficiency improvements, such as mandatory vehicle efficiency standards, measures to improve vehicle fuel efficiency, fuel-efficient non-engine components, improving vehicle operational efficiency through eco-driving and other measures toward transport system efficiency. Some key policy measures could make a considerable difference in the target regions, particularly in the SEMED-Arab region, which has the most energy-intensive transport sector globally and where transport is the fastest growing energy-consuming sector in the region.

As for buildings, if one considers a building as a complex system with a variety of distinct, but interacting, dimensions, **a multi-dimensional, holistic energy policy package is required to integrate the various factors that influence their energy consumption.** This package should include mandatory building energy codes and minimum energy performance standards (MEPs), eventually aiming for net-zero energy consumption in buildings, improving the energy efficiency of existing buildings, building energy label or certificate programmes, improved energy performance of building components and systems, reform of the district heating sector and public information campaigns.

Regarding appliances and lighting, regulatory policies appear to deliver significant gains in reducing the electricity consumption of electrical equipment, compared to other policy measures. In addition, early signalling and delivery of a comprehensive policy plan is a successful method of driving markets further and faster than can be achieved through commercial development alone. Mandatory energy performance requirements and labels are more effective when they are complemented with a package of measures that accelerate the transformation of the appliance market towards high-efficiency products, including test standards and measurement protocols, and efforts to phase out inefficient lighting systems.

In the case of the industrial sector, much of the potential to save energy can be captured through policies for promoting use and optimisation of energy efficient industrial equipment and systems, and improving overall efficiency through energy management. Industrial energy efficiency can also be improved by an integrative policy framework that includes the removal of energy subsidies, internalisation of environmental costs, targeted incentives and ready access to financing, as well as targeted policies for key sectors, and for small- and medium-sized enterprises.

Energy efficiency in the SEMED and ETC regions

Both the ETC and SEMED regions possess significant potential to make strides in the area of energy efficiency. The ETC region remains highly energy intensive, reflecting continuing inefficiencies in buildings, appliances, and the way energy is used by consumers, as well as climatic and structural economic factors, including electricity infrastructure systems inherited from the Soviet period**. All sectors present opportunities for savings in the ETC region, particularly industry and buildings, especially district heating. In the SEMED region, further attention could be given to transport and buildings, particularly in relation to efficient cooling and lighting.** In both regions, a logical starting point within industry may be SMEs given the high proportion of industry in both regions that comprise this category of company.

Barriers to the achievement of enhanced energy efficiency in both regions include lack of dedicated agencies to coordinate end-use data collection and monitor progress against energy efficiency targets. Of the fifteen countries examined, the majority have national energy efficiency targets of some sort, although these vary in ambition and there are still some without any targets at all (such as Jordan, Georgia, Mongolia and Turkmenistan). Of the countries with targets, many do not necessarily have comprehensive strategies in place to achieve their aims, with some having implemented overarching legislation without detailed secondary legislation (e.g. Tajikistan). Morocco is a leader in its region for having both an energy conservation target of 12% by 2020 and a supporting strategy. Of the ETCs, Kazakhstan emerges as a regional leader, with a target to reduce energy intensity 25% by 2020 linked to its Energy Efficiency Program 2020, which incorporates 78 activities (IEA, 2015b). Concerning institutional arrangements, Tunisia, Morocco and Moldova are notable for the existence of a dedicated institution for energy efficiency (and in some cases also for RE), while in most other countries, responsibility for EE policy, energy end-use data collection and analysis, rests predominantly with an overarching ministry, which can influence the success of meeting targets.

Conclusion

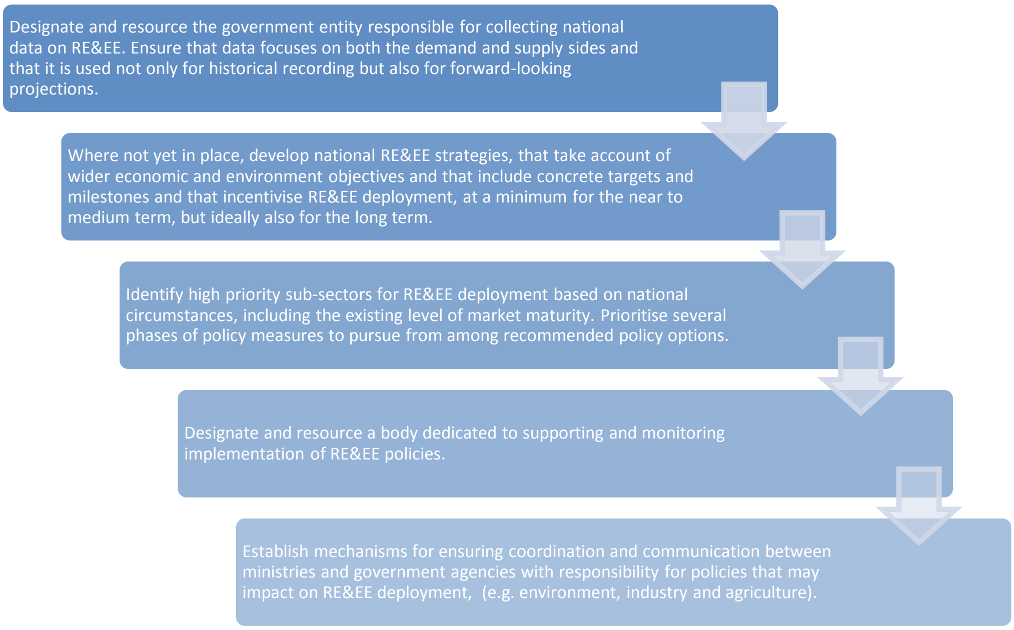
In concluding, the paper notes that while particular national circumstances will determine the appropriate policy mix, a range of policy options have already proven effective across a number of country contexts. These policies provide a sound basis for enhanced action in ETC and SEMED countries. Bearing in mind that fiscal and capacity constraints may limit SEMED countries and ETCs countries from rolling out multiple sub-sectoral policies simultaneously, the steps in Figure 1 are suggested for possible priority action in the near term. The recommended steps commence with a focus on data, given the **need for enhanced data collection efforts** in all countries under study. Coordination between energy ministries/agencies to improve data collection produces significant inputs and outputs at various stages of RE&EET policy delivery, as well as multiple benefits for a wide range of national purposes.

Consistent with recent IEA analyses (such as *ETP 2015*), the paper suggests that efforts to support the market penetration of clean energy technologies are best set within the context of wider energy and economic strategies. While strongly advocating for the creation of dedicated RE&EET institutions, the paper also promotes the idea that such agencies should not operate in a "policy silo". Instead, agencies dedicated to RE&EET deployment should be conscious of wider national policy aims (in the energy sector and beyond), and where possible, develop integrative policies that achieve multiple outcomes. In the SEMED and ETC contexts, RE&EET policies must maintain consistency with broader sustainable development goals.

While the paper focuses on national level policy, the conclusion also highlights the potential value of regional and international collaboration, noting a range of opportunities that exist in

the ETC and SEMED regions (Table 8). Such collaboration can provide a useful means of sharing policy experiences and developing capacities, and strengthen opportunities for accessing climate and clean energy finance.

Figure 1 • Recommended steps for near term action[4]



[4] Unless otherwise stated, information in figures, graphs and tables derives from IEA data and analysis.

Introduction

The important role of energy in powering and supporting global economic growth is undisputed, and global energy demand is estimated to increase by more than one-third over the period to 2035 (IEA, 2014f). The challenge of universal access to affordable, secure and sustainable energy supplies is immense. At the same time, the energy sector comprises approximately two-thirds of greenhouse gas (GHG) emissions, unequivocally making it a critical focus for action on international, national and local scales to respond to the challenges posed by climate change. Even with the onset of increased multilateral collaboration on energy issues and climate policy within the last decade (IEA, 2014c), the call for bolder policy and more rapid implementation of low-carbon energy technology solutions is ever-present.

IEA analyses have consistently highlighted the critical role that RE&EET must play in contributing to decarbonising the energy sector. *Energy Technology Perspectives 2014* estimates that end-use energy efficiency accounts for 38% of GHG emission reductions between the 6°Celsius Scenario (6DS) and the 2°Celsius Scenario (2DS), while renewable energy must account for 30% (IEA, 2014a). Importantly, the rollout of RE&EET can bring a range of benefits, including enhanced energy security through supply diversification and reduced fossil fuel import dependency, reduced local air pollution, increased access to modern energy services and related support for enhanced economic and social development.

These benefits are increasingly supported by favourable markets and investment opportunities. The IEA *Energy Efficiency Market Report 2014* (IEA, 2014d) estimates that investment in energy efficiency markets worldwide in 2012 was between USD 310 billion and USD 360 billion. Investment in energy efficiency was larger than supply-side investment in renewable electricity or in coal, oil and gas electricity generation, and around half the size of upstream oil and gas investment (IEA, 2014d). Renewables are facing strong growth due to increasing cost-competitiveness and evolving policy environments. In 2013 alone, global renewable electricity generation rose by an estimated 240 terawatt hours (TWh) to reach nearly 5 070 TWh and accounted for almost 22% of total power generation (IEA, 2014b).

The global market is ripe for RE&EET investment and deployment, with the amount of international climate and clean energy financing also growing. In 2013, annual global climate finance flows[5] totalled approximately USD 331 billion, comprising USD 137 billion provided by public actors and intermediaries[6] and USD 193 from private investors[7] (CPI, 2014). This finance flowed almost equally to OECD member and non-member economies, at USD 164 billion and USD 165 billion respectively (CPI, 2014).

The countries that seize the opportunity to become leaders in RE&EET may have a significant advantage in accessing such funds as well as in responding to energy challenges in the coming decades of energy sector evolution. For the purposes of this paper, it is thus notable that the ETC and SEMED regions are not accessing international climate and clean energy financing to the same degree as some other countries with similar levels of development: only 4% (USD 10 billion)

[5] Including balance sheet financing, project-level equity, project-level market rate debt, low-cost debt and grants.

[6] Finance from public actors includes from development finance institutions, multilateral and national climate funds, direct government investments in renewable energy, direct public contributions from government agencies and ministries (including official development assistance (ODA) marked as having "climate change mitigation" or "adaptation" as its principal objective).

[7] Private actors include established national/regional energy utilities, independent power producers, other project developers specialising in renewable energy (including state-owned enterprises) and energy efficiency, corporate actors (including manufacturers and corporate end-users), commercial financial institutions, private equity, venture capital, infrastructure funds and institutional investors.

of the above-mentioned global finance was received by the ETC region in 2013[8] and just 1% (USD 4 billion) was received by the Middle East and North Africa region over the same time period. This compares to 30% in East Asia and the South Pacific (CPI, 2014). Investors face numerous types of market, environmental, technical, political and regulatory risks. To maximise climate and clean energy financing, governments must seek to create enabling environments that minimise such risks, for example through creating systems capable of assuring legal protection, planning for the establishment of financial sectors and providing multilateral agreements on investments (IEA, 2014f).

IEA analyses indicate that while a portfolio of RE technologies are becoming cost-effective in a growing range of circumstances, in many cases, both economic and non-economic barriers continue to hinder deployment opportunities. Even in instances where renewable energy technologies could be competitive, deployment can be hindered by regulatory uncertainty, inefficient institutional or administrative arrangements, infrastructure that is ill-suited to distributed energy supply or the high upfront capital demand of some RE technologies (IEA, 2011). The story is similar for energy efficiency, with key barriers in developing countries often including information asymmetries, subsidised energy prices, a lack of integration of EE strategies within the broader policy framework of economic development, poor EE governance, under-developed energy efficiency services markets and perceptions of high-risk associated with EE projects (IEA, 2012b).

The enhanced deployment of RE&EET requires both sound policy, and a wider enabling environment that effectively addresses potential barriers, be they economic or non-economic. Often, enhanced deployment also requires coordination across provincial or even national boundaries, spanning governing systems. It is also crucial to link policy dialogue to investment efforts through collaborative development with government and stakeholders, to produce "investment-grade policy" (EBRD, 2014).

This paper seeks to highlight policy instruments that can most effectively play a role in supporting and accelerating the deployment of RE&EET, taking account of global experiences but with a focus on the SEMED and ETC regions. Drawing on a wealth of IEA analyses, a wide range of additional resources and discussions at an IEA workshop on this topic in September 2014, the paper:

- provides a summary of the energy profiles for the ETC and SEMED regions, noting significant country and resource variations and comparisons;
- highlights overarching, "enabling" factors that can help set the necessary foundations for implementing policy to support RE&EET deployment (and, using the same analytical framework, summarises potential barriers and response actions in Annex 2);
- analyses policy options for both RE and EE, drawing on practical examples and highlighting indicative policies that correspond with varying levels of market maturity; and
- provides a checklist for assessing the level of supportiveness of national policy frameworks for RE&EET (Annex 1).

[8] This figure of 4% for the ETC region does not include Mongolia, although Mongolia also receives very little climate or clean energy financing.

Energy profile of the ETC and SEMED regions

Reviewing the energy profiles for the ETC and SEMED regions in this paper sets the context for historic and current energy trends in two regions that present valuable opportunities for sustainable growth, particularly within the energy sector. The four SEMED countries examined cover approximately 1.7 million square kilometres, while the eleven countries in the ETC region cover 7.5 million square kilometres. Together, the population of these regions is roughly 290 million. All of the countries included have significant ethnic, historical and economic differences, and vary in size, geopolitical location, energy endowment, economic outlook and developmental milestones and prospects. Nonetheless, situated in proximity to the West, East and the major oil-producing Middle East, and given their extensive natural resource bases (both utilised and under-utilised potential), the ETC and SEMED countries are high priority energy regions.

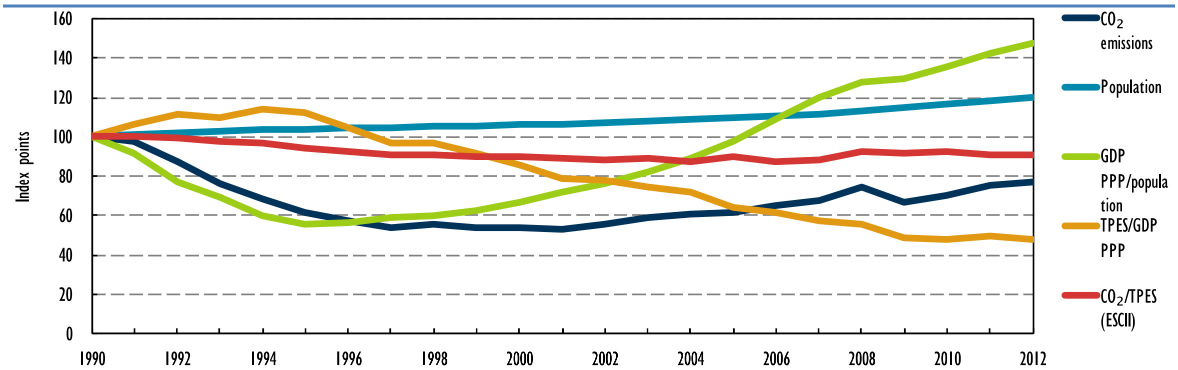
ETC region

For the purposes of this study, and the IEA-EBRD collaboration from which it derives, the ETCs reviewed include the Republic of Armenia (“Armenia”), the Republic of Azerbaijan (“Azerbaijan”), the Republic of Belarus (“Belarus”), Georgia, the Republic of Kazakhstan (“Kazakhstan”), the Kyrgyz Republic (“Kyrgyzstan”), the Republic of Moldova (“Moldova”), Mongolia, the Republic of Tajikistan (“Tajikistan”), Turkmenistan and the Republic of Uzbekistan (“Uzbekistan”), with a total population of just over 100 million. A critical common factor is their shared Soviet past, resulting in similar economic and governance structures, public institutions and infrastructure inherited from the previously common system. As political and economic situations continue to develop, the divergence of new regional preferences also emerges, based on varied national aspirations and resource availability. Throughout these transformations, the energy sector has suffered in many instances, with energy infrastructure working beyond its designed lifespan, resulting in a failure to absorb and utilise newer technologies. The potential to incorporate vast indigenous renewable energy sources and enhanced energy efficiency has remained largely untapped due to such aged infrastructure.

During the 1990s and into the 2000s, the energy intensity of ETC economies declined, primarily because of structural changes to these economies resulting from the break up of the Soviet Union. Figure 2 shows that as the decline in GDP outpaced the decline in total primary energy supply (TPES), the energy intensity of the economy (TPES/GDP PPP) initially increased but then declined steadily. Correspondingly, CO_2 emissions decreased sharply in the early 1990s in concert with falling GDP per capita. In the mid-1990s, GDP per capita began to recover and has since grown steadily. For nearly two decades, even as the population grew and standards of living and economic growth improved, declines in energy intensity (from very high levels during the Soviet period) meant that CO_2 levels remained fairly flat. However, in recent years, energy consumption in the ETC region has been growing such that the energy intensity of the economy (TPES/GDP PPP) is no longer decreasing. CO_2 emissions are also beginning to rise again after a small decline following the Global Financial Crisis.

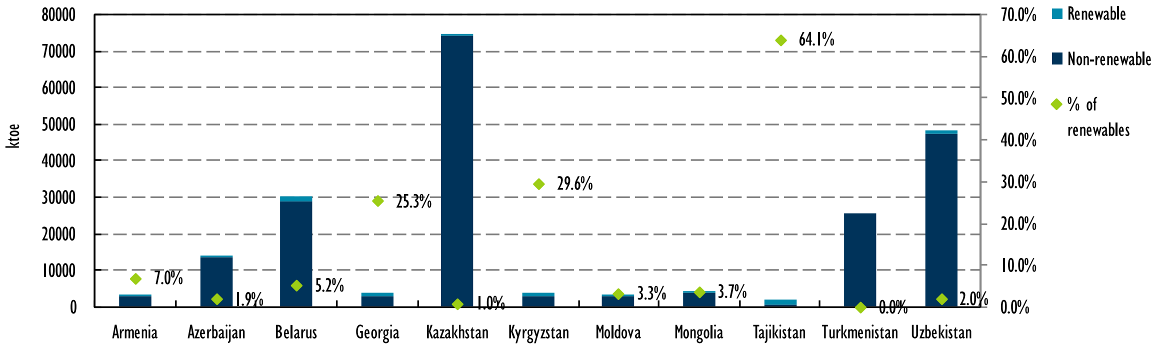
The ETC region is abundant with diverse energy resources, including hydrocarbon, hydro and renewable energy resources, concentrated around the Black and Caspian Sea basins. The sources forming the electricity mix vary considerably among the countries in the region. With giant oil and gas fields in Azerbaijan, Kazakhstan, Turkmenistan and Uzbekistan that place the Caspian region among the richest worldwide, gas is the dominant fuel for electricity generation. Kazakhstan, Mongolia and Ukraine also possess large coal deposits, and Belarus peat deposits, while Tajikistan, Kyrgyzstan and Georgia top the list of countries with ample hydro resources.

Figure 2 • CO_2 emissions and drivers in the ETC region



Notes: Kaya decomposition: CO_2 emissions = CO_2/TPES x TPES/GDP x GDP/population x population. 1990 = 100.
Source: IEA (2014f), *CO_2 Emissions from Fuel Combustion*, OECD/IEA, Paris.

Figure 3 • Renewable and non-renewable sources of total primary energy supply (TPES) in ETCs (2012)



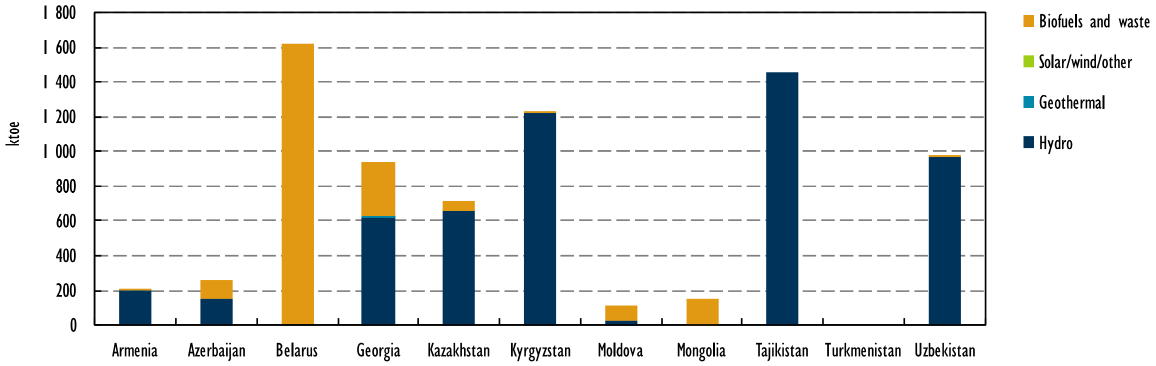
Source: IEA (2014n), *World Energy Balances*, OECD/IEA, Paris.

Figure 3 shows the contribution of renewable energy to TPES for each country in the ETC region in 2012. Unsurprisingly, given the size of its population and economy, Kazakhstan consumed the most primary energy in 2012 at 74 852 ktoe. At the other end of the scale is Tajikistan, which consumed just 2 267 ktoe of primary energy in 2012, despite having a population close to half the size of Kazakhstan's. This large disparity in energy use is explained by the fact that Tajikistan's economy was also much less developed, with GDP per capita of just USD 953 compared to Kazakhstan's USD 12 120 (World Bank, 2015), hinting at the regional diversity between the ETCs in terms of economic development.

Figure 3 also shows how little of Kazakhstan's TPES was supplied by renewable energy sources at just 1%, the second lowest in the region, above only Turkmenistan, which effectively consumed no renewable energy. The other major consumers of primary energy are Belarus, Uzbekistan and Turkmenistan. Of these, Belarus stands out for having used the highest percentage of renewable energy at 5.2% of TPES. At 1,590 ktoe this was also the highest amount of renewable energy consumed by any country in the ETC region in 2012, the majority of which came from biofuels and waste (IEA, 2015b).

Proportionally to TPES, Tajikistan emerges as a clear regional leader in renewable energy use, with 64.1% of its TPES sourced from renewable energy. Other countries with high proportions of renewable energy for TPES include Kyrgyzstan at 29.6% and Georgia at 25.3%. Figure 4 examines the breakdown of renewable energy sources in TPES. 100% of renewable energy generated by Tajikistan, Kyrgyzstan and Uzbekistan and 96% and 92% for Armenia and Kazakhstan respectively was hydropower for electricity. Georgia's renewable energy use was also predominantly hydropower, with one-third sourced from biofuels and waste. Belarus and Mongolia's use of renewable energy was limited to biofuels and waste (Figure 4).

Figure 4 • Renewable sources of total primary energy supply (TPES) in ETCs (2012)

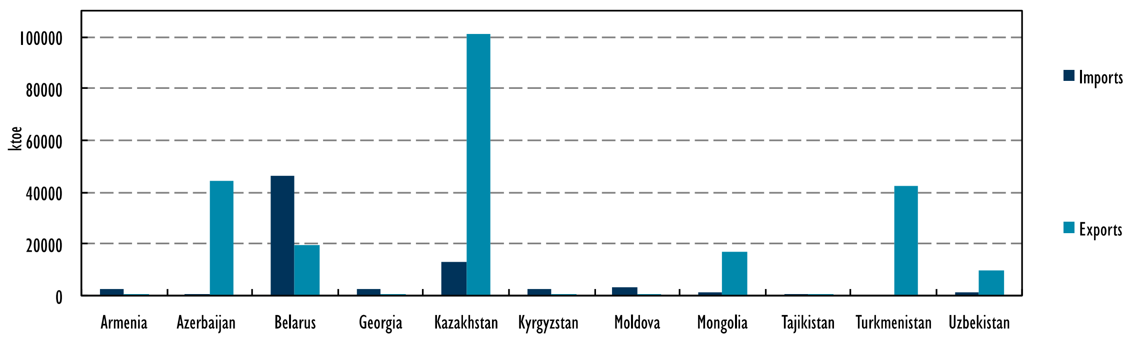


Source: IEA (2014n), *World Energy Balances*, OECD/IEA, Paris.

Figure 4 shows that the contribution of modern renewables (such as solar and wind) remains marginal across the region, significantly hindered by sector inability to attract investors due to evident price competition from other sources and conventional fuel resource and industry prominence, as well as government and grid capacity. However, recognition and promotion of possibilities for the development of renewable energy is on the rise in certain countries in the ETC region. Some countries in the region have set ambitious goals for renewable energy and primary source diversification, principally Kazakhstan with its goal for a 50% share of alternative and renewable sources in its primary energy mix by 2050.

A comparison of Tajikistan and Turkmenistan is notable because of their divergent energy profiles and resources. Both Turkmenistan and Tajikistan use resources that are abundant domestically, but the contrast between the type of energy used by each and the impacts of this, for example on national CO_2 emissions, is significant. While Turkmenistan currently uses close to zero renewable energy, the country has tremendous potential wind and solar resources, with wind energy potential estimated at 500 GW, or which 10 GW could be feasibly developed in the mid-term (IEA, 2015b).

Figure 5 • Total imports and exports in ETCs (2012)



Note: Data includes imports and exports of coal, crude oil, oil products, natural gas, nuclear, hydro, geothermal, solar, biofuels, waste, electricity and heat.

Source: IEA (2015e), Statistics database for energy balance flows for 2012, IEA/OECD, Paris, www.iea.org/statistics/statisticssearch/report/.

Figure 5 shows the level of total energy imports and exports across the ETC region. The figure points to the fact that some ETCs are now significant global suppliers of energy. Kazakhstan is the largest energy exporter in the region, with oil exports accounting for nearly 80% of the country's total energy exports (EC, 2015). Azerbaijan and Turkmenistan are also significant energy exporters, with both countries exporting most of the oil and gas they produce (IEA, 2015b). This has implications for these countries' own energy consumption as energy extraction and conversion processes tend to be very energy-intensive activities.

Belarus is the region's top importer (primarily oil and natural gas), but also exports oil and oil products to its main trading partners, the Russian Federation ("Russia") and the European Union ("EU") (MFA of the Republic of Belarus, 2014). Given its reliance on energy imports, a main priority for Belarus is to develop its indigenous resources (including renewables) further, to provide a reliable and sustainable energy supply for the national economy (IEA, 2015b).

Most countries have put in place strategies and financial support mechanisms (including green tariffs in some cases) and relaxed investment procedures for developing renewable energy potential. However, these measures do not appear to be sufficient in reaching the expected level of renewable technology deployment (IEA, 2015b). Common barriers that hinder RE deployment include the absence of secondary legislation that elaborates on legal, regulatory and financial mechanisms and clear and enforceable technical rules for grid integration. Low feed-in tariffs in some countries are also a barrier to renewable energy deployment, from the perspective of private investors. Governments could also greatly benefit from cost benefit analyses, considering all renewable resources and available technologies with competitive advantages to help them further develop renewable energy strategies and promote sustainable sector development (IEA, 2015b).

The ETC region remains highly energy intensive despite declines in TPES/GDP and carbon intensity (as shown in Figure 2), reflecting continuing inefficiencies in the way energy is used, the remnants of and responses to Soviet era power infrastructure, climatic and structural economic factors. Many countries in the ETC are yet to fully implement energy price reforms, providing little incentive for energy consumers to change behaviour. Turkmenistan continues to provide consumers (including households and the agricultural sector) with free electricity up to a certain level of consumption (25 kWh per person per month). While it is understandable that governments wish to insulate certain vulnerable consumers from rapid price increases, IEA analysis suggests that energy price reform can be a key driver of efficiency improvements. Energy price reforms may also provide a vital source of revenue, which could be used to upgrade aging transmission and distribution infrastructure so that grids will be both more energy efficient and able to support additional renewable generation.

Figure 6• Energy consumption by sector in the ETC region (2012)

Source: IEA (2014n), *World Energy Balances*, OECD/IEA, Paris.

Figure 6 shows energy consumption by sector in the ETC region. The largest energy consuming sector is industry at 32%. Residential users are the next highest at 26% followed by transport (16%). The relatively high percentage of energy used by the residential sector indicates the considerable potential for energy savings in district heating and buildings. Electricity generation and networks, and industry, have been identified as other key areas for energy savings. In total, the energy savings potential is enormous; if the region were to use energy as efficiently as OECD countries, for example, the consumption of primary energy in the Caspian as a whole would be cut by one half (IEA, 2015b), which could simultaneously provide countries with multiple benefits such as improved industrial productivity and service to customers (see Box 6 for more on the multiple benefits of energy efficiency). There is large scope for raising public awareness on the tangible benefits of both RE&EE, which may help to stimulate uptake of variable renewables into power systems and markets.

Policy makers in ETCs are beginning to recognise the value of increasing energy efficiency and as a result, many countries have set high-level EE targets. Armenia, Azerbaijan, Belarus, Kazakhstan, Moldova and Tajikistan each have some form of EE targets in place (IEA, 2015b). As with RE, translating these targets into tangible improvements in EE will depend on how well ETCs are able to implement secondary legislation and implementing institutions to support national targets.

Throughout the region, RE&EE technologies face similar challenges brought about by insufficient energy infrastructure that can impede the absorption of new technologies. Another key barrier to energy efficiency improvements is the lack of dedicated national agencies to co-ordinate end-use data collection and in turn, lack of sector-specific energy efficiency targets and ability to monitor progress. (See Box 5 for more details on barriers to EET deployment in the ETC and SEMED regions.)

SEMED region

Consistent with the IEA-EBRD collaboration that supports this paper, the SEMED countries[9] examined comprise Egypt, Jordan, Morocco and Tunisia, with a combined population of 134 million. A snapshot of these countries today reveals a diverse profile in terms of infrastructure, resources, political situations, socioeconomics and culture. Nonetheless, these countries share commonalities that affect the energy sector. These include structural factors such as costly fuel subsidy programmes, large fiscal and external deficits, and – in some instances – the possibility of instability that has the potential to enhance risk perceptions or compromise the medium-term development of the region as a whole (World Bank, 2014).

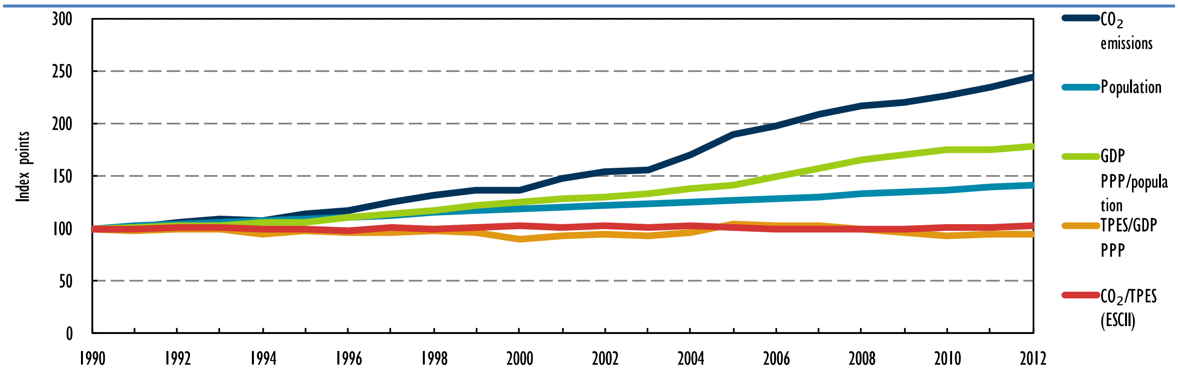
In spite of a somewhat gloomy outlook, it is expected that economic growth will pick up between 4.2% and 5.2% in 2015 based on an increase in public and private consumption from expansionary fiscal policies, subsidy reforms in Morocco, Egypt and Jordan, and easing political tensions in Egypt and Tunisia (World Bank, 2014). While there are significant regional challenges, the SEMED countries benefit from being endowed with a plethora of natural resources, including oil and gas reserves and promising abundant solar and wind potential that is currently underutilised.

With relatively unchanged carbon intensity of the energy mix (CO_2/TPES) and energy intensity of the economy (TPES/GDP), CO_2 emissions have more than doubled since 1990, following population growth and growth in per capita GDP (Figure 7). CO_2 emissions exceed the rate of

[9] Typically, the MENA region covers a far wider geographical area. The four countries selected for study in this paper are synonymous with the EBRD's collaboration with the "SEMED" region.

increase for population growth and all of the other variables. This is partly due to unrestrained subsidisation of energy prices, which can lead to high consumption.

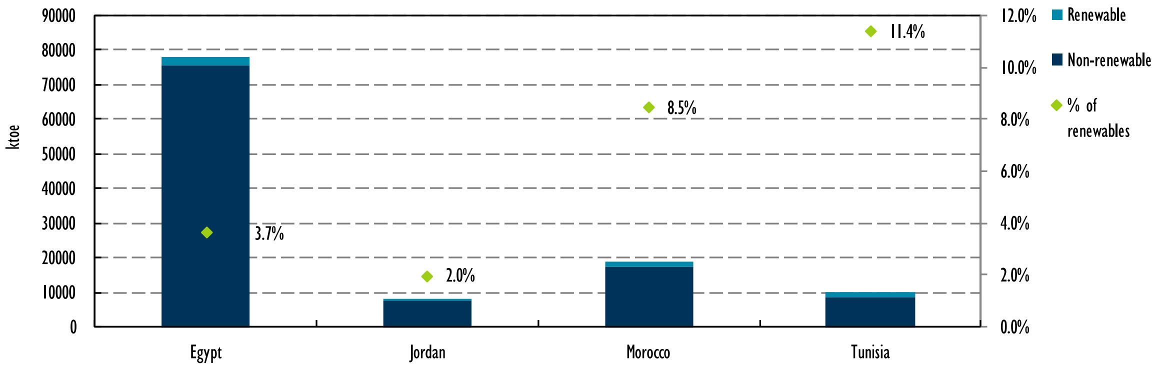
Figure 7 • CO_2 emissions and drivers in the SEMED region



Note: Kaya decomposition: CO_2 emissions = CO_2/TPES x TPES/GDP x GDP/population x population. 1990=100.
Source: IEA (2014f), *CO_2 Emissions from Fuel Combustion*, OECD/IEA, Paris.

Like the ETC region, gas is currently the dominant source of primary energy. All of the SEMED countries derive the majority of their primary energy supply from gas, oil or coal. Historically, renewables have played a minor role in the region due to the abundance of low-cost and typically subsidised oil and gas (REN21, 2014a). Public sector reform and greater inter-regional equity (particularly in Egypt and Tunisia) are factors currently causing uncertainty and are cited as factors hindering domestic and foreign investment to trigger sustainable growth (REN21, 2014a).

Figure 8 • Renewable and non-renewable sources of total primary energy supply (TPES) in SEMED countries (2012)

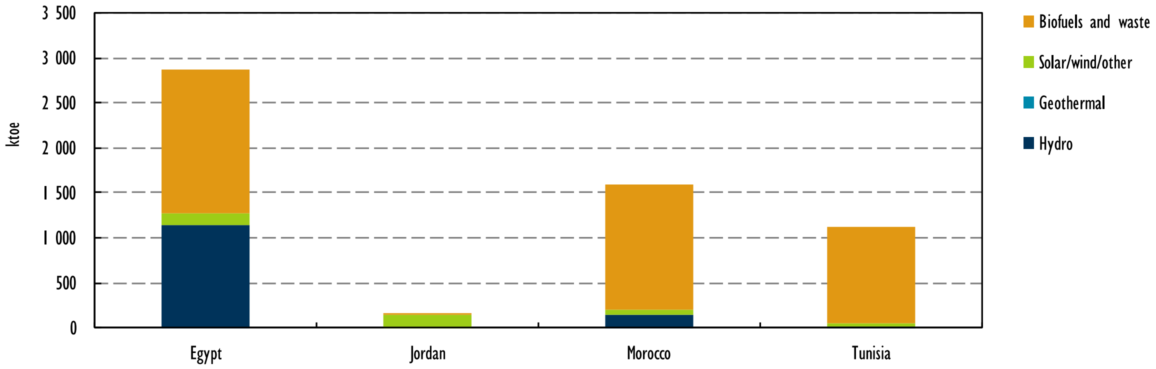


Source: IEA (2014n), *World Energy Balances*, OECD/IEA, Paris.

Figure 8 shows total primary energy supply (TPES), and the contribution of renewable energy to TPES for each country in the SEMED region in 2012. It shows that in 2012 Egypt consumed by far the most primary energy of the four SEMED countries at 78 214 ktoe, which was mainly used for transport and industry. While only 3.7% of Egypt's TPES was sourced from renewables, at 2 872 ktoe this was the highest amount of renewable energy sourced amongst the four SEMED countries. Morocco used the second highest amount of renewable energy at 1 589 ktoe followed by Tunisia with 1 127 ktoe, while for Jordan, TPES was dominated by non-renewable sources (7 472 ktoe) with renewable energy sources comprising just 152 ktoe of TPES.

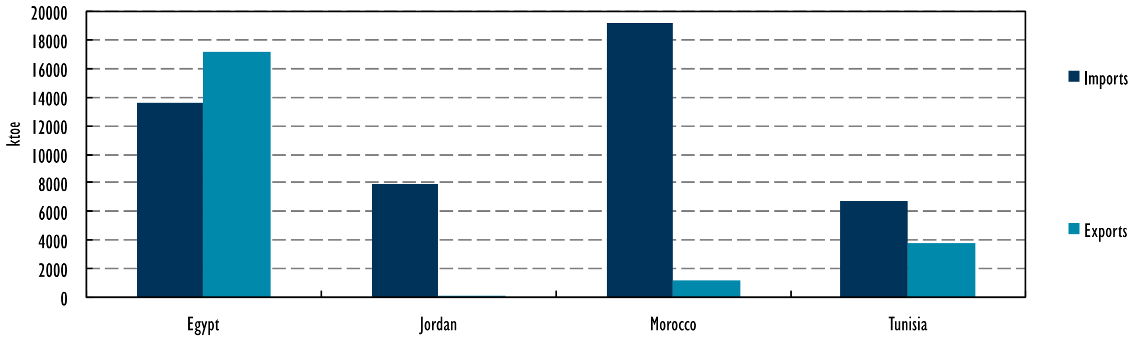
As a proportion of TPES, Tunisia used the most renewables in 2012 with 11.4%, followed by Morocco at 8.5%. Figure 9 shows that of the renewable sources of TPES, biofuels and waste have dominated renewable energy use in Tunisia and Morocco, comprising 94% and 87% of renewable energy respectively. Egypt's renewable energy use has been the most diverse, with 56% from biofuels and waste, 40% from hydro and 4% from wind and solar in 2012. Expansions to Egypt's renewable use are unlikely to come from hydropower, as resources have all but been exploited (IEA, 2014b). While using just 152 ktoe of renewable energy in 2012, Jordan's renewable energy use is notable for being 92% comprised of solar and wind.

Figure 9 • Renewable sources of total primary energy supply (TPES) in SEMED countries (2013)



Source: IEA World Energy Balances, OECD/IEA, Paris, 2014.

Figure 10• Total imports and exports in SEMED countries (2012)



Note: Data includes imports and exports of coal, crude oil, oil products, natural gas, nuclear, hydro, geothermal, solar, biofuels, waste, electricity and heat.

Source: IEA (2015e), Statistics database for energy balance flows for 2012, IEA/OECD, Paris, www.iea.org/statistics/statisticssearch/report/.

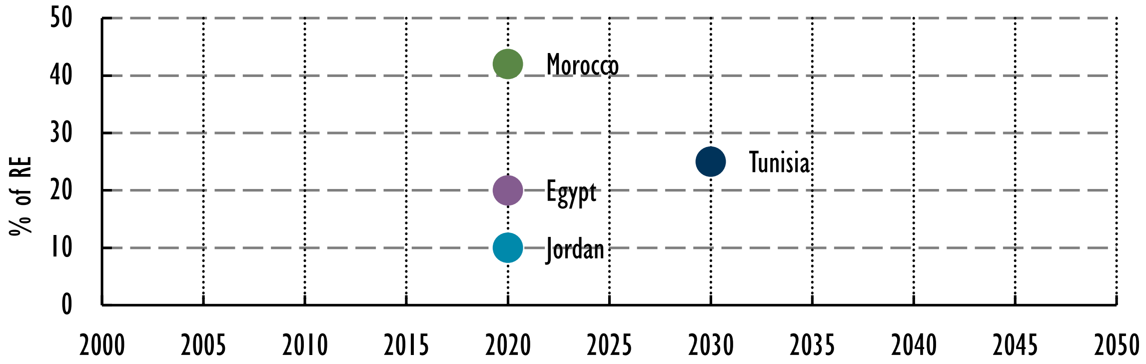
Figure 10 shows total energy imports and exports in the region in 2012. Unlike some of its neighbours in the region, Morocco is highly dependent on imported energy. Over 91% of energy supplied comes from abroad: coal, oil and oil products from world markets; gas from Algeria; and imported electricity. This is a significant burden on the balance of payments, and, insofar as some energy supplies are subsidised, a drain on the budget (IEA, 2014l). Egypt, on the other hand, is the largest non-OPEC oil producer in Africa and the second-largest dry natural gas producer on the continent (US EIA, 2013).

While each of these four countries individually acquires the majority of its electricity generation from gas, coal and oil, national energy plans are in place in each case that have set targets for further utilising and incorporating a larger share of renewables (see Figure 11). Data shows that CO_2 emissions are rapidly increasing (Figure 7), which sets a valuable focal point on the need for RE&EET for future growth in the energy sector. Furthermore, in a study conducted by the Regional Center for Renewable Energy and Energy Efficiency (RCREEE)[10] that examines conditions

[10] The *Arab Future Energy Index*[TM] *(AFEX): Renewable Energy* (2013), conducted by RCREEE, provides an assessment of current conditions for development of renewable energy and progress to date in the Arab region according to four evaluation categories:

for development of renewable energy in 13 Arab countries, the four SEMED countries examined in this *Insights Paper* were ranked highest, indicating that conditions for increased market penetration of RE are ripe.[11] A key factor for these countries to enable RE&EET investment and adoption is the presence of a dedicated agency to handle data collection, setting targets, monitoring progress and coordinating implementation activities.

Figure 11 • RE targets in the SEMED region



Notes: Morocco's target is expressed as installed capacity, Egypt's as electricity generation, Tunisia's as total primary energy supply, and Jordan's as energy mix. Therefore, this figure is for illustrative purposes and should not be relied upon for direct comparison of countries' ambition towards RENEWABLE ENERGY TECHNOLOGY deployment.

Sources: IEA and IRENA (2015), Joint Policy and Measures Database, OECD/IEA, Paris; REN21 (2013), Interactive Map Country Profiles, http://ren21.net/REN21Activities/InteractiveMap.aspx (accessed 2 March 2015); RCREEE (2012), Country Profiles, www.rcreee.org/content/member-states (accessed 2 March 2015).

It is important to note that the measurement chosen to express an RE target has important implications for the meaning and level of ambition of the policy. For example, a target for RE as a percentage of "installed capacity" has a very different meaning to a target for RE as a percentage of the "energy mix" or "electricity generation", taking into account the data involved as well as the context of the country's energy profile. This should be borne in mind when assessing and comparing different countries' targets. While comparisons such as that shown in Figure 11 can be valuable from a policy perspective, targets should not be relied upon as a comparative tool of ambition unless they use the same unit of measurement (not the case for the targets shown in Figure 11).

Figure 12 shows energy consumption by sector in the SEMED region. The largest energy consuming sector is transport at 35%. Industry is the next highest at 26% followed by the residential sector at 24%. The dominant share of transport energy use in the region suggests that this sector should be a priority area for the deployment of renewable energy and energy efficient technologies. Indeed, pending the electrification of the transport sector (through modal shifts from vehicles to electrified public transport or the electrification of vehicle fleets) most of the SEMED region's recent progress developing "unconventional" renewable energy resources such as wind and solar, will not be used by the transport sector. This suggests a pressing need to improve transport energy efficiency in particular.

Market structure, policy framework, institutional capacity and finance and investment. The study analyses conditions in Morocco, Jordan, Egypt, Palestine, Tunisia, Algeria, Lebanon, Syria, Bahrain, Sudan, Yemen, Libya and Iraq.

[11] Given that many aspects of an enabling environment for RE overlap with EE, this study can potentially indicate that market conditions for EE are similarly supported.

Figure 12 • Energy consumption by sector in the SEMED region (2012)

Source: IEA (2014n), *World Energy Balances*, OECD/IEA, Paris.

In many ways, Morocco emerges as the regional leader. The Agency for Development of Renewable Energy and Energy Efficiency (ADEREE) is a public institution that aims to implement national policies and targets for RE&EET, specifically by increasing installed capacity to 4 GW from solar and wind and 42% of installed capacity from renewables by 2020, which will in practice equate to approximately 25% of power generation. The Moroccan Agency for Solar Energy (MASEN) is an executive agency managing bids for solar power projects and partnering with the companies that develop them, which has proven very effective and could be viewed as a model to adopt by other countries. Additionally, the government has recently established the Institute for Research in Solar and New Energies (IRESEN), which plays a key role in coordinating and optimising the government's research efforts as well as its international collaboration. Currently, 2.7% of Morocco's electricity is generated by renewables, predominantly wind and solar. Hydropower is separately categorised from renewables and consists of 6-10% electricity generation, depending on annual climatic fluctuations.

The Arab Future Energy Index[12] indicates that Morocco has demonstrated ambitious RE targets and, importantly, has supported these targets with concrete actions while attracting more investment than any other country in the region (RCREEE, 2013). Morocco pursues a market-driven approach to its energy development by keeping its prices almost unsubsidised, creating a competitive marketplace for renewable energy, without causing a heavy burden on the government budget (RCREEE, 2013). Situated in a key geographical position that enables it to act as a regional hub, it has promising potential to become a significant exporter of renewable energy to countries in Europe and Africa. With an electricity network that is already inter-connected with Spain and Algeria, investment may be well-placed in expanding network connections that could in turn stimulate growth in demand for renewable energy exports.

ADEREE takes responsibility for the national Energy Efficiency Strategy, which includes initiatives such as promoting the replacement of incandescent light bulbs with compact fluorescent lights (CFLs), improving building efficiency codes (BECs), encouraging the deployment of direct solar water heating, implementing an accelerated depreciation for a list of efficient industrial equipment, establishing mandatory energy audits for industries beyond an evolving consumption threshold, and integrating the criteria of mandatory energy efficiency in programme and sector contracts.

[12] The Arab Future Energy Index (AFEX) is a policy assessment and benchmark tool that provides a detailed comparison of renewable energy and energy efficiency development in 17 countries of the Arab region on more than 30 different indicators. Despite ongoing turbulence in the region, these countries have continued to make progress toward creating better conditions for renewable energy and energy efficiency investments.

Egypt's New and Renewable Energy Authority (NREA) was established to act as the national focal point for expanding efforts to develop and introduce renewable energy technologies on a commercial scale and to implement energy conservation programmes. The law that established NREA was amended to allow it to establish companies, independently or in partnership with the private sector, to implement renewable energy projects. In May 2009, investors were invited to submit prequalification documents for the first competitive bid for a 250MW wind farm, and more wind projects via competitive tenders are expected to be launched within the next few years (NREA, 2015). Preparation is underway to allow third party access to the national electricity grid so that investors can pay a wheeling charge, which would allow them to sell RE generated directly to the customer.

To date, Egypt is the only country in the region that has allocated land for wind and/or solar power projects (7650 Km^2 which can host about 87 GW) beyond the limits required by existing funded projects, which supports market confidence for expanding its strong natural resource potential. The government has a target to procure contracts to reach 1 890MW from wind energy and 80MW from grid connected PV power plants. NREA identifies two phases for meeting 2020 targets for 7 200MW renewable capacity: (I) adopt a competitive bids approach as the Egyptian Electricity Transmission Company is issuing tenders internationally, requesting the private sector to supply power to build, own and operate wind farms and selling electricity for the agreed price between the company and the investor; and (II) apply a feed-in-tariff (FIT) system, taking into consideration the prices and experience gained in phase I. An interim target for the first regulatory period (2015-2017) is to contract 4 300MW of both solar and wind energy (300MW for small solar systems less than 500KW; 2 000MW of medium and large size of solar plants; and 2 000MW of medium and large wind plants). A tariff reform programme for 2014 to 2019 has also been adopted; consequently the price of the electricity generated from RE will be increased annually at the same rate as wholesale electricity. Much of Egypt's financing for the promotion of RE comes from international soft finance. Wind farms have been developed largely through resources from the German, Spanish, Japanese and Danish governments, the European Investment Bank and/or the World Bank.

Lighting in Egypt is a substantial component of electricity demand. Other countries have deployed more efficient lighting standards and have realised substantial energy savings simply by changing incandescent light bulbs to light emitting diode (LED) or CFL systems. Egypt is recommended to follow these models given its high lighting demand, in particular by phasing out incandescent light bulbs and the rollout of 10 million LED lamps as a first phase. Because the climate is so benign for heating and cooling, lighting is an effective target for EE in Egypt, and more efficient lighting should be an objective of municipal and industrial EE strategies and building standards.

The government of Jordan launched the 2007 Master Strategy of the Energy Sector with a target to generate 7% of Jordan's total primary energy supply from RE by 2015 and 10% by 2020. In view of these targets, Jordan adopted the Renewable Energies and Energy Efficiency Law (which became a permanent law in April 2012 under the Law No. 13) to incentivise private sector investment in RE and EE (OECD, 2015). One of the key features of this law is that all RE sources, energy conservation systems and equipment and production inputs are exempt from customs duties and sales tax. The law also set up the Jordan Renewable Energy and Energy Efficiency Fund (JREEEF), which is financed by the Jordanian government and international donor agencies. The Fund provides RE subsidies to privately owned and operated facilities, interest rate subsidies on commercial loans, a Public Equity Fund to support the deployment of private investment in the sector, a renewable energy guarantee facility to ease credit access for RE and EE project developers and research and technical co-operation grants for targeted programmes and feasibility studies.

While Jordan has created a favourable environment for investment in RE, a supplemental focus is arguably needed to maintain confidence from investors through strengthening institutional support and establishing a dedicated agency to foster further deployment of RE&EE programmes (RCREEE, 2013). As the structure currently operates, domestic and international companies negotiate directly with the Minister of Energy, which aims at easing the implementation process by bypassing bidding processes with external agencies, but it is unclear how effective the process is without an agency for RE&EE to advocate for and implement RE&EE projects.

Tunisia's dedicated body is the National Agency for Energy Conservation (ANME). A public institution under the supervision of the Ministry of Industry, ANME was established in 1985 to ensure the implementation of a national policy in the field of energy management, including the promotion of RE&EE. In November 2003, the project Promotion of Renewable Energy and Energy Efficiency (ER2E) was initiated in the context of Tunisian-German cooperation to assist the ANME in developing appropriate approaches for energy management in Tunisia. Following the Tunisian revolution in January 2011, political and economic constraints have become more important with rising energy demand, ongoing fossil fuel subsidies, declining national gas resources and an increasing unemployment rate all placing pressure on national energy policy efforts.

The World Bank (2014) cites job creation as a key priority area for the Middle East and North Africa, and this is particularly important in stimulating growth in clean energy development. According to the Tunisian Solar Plan and the German Federal Enterprise for International Co-operation (GIZ), RE&EE increases in Tunisia will generate additional employment for between 7 000 and 20 000 people by 2030 (GIZ, 2012). Total investment will be TND[13] 8.28 billion on RE and TND 1.5 billion on EE measures. A comparison of employment generated per investment of TND 100 million suggests that EE within buildings generates the most employment, followed by solar water heaters and photovoltaic (PV) installations and finally by wind energy and Concentrated Solar Power (CSP) (GIZ, 2012).

Tunisia could fulfil greater potential by eliminating policy barriers, as it already fosters a strong business environment that has the capacity to support more investment (RCREEE, 2013). In particular, access to international market prices for renewable energy technologies could reduce distorted market prices in Tunisia and enable affordability of residential systems. Implementation of a feed-in tariff could also improve investment security and make the environment more attractive to investors.

ETC and SEMED synopsis

Though it is important to note that there are national exceptions, it appears that the SEMED region has shown greater progress on RE policy frameworks while neither region has implemented a comprehensive set of policies for EE. In both cases, with the arguable exception of Morocco for RE, more could be done to see the actual deployment of enhanced RE&EET on the ground – even where sound policies have begun to emerge.

As noted, the ETC faces significant grid obstacles due to aged infrastructure, and with the exception of hydro, RE integration remains sparse. While the SEMED countries have set overarching targets for RE generation, the region lacks specific EE targets and could do much more to monitor progress and evaluate implementation of their EE plans.

Overall, end-use data collection is scarce in both regions, resulting in a stunted ability to monitor energy savings and progress made through EE improvements. Given such, a main recommendation for each region is improved coordination in data collection to stimulate the

[13] Tunisian Dinar. 1 TND = 0.45 EUR (January 2015).

ability to set—and meet—targets for EE in all sectors. More specifically, national plans and external investors may want to target improvements in efficiency for the buildings sector (in both regions) power and heat sectors (particularly in ETCs) and set higher transportation system fuel standards (particularly in SEMED countries) (Figures 6 and 10, and explained further in the EE transportation sector).

Setting the stage for RE and EE deployment: fostering an enabling environment

There is huge potential for RE&EE to support sustainable development globally, yet, many countries struggle with setting – and implementing – policy mechanisms that support the uptake of these technologies. Sound policy for RE&EE is dependent not only on the policy design itself but also on a wide range of underlying factors that may support, or indeed hinder, the successful implementation of the policy (IEA, 2011a; GIZ, 2012; IEA, 2011b).

The constituting factors within a country that together support the integration of RE&EE can be described as the "enabling environment". Given common barriers to RE&EET deployment, such as investment uncertainty and lack of clarity on who will bear the costs and reap the benefits, an enabling environment is crucial for low-carbon development in any phase of energy system or market maturity. Fostering an enabling environment can support smooth implementation of policies and realisation of their intended consequences, eliminating or minimising barriers from the outset. Importantly, an enabling environment is also crucial to show investors that the market can absorb support provided for the RE&EE sectors.

What is an enabling environment?

There is widespread use of the terms "enabling framework" and "enabling environment" across academic and policy literature.[14] While a review of this literature reveals varying conceptions and boundaries of each term, an enabling framework most often refers to policy, laws and regulations that support the uptake of RE&EE (IEA, 2013b; IEA, 2010a). An enabling environment tends to have a wider meaning, referring to factors that support RE&EE more broadly. This includes policies, laws and regulations that directly lead to greater deployment of RE&EE, but also covers wider energy and economic policies and strategies, social factors such as the dissemination of information and social acceptance, technical and infrastructure factors, and financing and market conditions.

Enabling factors (sometimes referred to as enabling "conditions") can determine the status of market readiness for deployment of RE&EETs. In other words, if a market is able to absorb the benefits or risks and successfully implement policy, it has been prepared by consideration of multiple, diverse enabling factors. Thus, some literature focuses on assessing the enabling factors for "market readiness", which can help the climate community and investors outline and prioritise support for market readiness efforts and potentially for establishing new market instruments.[15]

Contrastingly, barriers can block a policy or RE/EET from coming to fruition. Managing barriers in all phases of RE&EE deployment is essential — but avoiding them altogether is preferable. This

[14] For use of the terms "enabling framework", "enabling environment" and "enabling conditions" in the context of energy policy, see IEA, 2015a; IEA, 2014d; IEA, 2014g; IEA, 2013b; IEA, 2010a. See also BNEF et al, 2014 (enabling framework as fundamental structures and market conditions necessary to attract investment); EC, 2014 (in the context of shale gas development: legislative and/or non-legislative measures to manage risks, address regulatory shortcomings and provide maximum legal clarity and predictability to both market operators and citizens); Guermazi and Satola, 2005 (enabling environment as policy, legal, market and social conditions); ICC, 2014; Pueyo, 2013; UNEP, 2011 (enabling conditions consist of fiscal measures, laws, norms, international frameworks, know-how and infrastructure, capacity, information, dissemination of good policy practice, social assistance, skills, general education and awareness); UNFCCC, 2003 (enabling environment as government actions – such as fair trade policies, removal of technical, legal and administrative barriers to technology transfer, sound economic policy, regulatory frameworks and transparency); World Bank, 2008; World Bank, 2004 (enabling framework as policy, regulatory and legal elements).

[15] See IEA and OECD, 2010, which describes market readiness as the necessary technical, policy and institutional frameworks that a country and/or its entities need to employ for low-carbon development financing through market mechanisms.

sets the context for why an enabling environment is a critical component of the widespread uptake of RE and EE technologies. For example, one of the lessons learned from deploying renewables in Georgia is that the split of responsibilities between institutions and the absence of a systems approach, including lack of specific national targets for RE, acted as impediments to the creation of an enabling environment for donor projects, with the result that such projects have taken a fragmentary approach addressing only some parts of the local value chain (WEG, 2014).

Integrative policy

An enabling environment incites an approach where policies for the deployment of EE & RE are developed to function holistically with policies in other sectors that may support RE&EE deployment, rather than as the product of ad hoc layering processes that can create conflicting "policy silos" (IEA, 2015a; IEA, 2014h).

Taking an "integrative policy" approach has threefold benefit. First, such an approach can reduce duplication and service gaps, which are costly and inefficient. Second, in most instances, problems are more effectively addressed by achieving critical mass rather than undertaking many smaller actions simultaneously. Third, building links between distinct organisations and agencies is valuable in its own right as a way of building social capital (OECD, 2010). If implemented successfully, an integrative policy approach will also capture and value the multiple benefits of RE&EE, resulting in diverse social and economic benefits (see Box 6 for the multiple benefits of EE). Primary examples of areas of policy action that are likely to be relevant to support for RE&EET include water, climate, agricultural and industrial policy, and urban planning.[16]

Enabling factors for supporting RE&EET deployment

Integrative policies, enabling factors and market conditions are highly inter-related and use many of the same cross-sectoral factors to determine market readiness or progress. The remainder of this section describes the cross-cutting enablers that can together support enhanced deployment of RE&EET in five overarching categories:

- regulatory and institutional factors;
- financial and economic factors;
- technical, infrastructure and innovation factors;
- social factors; and
- environmental factors.

Annex 2 contains a table summarising these elements in terms of their inverse capacity to function as barriers to deployment, along with suggestions for corresponding response actions for each kind of barrier. These ideas are elaborated on in more specific terms in the subsequent RE and EE sections of this paper. What follows in Figure 13 and the text below is a brief overview of each element.

Regulatory and institutional factors

There are numerous options for regulatory policies and institutional arrangements to facilitate the deployment of RE and EE, however it is important to ensure the correct mix, that there is

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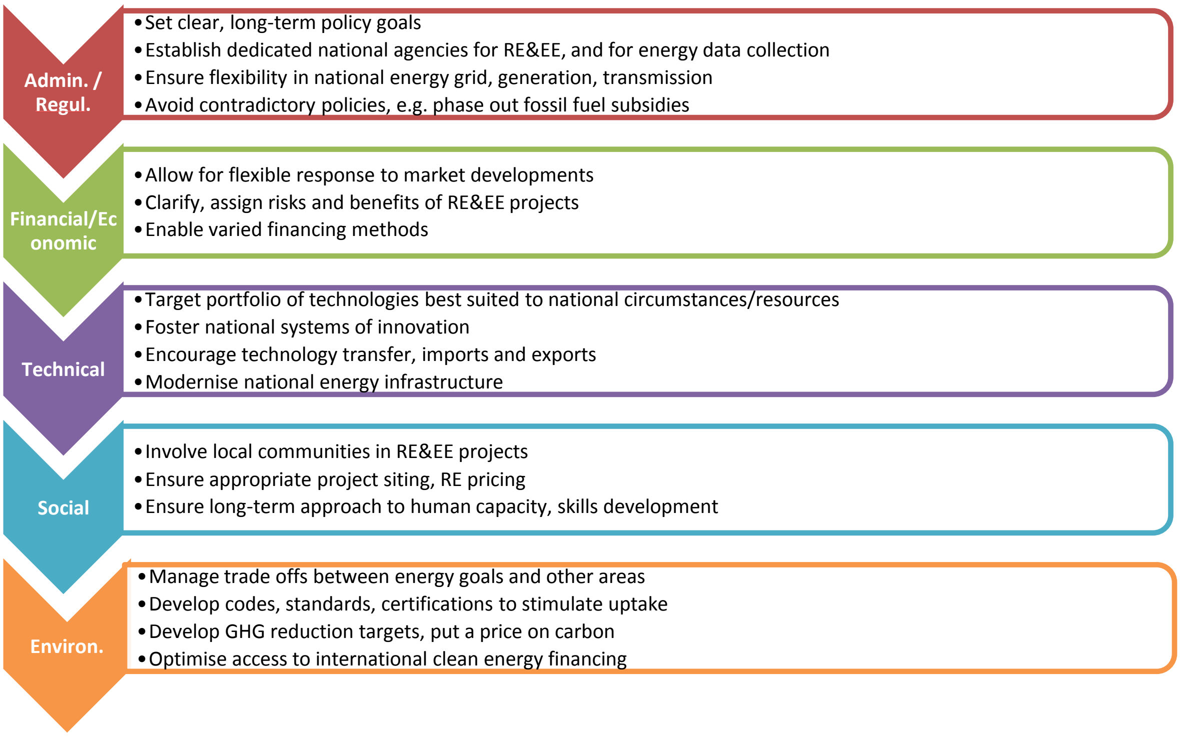
[16] An example of the use of integrative policy is the Action Plan for Energy-efficient Housing (APEEH), which was developed by the Committee for Housing and Land Management of the United Nations Economic Commission for Europe (UNECE) (which includes all European countries, Canada, the United States and countries in Central and Western Asia), and seeks to internalise energy efficiency into socially-oriented housing policy (UNECE, 2010).

effective integration with other policies, and that such policies are supported by appropriate implementing institutions (OECD, 2013a).

Figure 13 • Overview of enabling factors for RE&EE deployment

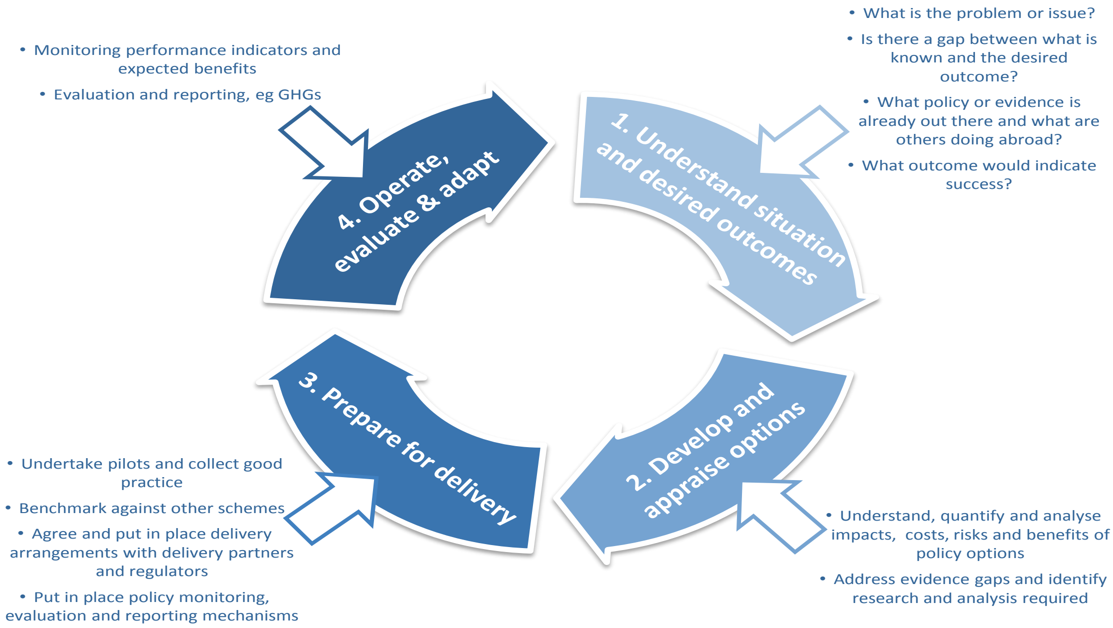


Dedicated national agencies that support RE&EE implementation and mechanisms for consistent data collection are critically important institutional elements. Consistent data collection enables the ability to design policies, set targets, track progress, assess impacts of policies, monitor market penetration of technologies and make proper adjustments to investment or deployment strategies as necessary. Without institutions to prioritise, advocate for and manage projects, agendas may be mixed and implementation may not receive as much support as necessary. There is thus high value in energy ministries/agencies working together with energy system operators to produce accurate energy statistics, so that the full picture of RE&EET policy progress can be monitored, in addition to providing multiple benefits at the national level. The multiple benefits of data collection in various stages in the policy delivery cycle are highlighted in Figure 14 below. The high percentages of "non-specified" energy consumption in the ETC and SEMED regions represented in Figures 6, 12, 37 and 38 indicate the large room for improvement of data collection in these regions.

Setting clear, long-term strategic policy goals, and aligning them across and within government levels provides certainty. Governments should aim to provide a relative degree of stability to enable long-term planning, recognising that economic, environmental and technological developments will demand some flexibility. Stable and predictable sustainable development or low-carbon policies have the potential to mitigate some of the problems associated with investment incentives, in particular the perception of high risk.

Ensuring consistency between RE and EE policy and other energy policy sends clear signals. Where possible, governments should aim for consistency across their entire energy policy portfolio. For example, implementing RE and EE policies while also supporting fossil fuels represents both an inefficient use of public expenditure and a failure to send clear market signals. To increase renewable energy deployment and encourage efficient energy use, a logical supporting measure is to reduce or eliminate fossil fuel subsidies. This provides a price signal to energy consumers and dampens the perceived price advantage of conventional fuels, making renewable energy comparatively more attractive to investors. Moreover, subsidy reform frees up additional public funding for further RE&EE support.

Figure 14 • Opportunities for data collection to impact various stages of the policy delivery cycle



Providing clear information on energy costs helps markets to respond. Related to the point above, greater transparency of the real costs of renewable and conventional energy will help markets make informed decisions. In addition to subsidy reform, SEMED countries and ETCs should focus on separating out the accounts for power production and distribution so that costs for each component are transparent.

Enabling the growth of markets for supportive services leverages the private sector for the delivery of EE projects. Businesses established to help energy consumers take advantage of government incentives or comply with regulations often play a major part in accelerating demand for EE technologies. Energy Service Companies (ESCOs) can provide a full range of services, including design, implementation and financing for EE projects, and governments can encourage their formation by setting up a regulatory framework for the companies and a professional qualification regime for the staff.

Removing regulatory barriers and providing incentives for intermittent renewable electricity generators and off-grid users. Offering rewards and incentives for flexible RE generation capacity and operation should be encouraged in conjunction with eliminating legal barriers for "prosumers", or those who self-produce and consume RE.

Financial and economic factors

A substantial challenge to the deployment of RE&EETs is that they must compete against other capex priorities with higher internal rates of return. Loans can be hard to obtain where RE&EET is unfamiliar to financial institutions (IEA, 2015a). Reorienting available financial instruments towards newer, low-carbon technologies requires dedicated policy support to target barriers such as perceptions of high risk. Governments can develop a combination of regulatory instruments (such as codes and standards) that complement instruments aimed at reducing the perceived risk of RE&EET (such as risk mitigation mechanisms), and foster an environment for the private sector to develop business models centred on RE&EET marketing, installation, and operations and maintenance (IEA, 2015a).

The private sector will be a key driver of the transition to climate technologies; and both foreign and domestic investors will base their decisions on risk assessments of investment in a given country using a given technology (World Bank, 2012). Donors and investors should also be aware of the practical lessons already learned from projects in the region, including the need to build trust through responsiveness to client needs, ensuring on-the-ground presence, managing expectations, enabling coordination between donors and maximising policy "absorption" capacity (EBRD, 2014).

To attract investors for RE and EE projects or programmes, risks and benefits can be distributed among a range of stakeholders. Sharing risks among stakeholders—thereby reducing risk for a single party — can help to attract investors by reassuring them that risks are manageable. Similarly, policies can be designed to distribute benefits of RE&EET cross-sectorally (i.e. across the residential, services, transport, and industrial sectors), providing incentives for investors from a range of sectors to work together to realise RE&EET projects.

Policy makers and regulators have to respond dynamically to the market, given the potential for market evolution and fluctuating costs. They must understand what is happening in the market (both in the country in question and internationally), monitor and review progress toward objectives, and fine-tune measures in light of successes and failures. For example, if feed-in tariffs do not accurately accord with the market, they can be a major impediment to investment in RE&EET by being below cost recovery levels. This requirement applies throughout the policy journey and for technologies at each stage of development.

Enable varied financing methods. If demand increases, the large upfront costs of RE&EET (mainly for retrofits) still need to be integrated in business models. In the context of energy efficiency, covering these costs through energy savings is possible, but further innovative business models need to be tested and supported to bring them to the market. "Green revolving funds" are one of a growing range of financing mechanisms that can be used to support both RE&EET projects but require well-clarified management and well-informed allocation strategies in order to be financially sustainable.

Social factors

Numerous non-technical barriers can block the deployment of technically sound and cost-effective technologies, including lack of information, consumer indifference and lack of immediate benefit. For example, in most of the ETCs, energy is considered to be a "public good" as it was provided almost free to the population during the Soviet period and thus most countries in the region are reluctant to reduce the heady subsidies of energy prices, which may cause public unrest. While Turkmenistan has recently capped the level of nearly free energy provision, the current price of electricity is still far below the market price in the ETC region. Consumers should be made aware of cost recovery prices to enable social acceptance of the required change to the current pricing structures (IEA, 2015b).

Community value is increased through proper siting of energy projects and RE&EE pricing schemes that bear in mind social impacts. Involvement of local committees and NGOs for RE deployment is particularly important for garnering societal acceptance and usage of technologies that are perceived as new and unfamiliar. Equity considerations such as formal recognition of socially vulnerable classes, conducting social impact assessments and other participatory approaches enable a societal foundation for transitioning energy infrastructure and further interest in investment in RE&EET.

Ensure information-sharing and awareness-raising campaigns are part of the rollout of all relevant RE and EE policies. Ongoing education campaigns for consumers improves societal acceptance and trust of RE&EET as well as enhances the progress of sustainable energy and water policies. Energy efficiency technologies, particularly in the residential, buildings and transport sectors, are often customer-side technologies and require sufficient societal outreach to be utilised and provide benefits.

Human and institutional capacity building is required for large-scale deployment of RE&EET. Setting up a network for specialised capacity building and regular training in the energy sector is critical, especially for design, operation and management of continually advancing technologies. Organisation of seminars for personnel in RE&EE sub-sectors builds practitioners who are aware of technology options and advancements.

Technical, infrastructure and innovation factors

Ongoing technology innovation is critical to a least-cost transition to modern, efficient, low-carbon energy systems. To realise the full potential of such innovation, an interactive and iterative innovation process that is aligned with policy and market frameworks and spans all phases of research, development, demonstration and deployment is required (IEA, 2015a). Ideally, integrative policies should seek to address innovation-related barriers to RE&EET deployment. For example, the creation of dedicated RE&EET agencies that undertake education, training, data collection and delivery can assist in overcoming technology and capacity shortfalls (IEA, 2013c). Other necessary conditions for innovation include lowering barriers to trade and foreign direct investment, enhancing intellectual property protection systems and securing access to low-carbon finance (IEA, 2015a). At the end stages of innovation, governments must facilitate stronger collaboration with the private sector to create market pull and certainty. Ongoing evaluation of innovation efforts in technology and in reforming policy and market frameworks is needed to assess and determine how to best bolster specific technologies (IEA, 2015a).

Modernisation of national energy infrastructure should seek to develop smart grids and micro grids that can harness variable renewable energy (VRE) that is distant and in many cases disconnected from the grid. Micro grids that can harness VRE from vast resources in areas that are not connected to a main grid supports utilising RE that may not otherwise be possible due to insufficient grid infrastructure. The modernisation of energy infrastructure is crucial to attract private sector investment, and should be regarded as a priority in the ETC and SEMED regions.

A portfolio of technologies best suited to meet national priorities should be developed, taking account of the country's energy infrastructure and indigenous resources. Given the differences in status and costs for RE&EET, policy makers need to tailor policies and incentives to bring forward the specific technologies required rather than using a technology-neutral approach (at least in the early phases) (IEA, 2011). It is also important for policy makers to adapt RE&EET to local climate and topographical conditions to optimise performance.

Box 1 • Smart grids for smart city planning: Opportunities for the "new Cairo"

In March 2015, the Egyptian government announced plans to build a new capital to the east of Cairo with the aim of easing congestion and overpopulation in Cairo over the next 40 years. The new capital is planned to be built over 700 square kilometres, house about five million residents and create more than a million jobs. As the Egyptian government plans this city, there is an opportunity for innovative city design, incorporating advanced technologies and electricity systems to meet the new city's needs, improve efficiency, and launch the capital into a new phase of innovation. With an ever-aging power grid and increasing electricity demand, Egypt needs to develop new ways to manage the energy sector, including infrastructural mechanisms that improve the sustainability of generation and consumption.

Deploying smart grid technologies is nearly essential for the Egyptian government to accomplish its goal of decongesting Cairo and the surrounding areas, while managing overpopulation and building a new capital. Smart grids provide cross-cutting benefits, many of which are directly related to facilitating higher penetration of RE&EET through greater ability to accommodate variability, distributed generation and high initial cost. Smart grid technologies can be used as infrastructural tools to facilitate integrative planning, helping to create enabling environments by easing the integration of distributed resources and RE, allowing for direct communication between utilities and customers, reducing transmission and distribution losses, and facilitating other smart technologies such as electric vehicles and vehicle-to-grid connections (among many other benefits).

According to the International Smart Grid Action Network (ISGAN), developing economies' top drivers for smart grid deployment are:

- reliability improvements;
- system efficiency improvements;
- revenue collection and assurance improvements;
- renewable energy standards or targets;
- economic advantages; and
- generation adequacy.

These project drivers and benefits that can be realised through smart grid technologies are particularly relevant to Egypt's energy and development goals in the near- and long-term. If deployed by the government of Egypt, smart grids will have a valuable role to play in unlocking sustainable development options for the new capital, as well as supporting RE&EET deployment nationwide.

Sources: IEA (2015d), *How2Guide for Smart Grids in Distribution Networks*, OECD/IEA, Paris; ISGAN (International Smart Grid Action Network) (2014), "Smart grid drivers and technologies by country, economies, and continent," ISGAN website, www.iea-isgan.org/index.php?r=home&c=5/378 (accessed 29 September 2014).

Foster national systems of innovation. Within the regulatory environment, governments should enable innovators to access special funds, subsidies, particular loans and incentives, and strengthen programmes that support technology pilot projects and research, development and deployment (RD&D). Policy should provide assistance to innovators and early adopters, and facilitate inter-agency and industrial alliances. It may also be beneficial to create technology development boards with cross-cutting stakeholders to support international, national and local level information-sharing. The ETC and SEMED regions will certainly benefit from international knowledge-sharing regarding advanced countries' RE&EET deployment, and the sharing of region-specific adaptations. It is also notable that the ETC region has a limited focus on R&D programmes and financial support (IEA, 2015b).

Increase demand by encouraging both technology import and export. Some countries produce technologies, export them, and see less domestic market adoption, which demonstrates that the technical capacity exists in the country but market policies are insufficient in attracting industrial and investor interest. Maintaining a multi-directional flow of technology expertise can stimulate demand and innovation while piquing investor attention.

Environmental factors

The development of our energy systems has been, and will continue to be, markedly affected by a variety of environmental concerns, from air quality issues and acid rain, to more recent emphasis on climate change (IEA, 2014g). This presents the need to develop a policy framework that inclusively addresses these issues with local, regional, national and international solutions. The energy sector and the environment at large can significantly benefit from more stringent GHG reduction targets and implementation mechanisms, while dually improving environmental conditions that will impact developed and developing countries alike. Environmental and climate policies should complement and support RE and EE goals and plans, and vice-versa, altogether forming part of the framework to enable RE and EE deployment. The importance of addressing the local level should not be underestimated – a partnership between local and national stakeholders should be established to accelerate the diffusion of knowledge, project proposals and industrial initiatives in the field of RE and EE (RES4MED, 2014).

Develop national GHG reduction targets and consider putting a price on carbon. Countries with GHG emissions reduction targets may provide a more favourable and predictable investment environment for RE and EE, as both will be required to meet emissions reduction targets, particularly in rapidly growing economies (World Bank, 2012). Although SEMED countries and ETCs are currently more motivated to pursue RE&EET for fuel diversification and energy security reasons, policy tools targeted at GHG emissions reductions can have positive spill-over effects for other policy aims. Stable and predictable market-based climate policies such as emissions trading schemes (ETSs) can provide investment incentives for RE and EET at a lower cost to government than other policy tools, such as grants or subsidies. However, key to the success of these instruments are decisions on design features (such as scheme coverage) and their complementarity with other energy policies.

Environmental codes, standards and certification schemes can be supportive mechanisms for stimulating increased uptake of RE&EE technologies and improving best management practices. Pollution standards for private and public vehicles, forestry certifications, equipment labelling (including EE labelling of appliances) raise public awareness by showcasing best practices in a certain industry or sector. Codes, standards and certification schemes provide a foundation and a framework for better practices than the status quo, resulting in heightened sustainable environmental practices across sectors. This can in turn support the uptake of more efficient appliances and equipment, and renewable energy technologies can benefit from increasing standards for energy generation or certifications requiring use of RE.

Manage trade-offs between energy goals and other policy areas. To avoid unintended negative impacts of energy goals, stakeholders from potentially affected sectors should be consulted when determining energy objectives, and included in implementation phases to seek win-win solutions. For instance, benefits from carbon markets and credits can be used to fund projects in other sectors, fostering joint ventures and partnerships between sub-sectors. This type of interplay supports an overall integrative policy environment while potentially increasing support for more stringent low-carbon energy goals and emissions reduction targets.

Sustainably managing natural resources is a vital component to long-term national plans, and of course integrating RE&EE technologies is no exception. Management and regulation must incorporate the inextricable links between resources to avoid unintended negative impacts such as resource scarcity due to poorly designed single-sector approaches. Box 2 exemplifies the need for “nexus” planning between the water, energy and agricultural sectors.

Box 2 • A deeper look into integrative policy: The Water-Energy-Food nexus

Global projections indicate that demand for freshwater, energy and food will increase significantly over the coming decades due to population growth, economic development, urbanisation, growing per-capita food consumption and diversified diets, climate change, resource degradation and scarcity (FAO, 2014a). As demand for land, water, energy, agriculture, fisheries and other natural resources grows, there may be competition among sectors for essential resources. The Water-Energy-Food (WEF) Nexus is an attempt to balance different uses of ecosystem resources, e.g. energy, water, land, soil and socio-economic factors, vis-à-vis different local interests and development priorities. The incentives for a nexus approach include economic efficiency, resource efficiency, reduction of food loss and improved livelihood options (FAO, 2014a).

Countries that deploy incoherent water, land and energy policies might find themselves with a severe scarcity of one (or more) of these resources (OECD, 2012a). For example, increasing production of bioenergy crops on irrigated agriculture land may improve energy supply, but may also result in increased water withdrawals and risks to food security (FAO, 2014a). Elsewhere, large-scale hydropower projects may provide power and water storage for irrigation at the expense of downstream ecosystems and food systems.

With binding synergies that span horizontally across the three sectors and vertically between the international, national, regional and local levels, achieving water, energy and food security while using natural and financial resources efficiently, requires co-ordinated, integrative policies that stimulate cross-sector benefits.

The FAO (2014a) identifies the following components of sustainable water, energy and food security:

Sustainable water

- Strengthen access to water resources for different users
- Sustainable use and management of water resources
- Resilient societies and ecosystems to water-related disasters

Sustainable energy

- Access to modern energy services
- Affordable energy prices
- Low-carbon renewable energy systems
- Efficient use of energy

Food security

- Food availability
- Food access
- Food utilisation and nutrition
- Stability of food prices and supply

The FAO has been developing the WEF Nexus Assessment methodology for stakeholders to use to: (i) gain knowledge of the sustainability of a system or territory (e.g. a country, or a province); and (ii) assess the performance of specific interventions (e.g. a new technology or policy) in terms of natural and human resource use efficiency. The methodology proposes indicators for which information is available from international data sets for the context analysis, and the assessment can be carried out at different levels and scales (see FAO, 2014a).

Sources: FAO (2014a), Walking the Nexus Talk: Assessing the Water-Energy-Food Nexus in the Context of the Sustainable Energy for All Initiative, FAO, Rome; OECD (2012b), Meeting the Water Reform Challenge, OECD Publishing, Paris.

Policy options for supporting renewable energy

Overview – market outlook, benefits and barriers

Renewable energy currently provides some 18% of total global energy needs[17] (SE4All, *Global Tracking Framework*, forthcoming), although this includes the traditional use of biomass, particularly in developing economies.[18] The IEA's annual *Medium-Term Renewable Energy Market Report* shows that use of renewable energy sources has been growing steadily and technologies are maturing, leading to significant cost reductions. Growth in RE use is expected to increase significantly not only in low-carbon energy futures, but in all scenarios considered by the IEA (IEA, 2014f)[19].

While renewables feature significantly in global and national efforts to mitigate climate change, they can also help meet a number of other important national objectives, such as:

- reducing the exposure of economies to rising or fluctuating fossil fuel prices in fuel importing countries, or, by displacing fossil fuel consumption, making more resources available for export in oil or gas exporting countries (e.g. Saudi Arabia);
- supporting enhanced access to modern energy services (e.g. the Subsidised Solar Home Systems in rural **Mongolia** has increased the electrification rate among nomadic herders from 0 to 70% in recent years);
- improving energy security by reducing dependence on imports and increasing the diversity of energy supply (e.g. biofuels in the United States and heat in Ukraine and other Eastern European countries);
- playing a role in reducing other environmental impacts of fossil fuel-based energy systems (e.g. in China); and
- providing opportunities for economic development by stimulating the use of indigenous resources and increased employment and innovation in renewable energy system development, manufacturing and operation (e.g. the solar market in **Morocco**).

In many emerging and developing economies it is these other motivations that are driving renewables deployment. While each of these drivers can apply in almost all countries with renewable energy potential, the relative weight given to each tends to vary significantly between countries depending on national priorities.

Barriers to RE deployment – the need for a policy response

There are a number of barriers to the deployment of renewables. Many of these arise from the characteristics of the technologies and from the interaction between these and the policy, market and regulatory frameworks in place, which have in general been developed with fossil fuel-based energy supply in mind.

Until recently, costs of have been a major barrier to the widespread uptake of many RE technologies. Policies have thus been designed to make RE economically competitive with fossil fuels, particularly since account is rarely taken of the external costs associated with the

[17] Measured in terms of the total final consumption of energy.

[18] Traditional use of biomass in IEA publications refers to the use of wood, charcoal, agricultural residues, animal and human dung for cooking and heating in the residential sector. It tends to have very low conversion efficiency (10% to 20%), often an unsustainable feedstock supply, and is associated with health, environmental and social problems.

[19] More details of the prospects and issues associated with each of the renewable energy technologies can be found in ETP 2014 and in the IEA's associated global technology roadmaps (http://www.iea.org/roadmaps/).

environmental impacts of fossil fuels. However, given sustained cost reductions in some of the key technologies, renewable energy is now cost competitive in an increasing number of cases where resource and market conditions are favourable, meaning that in some markets, economic barriers are less prominent than even five years ago.

That said, even when technologies that are potentially cost-competitive are introduced into new markets, costs will initially tend to be higher than international benchmarks for a number of reasons. These include the need for developers to understand the resource and market conditions, and for cost-competitive supply chains for locally supplied components and services to develop. Financing costs for projects in new markets also tend to be higher as they are seen as more risky than projects in mature markets. As deployment grows, costs should approach international benchmarks, but during these initial phases some financial support is likely to be needed.

Even where the economic barriers to RE deployment have been overcome, a range of other non-economic barriers can exist that either prevent deployment altogether or lead to higher costs than necessary. Following the categories of enabling factors set out in the previous section, barriers to RE deployment can be classified as:

- regulatory, institutional and administrative;
- financial and economic;
- technical and infrastructure;
- social; and
- environmental.

A more detailed listing of potential barriers to both RE and EE, together with possible response actions, is contained in Annex 2 and is also discussed through the sub-sectoral discussions on renewable energy below.

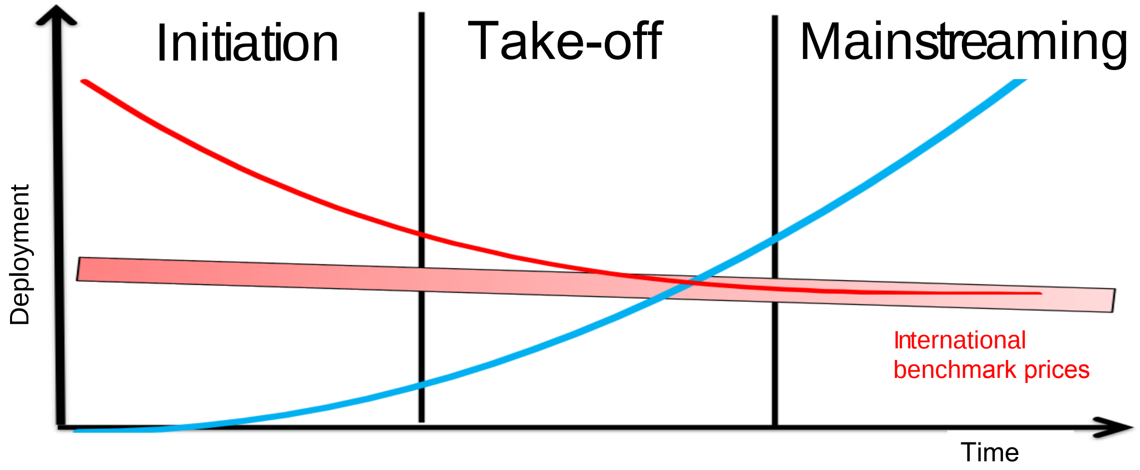
The relative importance of individual barriers may differ for each technology and in each market. It may also change as a technology matures along the commercialisation and deployment path. As one barrier is overcome, others may emerge – for example, integration of renewable electricity sources into a grid (a technical barrier) is easily managed at low penetration levels, but requires increased attention as the share of renewables in the system rises.

Previous IEA analysis (IEA, 2011a) has identified three principal phases as deployment grows and costs and prices reduce and converge with international norms: **Inception, Take-off and Mainstreaming**, as shown in Figure 16. The policy priorities between the phases differ: initially a very secure investment climate is needed to encourage early investors, and an appropriate regulatory framework must be put in place; once deployment takes off the emphasis shifts to encouraging cost reduction and to managing support costs; in the mainstreaming phase, physical and market integration become the key challenges.

The aim of government intervention is to provide a policy, market and regulatory framework that overcomes the barriers to deployment as cost-efficiently as possible and without introducing negative side effects. This generally means that a portfolio of measures needs to be put in place that is tailored to national circumstances and to the most appropriate set of technology options. In some recent cases, well-designed competitive tendering programmes (for example, for wind in **Egypt** and solar PV in Dubai) have enabled very low electricity prices to be obtained, even at early stages of deployment, effectively “leap-frogging” down the cost curve.

In formulating the policy framework for promoting private sector investment in RE, evidence indicates that the most cost-effective policy interventions tend to be those targeted at mitigating investment risks associated with high upfront costs for renewable energy, rather than simply paying an increased tariff-based price premium to compensate for risks (UNDP, 2014). For example, it is estimated that the implementation of public de-risking instruments in Tunisia has the potential to catalyse EUR 2.8 billion in private sector investment and create savings of EUR 712 million for large-scale wind energy and EUR 359 million for large-scale solar PV over 20 years (UNDP, 2014).

Figure 16 • The RE policy journey and changing policy priorities



Initiation

- The first examples of the technology deployed under commercial terms
- **Secure support needed to encourage early investors.**
- Local supply chain absent.
- Define regulatory framework e.g. permitting procedures may be unclear or lengthy).

Take-off

- The market starts to grow rapidly.
- **Policy priority is to encourage costs to converge with international benchmarks**
- Manage total support costs remain within the expected envelope.
- Refine regulatory procedures.

Mainstreaming

- The annual market has reached a significant scale
- The supply chain is well established
- Generation prices are consistent with international norms and approach fossil based alternatives
- **Technical and market integration becomes key issue**

There is now a considerable but still growing body of policy experience, covering the range of technologies in different types of energy economy. This is particularly true for the Initiation and Take-off Phases, and from these experiences, some effective policy principles have been distilled (e.g. IEA, 2011a). Experience of the third phase, Mainstreaming, is so far more limited and is the subject of much policy debate, analysis and experimentation.

Given that the focus countries of this paper are at the earliest stages of the deployment journey for the principal technologies (except for hydropower), the rest of this report will concentrate on describing policy principles for the Initiation and Take-off Phases. The three sections that follow provide a summary of recent market developments and policy experience in three subsectors – renewable electricity, heat and transport.

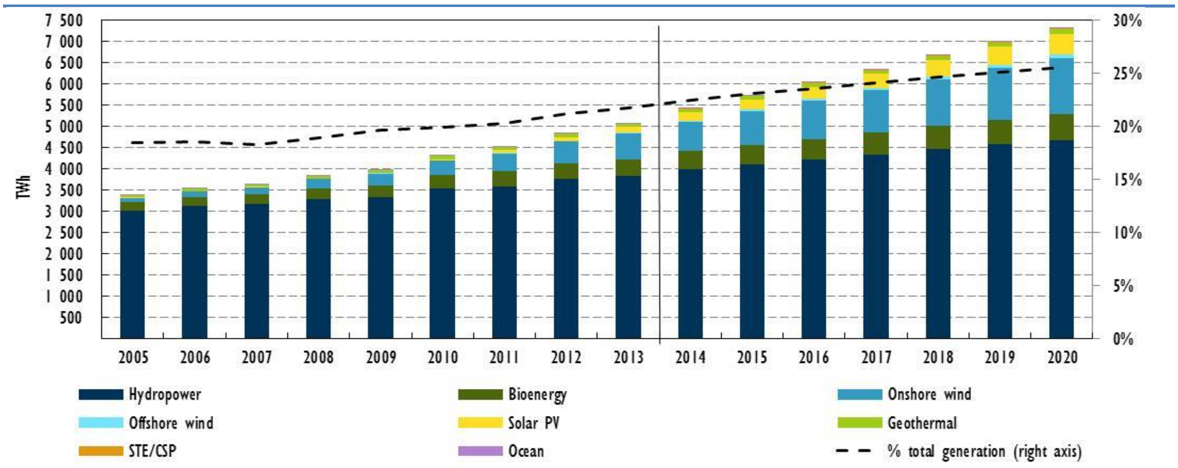
Renewable electricity

Global market trends

The amount of electricity produced from renewable sources has been growing rapidly, and in 2013 reached 5070 TWh. In that year, global renewable generation was on a par with generation from gas, and twice that of nuclear. IEA forecasts suggest that this growth will continue, increasing by 45% percent by 2020 to 7313 TWh (IEA, 2014b).

Moreover, the share of electricity produced from RE sources has also been growing, despite the continuing strong increase in overall electricity production globally, moving from 18.7% in 2007 to almost 22% in 2013. Renewable electricity generation is forecast to exceed 25% by 2020 (see Figure 17).

Figure 17 • Global renewable electricity production by technology – historical and forecast

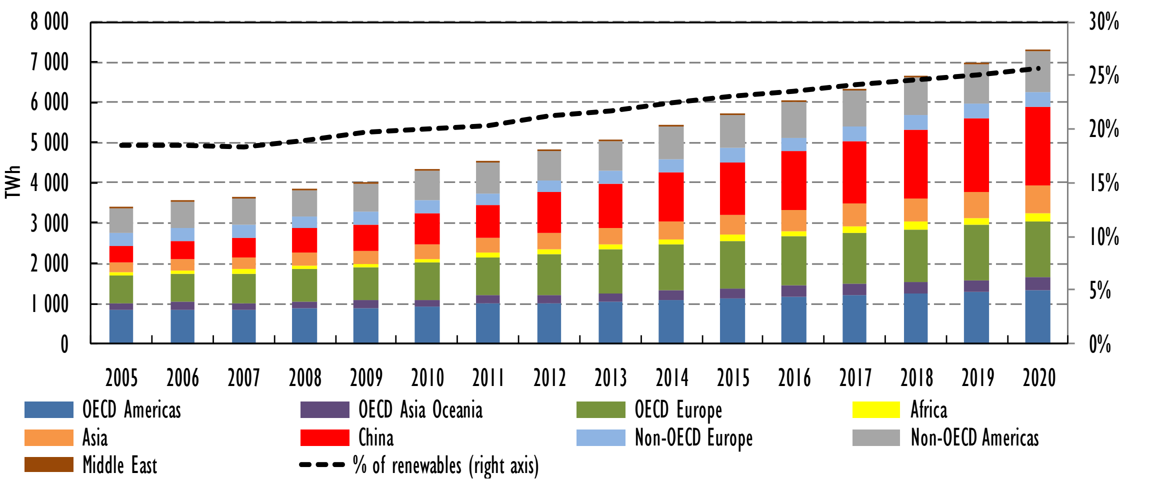


Source: IEA (2014b) *Renewable Energy Medium-Term Market Report*, OECD/IEA, Paris.

Hydropower, the most mature and most widely deployed technology, provided 75% of this generation in 2013. While hydro use has continued to grow, some of the "newer" technologies such as wind and solar PV have also been increasing at high compound average growth rates and their share of the electricity generation mix is rising rapidly. By 2020, hydro's share in renewable electricity generation is expected to decrease to 63% of the renewables generation total (IEA, 2014b).

In recent years, the focus for new renewable generation has shifted from OECD to emerging and developing economies, in response to their urgent need to meet increased electricity demand. China alone is expected to make up 40% of the global growth in the renewable electricity market to 2020, but deployment is also growing strongly in some other Asian, South American and recently, African countries (see Figure 18).

Figure 18 • Global renewable electricity production by region, historical and forecast

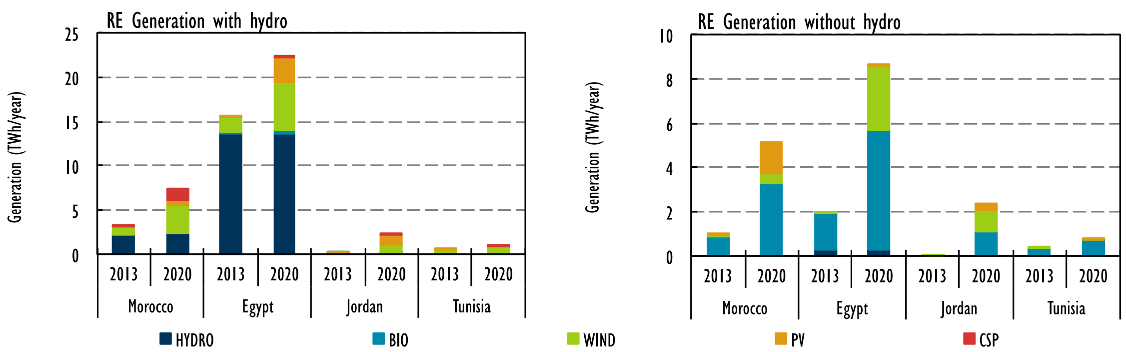


Source: IEA (2014b) *Renewable Energy Medium-Term Market Report*, OECD/IEA, Paris.

Trends in SEMED and ETC Regions

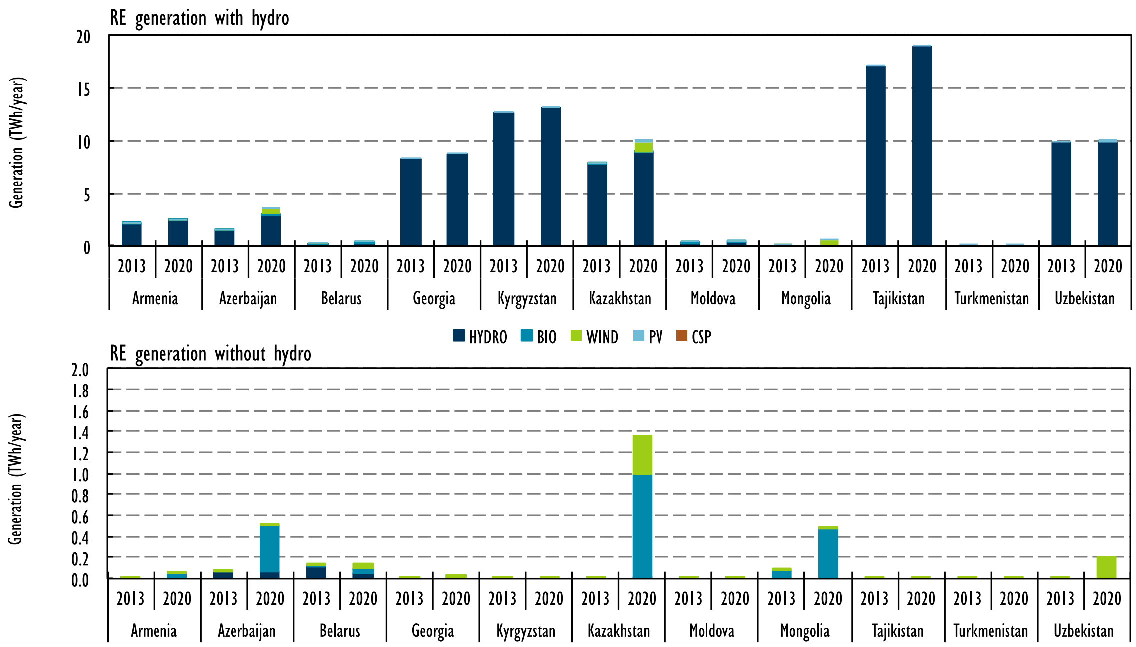
Figure 19 shows the level of generation from renewable sources in the **SEMED region** in 2013, and the anticipated generation in 2020 (IEA, 2014b) for each of the countries under study, both with and without hydro. **Egypt** and **Morocco** already have significant hydro generation, expected to grow slightly by 2020. It shows an ambitious programme of growth for non-hydro renewables, particularly in Egypt where new plans have recently been announced. Strong growth in wind power is expected in each country, with solar making an increasing contribution particularly in **Morocco**, **Jordan** and **Egypt**.

Figure 19 • Current and projected RE generation in SEMED countries, with and without hydro



Source: IEA analysis: 2013 data are IEA estimates based on IEA statistics; Platts (2014) "UDI World Electric Power Plants Database" December 2013 edition, McGraw-Hill Companies, New York. 2020: Renewable Energy Medium term Report, OECD/IEA (forthcoming).

Figure 20 • Current and projected RE generation in ETCs, with and without hydro



Source: IEA analysis: 2013 data are IEA estimates based on IEA statistics; Platts (2014) "UDI World Electric Power Plants Database" December 2013 edition, McGraw-Hill Companies, New York. ***2020: Renewable Energy Medium term Report, OECD/IEA (forthcoming).***

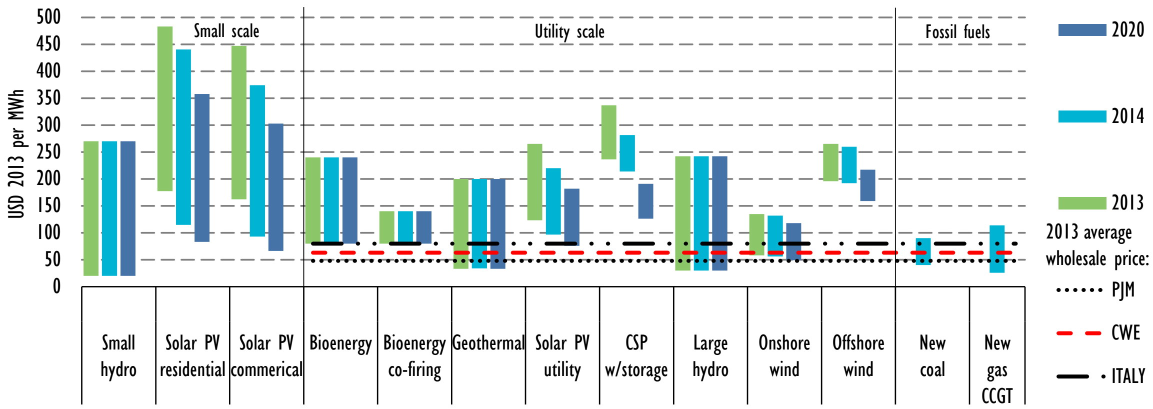
Figure 20 presents the same information for the **ETC region**. The figure shows the strong current contribution of hydro in **Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyzstan, Moldova,**

Tajikistan and **Uzbekistan**. It also reflects intentions to increase non-hydro renewables**,** particularly in Kazakhstan, but with much lower ambitions than in the SEMED countries.

Recent falls in the levelised cost of renewable electricity

Growing levels of renewable electricity deployment have stimulated significant capital cost reductions, particularly for wind and solar PV. These lower costs have in turn allowed deployment in a wider range of countries and circumstances. Figure 21 shows that the generation costs for a range of renewable technologies (as measured by their levelised cost of electricity - LCOE) have been falling rapidly and how these reductions are expected to continue to 2020. It also shows how they compare with costs of electricity from gas and coal generation, calculated on the same basis. The figure highlights that in an increasing number of circumstances, both the more mature technologies such as hydro, geothermal and bioenergy, and the "newer" options can be cost-competitive with fossil alternatives based on this measure, and comparable with wholesale electricity prices in a number of markets. The range of costs varies depending on the availability of resources and other local factors. This context is relevant to the policy recommendations that follow.

Figure 21 • Levelised costs of electricity (USD per megawatt hour [MWh]), beginning year



Source: IEA (2014b), *Medium-Term Renewable Energy Market Report*, OECD/IEA, Paris.

Barriers to the deployment of renewable electricity

The LCOE figures in Figure 21 provide a useful benchmark and show that on this metric, renewable electricity costs are falling and are set to fall further in future. In markets that are expanding or where new capacity is required for other reasons (e.g. plant retirements), this is one key criteria of competitiveness. However, comparing the cost of energy for various electricity generation technologies using LCOE alone may not take into account the value of electricity, which depends on the time and location of production, the market frameworks under which different technologies compete, or the recovery of fixed network costs.[20]

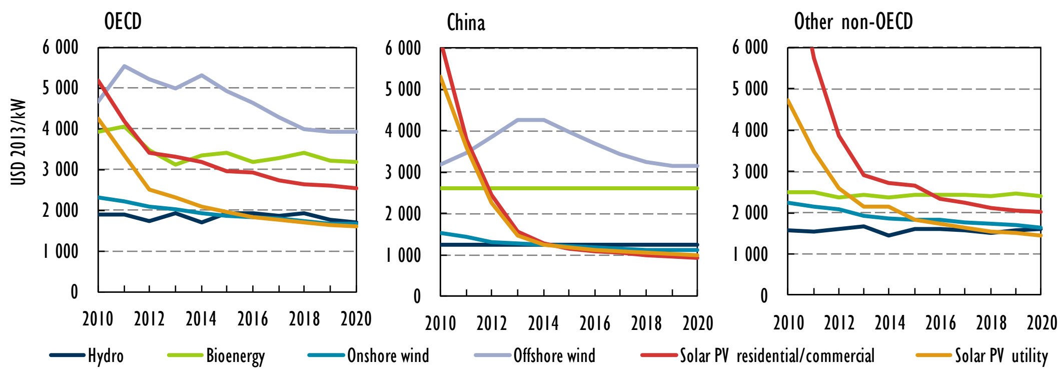
Actual costs for renewable electricity vary widely between markets, meaning that cost can still be a significant barrier to deployment in many cases. The maturity of the market is a key factor, with early projects in immature markets tending to cost more than international benchmarks. Factors influencing total project costs include the availability of the renewable resource, project investment costs, and financing costs. These are explained in more detail below.

[20] A more detailed discussion on the methodological approach to LCOE can be found in the study *Projected Cost of Generating Electricity* (IEA and NEA, 2010). An updated version of this study is to be released in 2015.

The local availability of the renewable resource affects the energy yielded by each unit of installed capacity or the costs of each unit generated (for example, how many hours of sunlight a photovoltaic panel receives per day).

Project investment costs include costs for project preparation, equipment, and grid connection. Each of these will vary between markets, and are influenced by policy and regulatory frameworks. Costs will be reduced by transparent permitting procedures, and where there is a predictable and competitive large-scale market. Grid connection costs will depend on the relative position of the renewable resource to user centres and on the policy of allocation of grid reinforcement costs. Figure 22 illustrates how investment costs have been falling, but still vary between countries and regions.

Figure 22 • Weighted average annual renewable investment costs, historical and projected



Source: IEA (2014b), *Medium-Term Renewable Energy Market Report*, OECD/IEA, Paris.

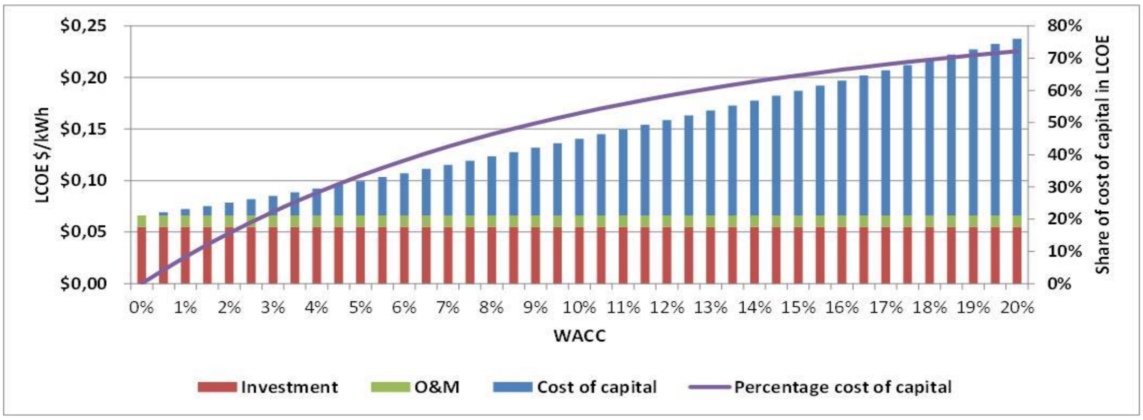
Financing costs for projects play a major role in determining overall costs, given that renewables projects require intensive upfront capital investment. The cost of the electricity produced is very sensitive to the rate at which capital for the project is made available through equity and debt funding. Figure 23 illustrates this by showing how the cost of electricity from a large-scale PV plant rises as the weighted average cost of capital (WACC) increases. At a WACC of 10%, financing costs make up 50% of the total cost. Reducing the WACC to 5% reduces the electricity production cost by some 30%.

Financing costs are determined by the perceived risks associated with the project such as:

- financial risks associated with operating in a particular country;
- confidence in the track record and credit worthiness of the technology, equipment supplier, project developer and power purchaser; and
- the certainty that there will be a regular and predictable income stream from electricity sales.

In assessing RE cost competitiveness, it is important to examine the market specific conditions in which they operate. For example, in markets with good resources, good financing conditions and rising demand, some renewables are able to compete under a market design based on wholesale pricing. Furthermore, the presence of an increasing share of low marginal-cost renewables in the power mix can put downward pressure on wholesale prices. For other markets, renewables may find it difficult to recoup their costs with wholesale prices, even as their generation costs decline. In such markets, renewables are remunerated at marginal prices according to the prevailing, short-term demand-and-supply balance.

Figure 23 • Influence of weighted average cost of capital on cost of electricity from a large-scale PV plant



Source: IEA analysis.

Non-economic barriers

Previous analysis established that while addressing cost-related barriers are important, other factors also influence the pace of deployment, which need to be addressed as part of any RE policy portfolio (IEA, 2011a). These include:

- ensuring electricity market and grid access on reasonable terms;
- putting in place a clear and transparent permitting system;
- taking measures to tackle skills shortages;
- avoiding penalising tariff barriers to import of RE systems; and
- providing public information.

Policies for renewable electricity

Policy and regulation can play key roles in minimising risks, creating conditions conducive to low-cost electricity generation from renewable sources. Based on clear and reliable targets for renewable energy, a comprehensive policy portfolio should be designed to:

- adequately remunerate renewable electricity generation;
- provide revenue certainty and facilitate access to debt and equity capital markets, including through sustainable long-term power purchase agreements and strategies to reduce currency risks;
- allow effective grid integration; and
- remove non-economic barriers.

The following section discusses a range of key policies for encouraging the deployment of renewable electricity technologies.

Role of strategies and targets

A clear and credible national renewable energy strategy, with short, medium and longer-term deployment targets, provides confidence to all stakeholders, including developers and investors, that renewables are being taken seriously in a country and that policies put in place will be sustained over a significant period. It should be clearly linked to the overall national energy strategy and meet strategic needs – for energy security, to help meet environmental goals, or to provide socio-economic benefits. Close consultation with all government bodies and industry players involved in the delivery of, or affected by, the strategy is critical during its development.

By early 2014, renewable energy support policies were in place at the national or state/provincial level in 138 countries (REN21, 2014b). A total of 144 countries have renewable electricity targets in place. In the case of the two focus regions of this study, all of the countries in the **SEMED region** and seven of the countries in the **ETC region** (**Armenia, Azerbaijan, Belarus, Kazakhstan, Moldova, Mongolia, Tajikistan**) have some form of renewable target in place.

However, targets are not significant unless they are binding in some way and are backed up with a credible action plan aimed at stimulating deployment by removing barriers and encouraging investment.

Renewable electricity remuneration policies

A number of different policy mechanisms have been used to support renewable electricity deployment through the early stages of deployment, which broadly serve one or more of three functions: obligate electricity producers or suppliers to generate a minimum amount of renewable energy; provide economic support that makes renewable generation more attractive to investors and/or more competitive compared to fossil alternatives; and secure remuneration for renewables through the offer of long term supply contracts.

Common policy mechanisms, of which more than one can be applied at the same time in a complementary way, include feed-in tariffs (FITs), feed in premiums (FIPs), auctions, renewable portfolio standards, quotas and tradable green certificate schemes, tax rebates and capital grants.

As Figure 24 shows, FITs are the most widely used mechanism, but recently many countries have introduced a system of auctions, leading to the award of long-term power purchase agreements as a way of stimulating deployment while encouraging cost reduction through competition.

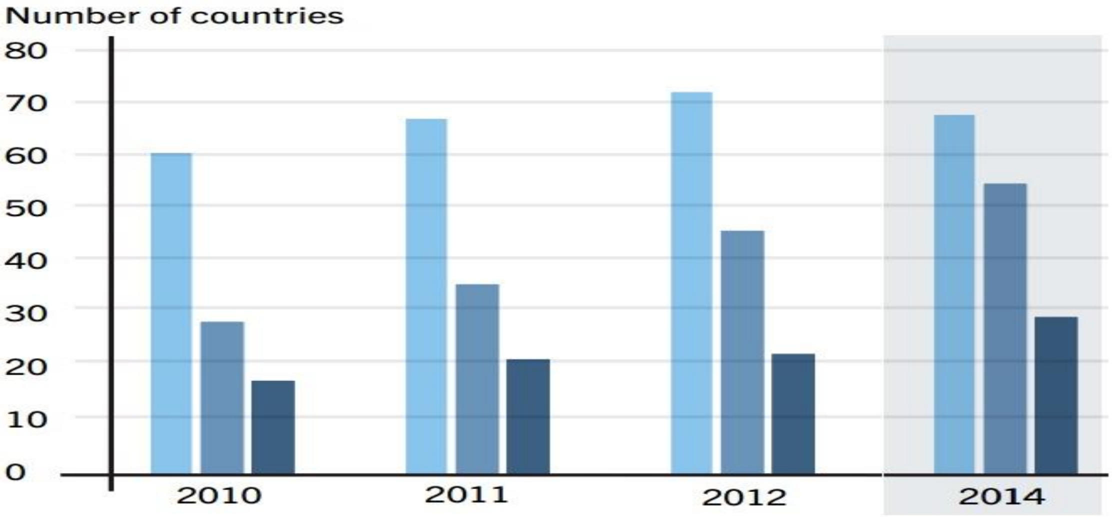
Feed-in tariffs (FITs)

FITs guarantee the generator of renewable electricity a certain price per unit of generation (kWh or MWh) over a long period of time (commonly 20 years), sometimes indexed to inflation. Tariff adjustments can be made periodically for new plants. FITs have been mostly used, particularly in Europe, to stimulate deployment. As a FIT is a standardised, long-term power purchase contract, it provides a very high level of investor security. FITs often include a number of favourable conditions for RE project owners: guaranteed connection to the grid, compensation if output cannot be fed into the grid, and no requirement to forecast generation on a project level. FITs have most frequently been funded via a levy on consumers but in principle could also be funded by taxation.

FITs are relatively easy to design and administer and so have been used for projects covering a very wide range of technologies and scales and are accessible to investors of all types, including householders. They have also been used in both highly regulated and liberalised markets.

In FIT systems, the prices are set administratively – usually by modelling a price estimated to provide an adequate return to investors, based on current project costs and financing conditions. Tariffs are usually set according to technologies and specific circumstances – for example, different scales of generation, or for ground-mounted and roof-mounted PV systems. This allows FITs to stimulate development of a broad portfolio of technologies with different costs and at different stages of maturity. It also requires the regulators setting the tariffs to have a detailed and current knowledge of these cost factors, difficult in markets where costs are changing rapidly (such as the global PV market). Setting the tariff in a way that provides adequate but not excessive returns to investors is the most challenging aspect associated with FITs, given the asymmetry of information between regulators and developers.

Figure 24 • Number of countries with renewable energy policies by type

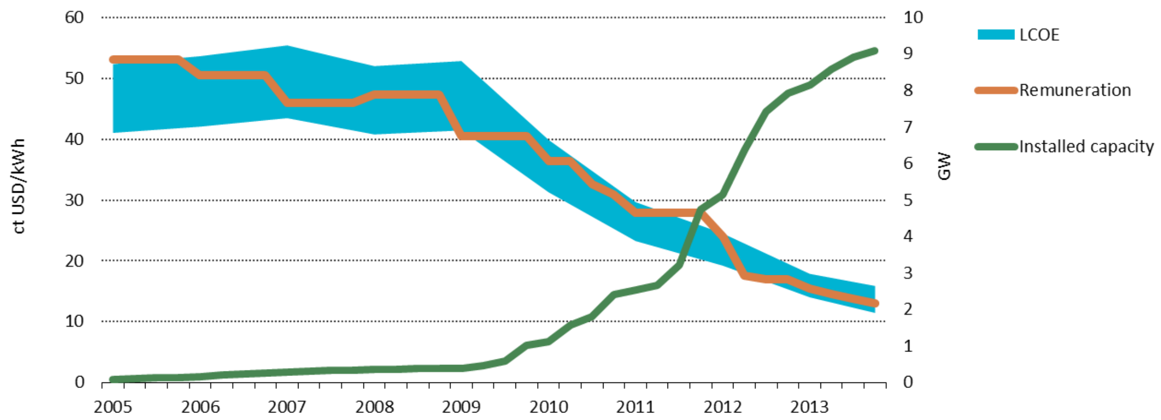


Source: REN21 (2014b), Renewables 2014: Global Status Report, REN21 Secretariat, Paris.

A FIT provides fewer economic incentives to developers to innovate to reduce costs than other policy mechanisms because a regulator sets the tariff. Conversely, the very clear tariff signals to investors and developers provided by FITs have been successfully used to stimulate large-scale markets (for example in Germany and elsewhere in Europe), which have in turn stimulated global cost reductions.

Tariffs need to be reviewed and adjusted regularly in the light of cost changes and deployment rates, while also providing project developers some certainty about tariffs for future projects to avoid a "stop-start" market situation. In Germany, for example, the FIT tariffs are automatically reduced once threshold levels of deployment are achieved. Figure 25 shows how the FIT tariffs for solar PV have been progressively reduced as costs have fallen and deployment has grown.

Figure 25 • Development of LCOE, remuneration levels and installed capacity for utility scale PV, Germany



Source: IEA analysis.

Price-based incentives like FITs do not (in their "purest form") include any constraint on deployment levels. There is an associated risk that the generation stimulated by these incentives may exceed that expected, pushing up the associated overall policy costs beyond what was predicted or was affordable. There were a number of cases (including in Spain, Czech Republic, Thailand, and Italy) where deployment levels far exceeded initial plans, leading to very high policy costs because FIT levels were not adjusted to account for sharp falls in global PV module prices (IEA, 2011a). Such rapid cost reductions are now less likely to occur and the market for PV is now much more diversified. Nonetheless, it is prudent to include some constraint (known as a cap), either on capacity or on the budget, which allows deployment volumes to be managed.

In cases where the capacity has outrun the expected levels and budget provision, some governments have introduced retroactive measures to reduce budget exposure. Such measures are extremely damaging to investor confidence and can harm future markets so should be avoided at all costs. Such over-runs can be avoided by incorporating a capacity or budget cap into FIT design.

Market or feed-in premiums (FIPs)

These are intended to complement revenues generated on the standard electricity market by paying investors according to the amount of electricity they generate or the amount of capacity they build. FIPs can take a variety of different forms (fixed, variable, per energy, per capacity) but all share the basic idea of complementing standard revenues in a way that increases sufficient investor confidence while exposing them to some market signals.

FIPs are replacing FITs in a number of European Union countries. They provide a lower level of investor security than FITs but also in some cases allow generators to take advantage of opportunities to maximise the value of their electricity in the market. They may therefore offer an advantage to generators who can schedule generation and have significant marginal generation costs (such as bioenergy generators), or who may have other constraints on overall generation levels (such as hydro generators).

Contracts for difference (CfDs)

CfDs are similar to FITs and premiums in that they provide a standardised, long-term power purchase agreement (PPA) for renewable energy projects. Under a CfD, generated electricity is sold directly on the market. If market revenues fall short of a predetermined price (the strike price which can either be set administratively or via a competition for capacity), investors receive additional compensation such that market revenue and support payments equal the strike price. Conversely, if market revenues exceed the strike price, investors reimburse what is surplus to the strike price. Such a scheme is currently being introduced in the UK.

Tenders or auctions

Centralised procurement via a government or public body can be used to contract a certain amount of renewable energy or capacity within an overall allocation. Often, auctions are held to contract a predetermined quantity while the price is set in a competitive bidding process. Auctions may contain specific requirements (e.g. shares of local manufacturing, details of technological specifications, maximum price per unit of energy). They can be technology specific (to develop a portfolio of technologies at different stages of maturity and costs), or technology neutral (to select projects on a least-cost basis). RE project developers are invited to bid to win the contract and the bidders with the best offers are selected.

Usually the winning parties sign a long-term PPA for power generation, and can therefore provide a high level of investor security. However, such a long-term PPA is only of real value when there is confidence that the contract will be honoured by a credit worthy party, such as a large utility. If the utility is in the private sector, the credit-worthiness will be assessed. In other cases the off-taker may be a government owned utility or an entity established to enter into such long-term supply contracts. In these cases, the credit worthiness can be established via a guarantee that the government will honour financial commitments in case of any payment defaults. For example, in South Africa the national utility Eskom signs the PPA contracts, backed by a government guarantee.

For bidders, tenders require significant work ahead of contract award, which risks substantial upfront expenditure. For government, the risk is that bidders will "underbid" in the competition to win contracts, then later be unable to deliver the projects at the budget costs and so default, leading to lower than anticipated capacities. This problem can be avoided to a large extent by insisting that bidders provide a bond or face other penalties if they fail to deliver projects.

Given upfront costs and the need for guarantees, tenders are best suited to larger scale projects and most tend to involve well-financed and experienced international developers (sometimes in collaboration with local players and investors). They are less appropriate for smaller scale projects or where there is a desire to encourage development and investment by smaller players.

To attract investors to participate in an auction, to bring real pressure to bear on prices, the auction arrangements, including bidding conditions, must be carefully specified. Tenders are most effective when there is a pool of potential bidders backed up with a competitive supply chain, and after an efficient and transparent regulatory framework is in place. Therefore they are most appropriate for markets that have progressed beyond the earliest stages of market development.

Well-run tenders also require a qualified professional and independent body to manage the preparation, competition and award of contracts in a very transparent, impartial and professional way, to secure the confidence of bidders and financiers (IRENA, 2014).

There is increasing evidence that well-managed competitive auction processes can very effectively drive generation costs down and their use is growing, especially in emerging and developing economies. Figure 26 shows how over successive auctions for renewables capacity in South Africa, costs for wind solar and solar thermal generation fell sharply.

Tenders have already been used successfully to stimulate RE development in the **SEMED region**. **Morocco** has run international competitive tenders for both CSP and PV projects, leading to very low offers of price per Kwh, and **Egypt** is just concluding an auction process for large wind farm projects which offer world record-breaking low prices (around USD 40/MWh).

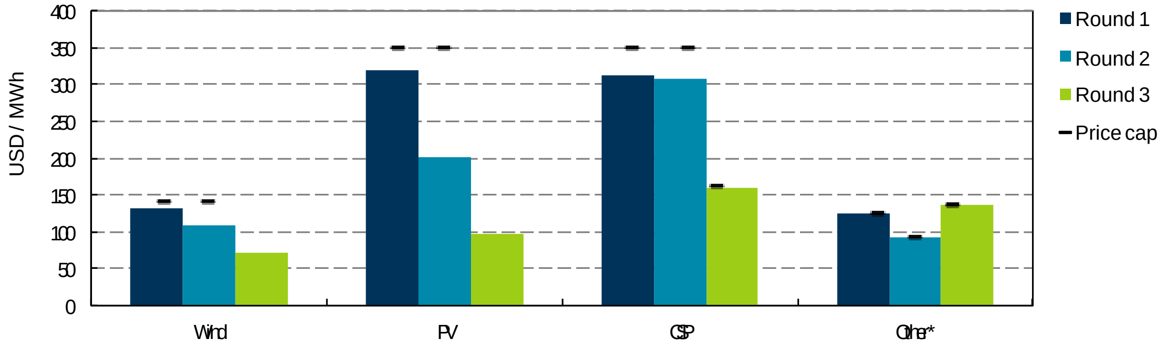
Quotas with tradable green certificates (TGCs)

These work by setting a specific amount of electricity that needs to be produced by renewable energy generators. This obligation is usually imposed on electricity suppliers. To facilitate meeting this obligation more efficiently, a market is established for certificates that are issued for each unit of green electricity generated towards meeting the quota. The certificate market is thus an additional market that is based on the idea of separating the actual power and its "greenness". The electricity component is remunerated in the same way as non-renewable electricity, for example via the wholesale power market. TGC schemes usually include a fine that the entities under the obligation have to pay if they fail to buy enough certificates. In most cases, this penalty rate determines an upper bound for the value of certificates.

Renewable Portfolio Standards (RPSs)

RPSs set a target share or total amount of energy generation from renewable energy sources for electricity producers or suppliers. Obliged entities may then procure renewable energy in one or more of a number of ways - by directly developing projects, by entering into a PPA or by using other remuneration mechanisms. RPSs operate on the assumption that the obliged entity has sufficient opportunities to build or purchase renewable energy directly. Where this is not the case, a quantity obligation can be combined with trading of green certificates.

Figure 26 • Average awarded tender prices under the South African REIPP



Source: IEA analysis based on South Africa Department of Energy (2013), Bid Window 3, Preferred Bidders' announcement, Pretoria, 4 November.

Note: Price caps and average prices were converted using average exchange rates of ZAR/USD 0.116 from December 2011 for Round 1, ZAR/USD 0.123 from May 2013 for Round 2, and ZAR/USD 0.098 from November 2013 for Round 3.

Tax incentives or credits

These are often used to reduce the cost of renewable energy projects from an investor perspective. Mechanisms include reduced tax rates or waiving certain taxes for equipment or revenues from energy sales. Tax incentives can also be given by reducing tax liabilities per unit of generated electricity; this is the case for the production tax credit in the United States. Tax incentives may also take the form of accelerated depreciation of renewable energy assets. While tax credits are widely applicable, they do not in themselves provide income security, nor a string incentive to reduce costs. They are often used in conjunction with other remuneration or support mechanisms (for example with RPS systems in the United States).

The principal design issue relates to the longevity of the measures. Frequent discussions and decisions about whether to prolong the tax benefits does not provide long-term market confidence and can lead to cyclical deployment patterns as developers rush to meet qualifying dates. A long-term commitment to keep such measures in place helps stabilise the market.

Direct cash grants/rebates

These can be used to reduce net investment costs and so improve returns for investors. While providing neither income certainty nor pressure to reduce generation prices, grants are easy to manage from the perspective of both the awarding and receiving parties. Grants have most frequently been used for technologies at the demonstration stage or for small-scale distributed technologies where providing a capital grant is administratively simple and does not require metering of output.

Loan guarantees

Government backed loan guarantees have been used in some cases (e.g. in the United States for concentrated solar power plants), as a way of opening access to financing or reducing the costs of capital for projects, especially during the early stages of deployment when there are still perceived technical or financial risks associated with projects. The guarantee is only called in if difficulties are encountered.

Assessment criteria

Each mechanism has some potential strengths and weaknesses that affect the extent to which it meets a number of criteria including the following:

1. **Investor price risk:** To what extent does the mechanism provide price certainty for developers and investors?

   As discussed above the costs of renewable electricity are very sensitive to the financing costs, which are in turn dependent on the perceived risks to investors. Options that provide a steady and predictable income stream to investors effectively reduce the price risk and so can lead to lower costs, so long as project developers and investors have confidence that the organisation responsible for paying is credit worthy.

   Mechanisms like FITs, CfDs, auctions and RPSs lead to long-term (typically 15-20 year) power purchase arrangements, which provide long-term guarantees on income that are "bankable" and provide assurance to lenders that sufficient funds will be available to service debts. Such mechanisms can be used even when the electricity from renewables is broadly with that from other sources.

   Other options expose investors to price risk either via a link to electricity market prices (such as premiums and grants) or to the value of their renewable nature, or both (TGCs).

2. **Scope of Application:** Is the mechanism appropriate for a range of project scales and investor types and in different regulatory regimes?

   Some mechanisms are applicable across a wide range of scales of projects while others are more appropriate for large-scale projects and developers and investors, and are more or less suited to liberalised or regulated markets.

3. **Cost pressure:** How strongly does the mechanism encourage cost reduction through technical and financial innovation?

   Prices paid to generators can either be established administratively through a market price setting mechanism, or through competition.

   Administratively set systems concede some advantage to the developers, since they inevitably have better real-time information on costs, and may therefore not be as good as competitive mechanisms at driving cost reductions through encouraging technical and financial innovation.

   By contrast, where prices are set by competitive processes, investors and developers are incentivised to be creative in reducing costs by optimising the technical and financial engineering of projects. However, stimulating effective competition requires a high level of administrative capability and independence to prepare and execute the bidding process impartially and professionally, and "underbidding" by developers must be discouraged. High upfront costs associated with competitions may discourage smaller scale projects and restrict the pool of developers and investors who participate.

4. **Portfolio development:** How does the mechanism assist the development of a portfolio of technologies perhaps at different stages of development?

   Some systems are more easily adapted to situations where there are several technologies at different stages of maturity and costs and others favour a technology neutral approach.

5. **Link to market value:** Does the mechanism provide a signal that encourages generation at a time when the value of the electricity is highest or discourage generation at times of when generation may be in excess?

One other important factor is how the mechanisms are funded. Mechanisms funded directly from the general government budget are more susceptible to review and changes as part of periodic reviews of government expenditure, and so are less secure. Those funded via a levy on consumers tend to be more stable. However, the question of who bears the levy needs to be considered. In some cases industrial consumers are sheltered from levy payments to protect the economic competitiveness of energy intensive industries (e.g. in Germany). This inevitably increases the impact of the levy on other consumers. In other cases (e.g. China), domestic customers are sheltered from the levy to avoid pushing up electricity costs for poorer households. The best solution is probably to put a levy on all consumers proportional to electricity use, and then to make social or industrial compensations via other mechanisms.

Characterisation of remuneration mechanisms

Table 1 provides a summary of the characteristics of each of the principal support mechanisms in terms of these factors. It also identifies key risks associated with their design and operation along with measures to counter those that can be included in their detailed design.

Which instruments are the best?

The selection of which instrument (or portfolio of measures) to use depends on factors in each local context including: the available resources; the extent to which the electricity market is liberalised or deregulated; the maturity of institutions; and political preferences. It is not possible to recommend a "one size fits all" policy package and past experience with the impact and cost-effectiveness of support instruments have highlighted that more than the choice of instrument, the overall policy package, including implementation details, drives success or failure of the framework (IEA, 2011a). This notwithstanding, it is possible to derive some general lessons for policy design depending on the maturity of the local market.

In the **Initiation phase** the emphasis needs to be on providing a secure investment climate for what are seen as risky investments, in the **Take-off** phase the main priority is to reduce and manage support costs, and in the **Mainstreaming** phase the aim is to expose each renewable source to more competition with other renewables and with fossil-fuel generation, and to encourage generation when its value to the system is highest. Figure 27 shows the support mechanisms most suited to each of the deployment phases.

Based on this analysis the following conclusions are drawn:

- FITs, used in over 70 countries countries, can be used to encourage deployment of a wide range of technologies, and from large to small scale projects. They are also accessible to a very wide range of investor types and across the whole of the deployment journey for smaller scale projects, while larger scale projects may benefit form a more competitive mechanism in the mainstreaming phase. The principal challenge is to establish tariff levels that encourage cost reduction – international benchmarking could play an important role here.
- Tenders or auctions for long term power purchases can effectively reduce generation costs through competition. They can be particularly effective in the Take-off phase to reduce prices down towards international benchmarks. They are best suited to larger scale projects and may constrain the types of projects and investors who participate. They are only effective with a clear regulatory framework in place, and for there to be real competition for projects they are best used once some initial experience and capability has already been established. Under these circumstances they could be deployed at an earlier deployment stage.
- FIP schemes (now increasingly deployed in the EU) expose project owners to the market value of their generation while also increasing price risks. They are therefore best suited towards the consolidation phase of deployment.

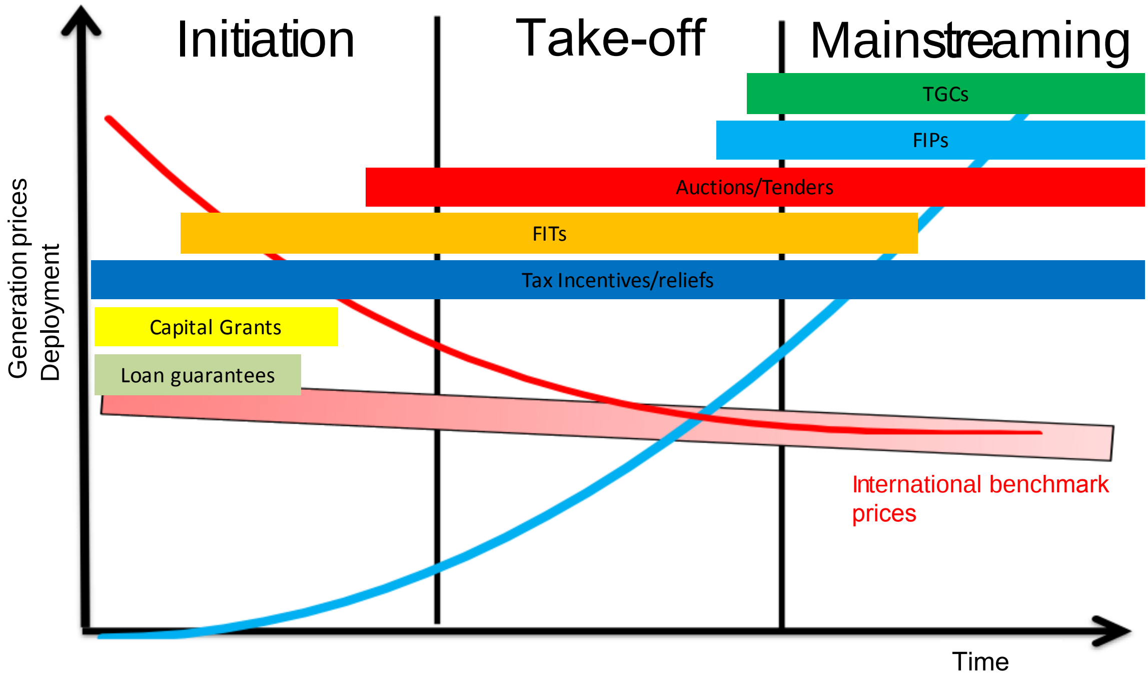
Table 1 • Features of RE Electricity Support Mechanisms

	Income Certainty	Scope of Application	Cost Reduction Incentive	Portfolio Management	Exposure to market value of generation	Comments
Auctions/Tenders **Including RPS with auctions for associated PPAs**	Provide income certainty via long term PPA's	Extensive preparatory work at risk favours large scale projects and developers	Strong incentive for innovation to reduce costs	Can be technology specific or technology neutral depending on needs	None	Needs strong and independent administrative capability to organise and manage effective processes
Feed in tariffs (FITs)		Any	Provide a long term market stimulus which helps reduce prices, but administratively set prices may not provide strong cost reduction stimulus.			Require excellent cost knowledge to set appropriate prices
Feed in premiums (FIPs)	Some exposure to electricity market price risk (depending on design)				Provide exposure to market prices signals	
Traded Green Certificate Schemes (TGCS)	Exposure to electricity and green certificate market prices	Trading transaction costs favour larger scale players and projects	Limited	Technology neutral, so favours lowest cost technologies. To promote portfolio diversity, "banding" is needed		Market risk pushes up prices. Over-rewards cheapest generators, pushing up policy costs. May be appropriate once technology prices converge and supply curve is "flat"
Tax relief or incentives	Exposure to electricity market prices	Any		Can be technology specific or technology neutral depending on needs		Funding vulnerable to government budgeting cycles
Capital Grants						

- Certificate trading schemes expose project owners to price uncertainty associated with both electricity and certificate markets. This increases investor risk compared to other policies and may push up generation costs. They are better suited to the consolidation phase, once the technologies' costs converge and the generation supply curve is "flat".
- Tax relief or incentives can help improve the economics from an investor perspective, but do not provide income certainty, incentives to reduce costs, or signal the value of the generated electricity, so are best used in conjunction with other mechanisms, as in the US where they complement renewable portfolio standards and other measures.

- Capital grants are easy to manage and applicable across a wide range of technologies and scales of operation, but also provide neither income certainty nor motivation to reduce costs. They are most appropriate for small-scale projects or at the demonstration phase for new technologies.

Figure 27 • Support mechanisms at different parts of the deployment journey



Source: IEA analysis.

Policies for distributed generation – socket parity

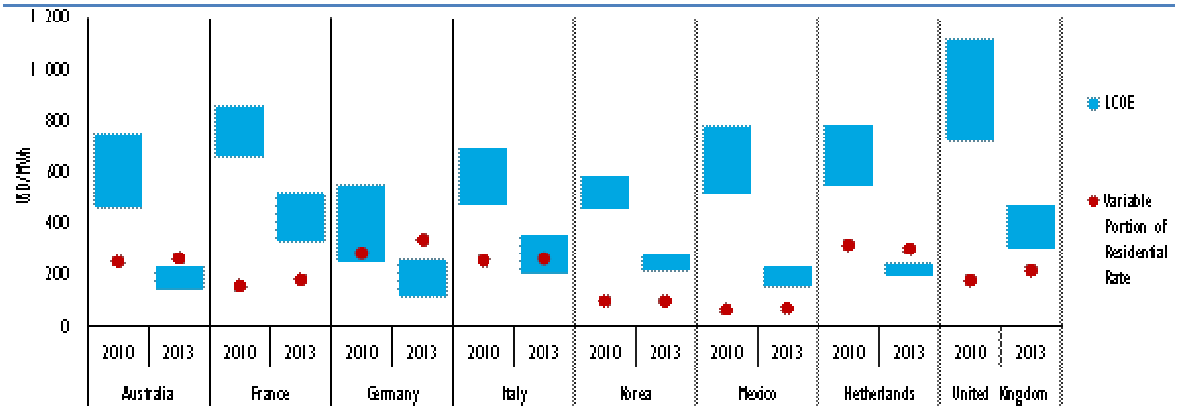
The deployment of renewables at a small scale – principally for solar PV in the domestic and small commercial markets – poses some particular policy questions. The policy measures discussed above, particularly feed-in tariffs, have succeeded in stimulating deployment and helped to reduce costs in many markets. Electricity from roof mounted PV systems can now be produced at costs to the consumer (including the capital and financing costs of the system), which are lower than the variable component of the price that they have to pay for power bought from the grid – so-called grid parity. At this point there is a powerful motivation for the householder to invest and this is likely to be a major stimulant for PV deployment.

Often a proportion of the electricity produced by the consumer can be used to meet the household's electricity demands, but in the absence of low-cost electricity storage (batteries), there is often a mismatch between when the power is produced (peaking at midday) and when it is needed (generally in the evening). Consumers still need grid access for power when the PV system is not producing, and to sell power produced when it exceeds their needs, but in a system with high levels of PV the value of this power may be limited (see Figure 28).

This raises the question of how consumers should be rewarded for the electricity produced which they themselves consume and which they inject into the grid. A number of models are currently being used, including:

- **Net energy metering**: This allows the consumer to pay just for the balance between the electricity they draw from the grid and that which they inject, taken over an extended period. This system is used, for example, in 43 states of the US, Australia and Italy. This model is very attractive to consumers, particularly where electricity is highly taxed but can have issues from a system perspective; excess PV electricity is rewarded at retail prices, which exceed the value of that PV production to the system. To prevent excessive surges in deployment, policy makers in Denmark have restricted "netting" to an hourly basis, and many states in the US have introduced capacity limits of between 0.1 and 20% of total consumer peak demand.
- **Self-consumption and remuneration of excess production**: In this model customers are rewarded at a fixed rate for electricity injected into the grid via a FIT, which is set well below retail prices to encourage consumers to maximise own-use and limit costs to the system. In Germany such FITs are available for up to 90% of the system's production. Given the higher reward associated with the self-consumed electricity, the FIT rate can be set at a low level while still providing sufficient incentive to encourage deployment
- **"Buy all, sell all" models:** here consumers continue to pay for all their electricity at the standard rate. PV electricity cannot be used to offset grid electricity consumption but is rewarded at a specific rate. This system has been introduced in Austin, Texas and the state of Minnesota, with repayment for the PV generation based on a calculated value of the generation to the system. While such a system is compatible with existing market arrangements, calculating the system value of the generation is complex and controversial, and, as large r penetration levels are reached, the value of the PV generation levels will decline.

Figure 28 • Comparison of variable component of electricity tariffs and solar PV LCOE



Source: IEA (2014b), *Medium-Term Renewable Energy Market Report*, OECD/IEA, Paris.

High levels of distributed PV also have some broader implications for the power system including:

- impacts on grid costs and how the costs are to be recovered as less electricity is purchased from the grid;
- responsibility for additional balancing costs associated with increased levels of PV;
- foregone renewable energy surcharges, since the costs of renewables support policies are often recovered through a levy on electricity sales which are avoided by self-generators;
- impacts on cross-subsidisation in cases where industry and commercial consumers pay a premium price which is used to subsidise domestic consumers. If the larger scale consumers

opt for distributed generation this could lead to a deficit that would have to be covered by other funds; and

- impacts on the tax take where electricity sales are taxed.

These issues become more pressing once the penetration of distributed renewable generation rises, and this is still an active area of policy development and analysis. At earlier stages of deployment, the best route may involve a progression from the use of feed-in tariffs to a net metering scheme and then to a less generous scheme based on specific tariffs calculated on the basis of the value of the electricity to the system.

Creating an enabling environment for renewable electricity

Given recent cost reductions, renewable electricity technologies often no longer require large financial incentives where resource and market conditions are appropriate. Where financial incentives are required to overcome economic barriers to deployment, a range of policy options exist (outlined above).

However, due to the presence of a range of non-economic barriers – such as lack of market access, difficulties in gaining the necessary permits, and skills shortages – the policy options discussed above still require the creation of an enabling environment if they are to be effective. An enabling environment for renewable electricity can be created through measures that establish a high level of confidence in the market, clear rules governing the way electricity is sold, and transparency about risks.

Key to creating an enabling environment for renewable electricity is to establish conditions in which renewable electricity sources can be easily integrated into grid operations. This is discussed in more detail in the following section.

Integration

The integration of renewable sources into an electricity grid is important, particularly for "variable sources" such as wind and solar PV, which are only generated when the wind blows or the sun shines. The impact of this variability on the grid depends on if it matches demand patterns (for example, how generation matches air conditioning use in sunny climates). It also depends heavily on the characteristics of the particular electricity system – the flexibility of other generation sources, the strength of the transmission and distribution system and other factors.

Recent IEA (IEA, 2014k) work concentrating on this issue has reached the following conclusions:

- Many countries have already achieved significant levels of penetration of variable renewable generation in their generation mix without encountering serious problems by taking relatively simple measures including:
  - avoiding concentrations of generation in areas where grid infrastructure is weak and ensuring any necessary grid improvements are carried out in parallel with the deployment of renewable generation; and
  - using modern forecasting methods to predict levels of generation.
- At higher deployment levels, measures must be taken to develop a more flexible system able to cope with the variable generation. These include:
  - encouraging renewable generation to be system friendly (for example by varying the orientation of some solar generation so as to spread the peak generation time);
  - improving market design and operations, with faster electricity trading, electricity pricing depending on time and location and better flexibility markets; and

- investing when necessary to improve the system flexibility in grid infrastructure, flexible generation sources, electricity storage and demand side management.

Currently the level of variable renewables in all countries in the **SEMED and ETC regions** are well within those already achieved in a number of other countries through low cost measures, so integration should not currently present a technical or commercial barrier to further RE deployment. However, some capacity building for regulators and grid operators will be needed to ensure that they are aware of current good practice. In addition, when transmission and distribution systems are upgraded to meet changing or growing electricity supply and demand, these changes should be made with increased future levels of renewables in mind.

Box 4 • Post-Soviet integration complexities

The possibilities for network modernisation and integration within the Caspian and Black Sea region are complicated as a result of attempts at restructuring in the post-Soviet era. At the outset of independence, Caspian and Black Sea countries found their energy infrastructure heavily interlinked with limited ability to function independently from each other. This was particularly evident for fixed energy infrastructure, designed to serve regional energy markets. In many instances, energy companies were split into two segments: decision-making authorities that became the basis for setting up energy ministries, and commercial operators, which were initially set up as vertically integrated national energy companies. In almost all the countries – with the exception of Belarus, Turkmenistan and Uzbekistan – national energy (electricity and natural gas) companies have undergone numerous waves of privatisation, restructuring and commercialisation with the aim of legally and/or commercially unbundling the energy sectors. National electricity generation and distribution companies have been privatised and sold to national or international investors to safeguard system operability, whereas transmission systems largely remained as state-owned commercial operators.

Recent attempts from governments to relinquish their direct arrangements have been observed in a bid to restore the independence of the regulatory authorities by revisiting tariff structures, methodologies and set-up. The absence of cost-reflective tariffs and weak public governance in most of these economies has led to an inability to provide adequate infrastructure funding, and most upgrades are carried out as a part of government guaranteed long-term loans from international financial institutions.

Source: IEA (2015b), *Energy Policies Beyond IEA Countries: Eastern Europe, Caucasus and Central Asia*, OECD/IEA, Paris.

Planned renewables generation may require investment in transmission or distribution systems if the generation occurs in areas where grid provision is not strong, and necessary grid upgrades should be planned and built in parallel to the development of generation or this can hold up the introduction of the renewables generation (as has recently been the case in South Africa).

Sound policy principles for renewable electricity

The right portfolio of policy and regulatory measures to stimulate renewable energy deployment will be governed by local circumstances – the renewable resources, existing legislative framework, market dynamics and the extent to which renewables are already deployed amongst others. There is an increasing body of policy experience on which to draw lessons, particularly for the Initiation and Take-off stages of deployment. Policy experience and analysis of the Mainstreaming phase is still evolving.

Some general principles from existing experience include:

- The importance of establishing **a long-term credible renewable energy strategy** linked to national energy objectives and backed up by credible concrete policies aimed at stimulating deployment. Short, medium and long-term targets are key components of this strategy.
- The need for **a market and policy framework** that provides an investment environment in tune with the needs of the sector. This preferably will involve mechanisms that allow investors to see a secure and predictable income over the lifetime of their projects, reducing risks, financing costs and ultimately generation costs.
- **Financial support may be needed to stimulate investment**. Such support should be reviewed regularly to avoid over payment and support levels should decline as the sector matures and costs reduce. Experience is that competition is a powerful way of achieving cost reduction.
- The portfolio of measures needs to **tackle potential non-economic barriers** by providing fair market access, clear and transparent permitting procedures and measures to build local skills and capacity, and provide good quality impartial public information.
- Measures to **facilitate the integration of variable renewable sources** into the grid need to be taken in line with deployment. Generally, integrating low and intermediate levels of variable renewables into the grid requires only relatively simple and low-cost measures

Renewable heat

The production of heat accounts for more than 50% of global final energy consumption. More than 75% of this is provided by fossil fuels – some 40% of all gas and 20% of all oil and coal are used to produce heat. This fossil fuel use is responsible for about one third of global energy related CO_2 emissions (IEA, 2014j). Reducing fossil fuel use in the heating sector therefore can play an important role in improving energy security and reducing global GHG emissions.

The traditional use of biomass plays an important role in providing energy for cooking and heating and accounts for 43% of energy used in the buildings sector, especially in developing and emerging economies (IEA, 2014j). While usually considered to be part of renewable energy supply, such fuel use is generally unsustainable and is the cause of health problems linked to indoor smoke pollution, and can be a cause of deforestation, amongst other disadvantages.

There is a range of well-developed and sustainable renewable technologies that can provide heat in a cost effective way when conditions are favourable. Such sources can provide heat directly to a building or site through on-site technologies such as solar thermal collectors, or via centralised district heating networks for use in households, commercial buildings or in industry. The main sources of renewable heat are:

- bioenergy;
- geothermal;
- solar thermal energy; and
- heat pumps.

A fuller review of these options is provided in *Heating without Global Warming: Market developments and policy considerations for renewable heat* (IEA, 2014j).

“Modern” renewable heat has received much less attention from policy makers than have renewables for electricity. This is an area that has considerable potential for enhanced policy attention, particularly in cold climates, such as those in the **ETC region**, and where energy security is a high priority issue. One such example from within the region is **Belarus’** State Programme for the Construction of Energy Sources on Local Fuels (2010-2015). This programme aims to increase the use of fuel wood, peat and other domestic fuels to 23.6 MW of capacity and

769.7 MWh of thermal output, leading to savings of 0.96-1.12 bcm per year in natural gas consumption by 2016 (IEA, 2015b).

Box 5 • Renewable cooling

According to the prevailing literature, renewable cooling is defined as the decrease in temperature of indoor air for thermal comfort, obtained through the conversion / transfer of a renewable energy source (IEA, 2014j). There are two principle ways of using RE for cooling. Direct cooling systems use a cold source such as water, ice or snow that is already in the required temperature range and does not require conversion, only transfer of thermal energy for cooling purposes. The second, and most common, including in **SEMED countries**, is known as indirect cooling, requiring external electricity or water input to reduce the temperature, and includes heat pumps as well as evaporative cooling. Thermally driven sorption cooling systems operate on a similar cycle to heat pumps, but use heat – which can be provided by a solar thermal collector – instead of electricity to drive the system.

At present, renewable cooling applications are still a niche market; further cost reductions and technology improvements are needed to make them generally competitive with conventional cooling technology. The IEA Implementing Agreement on Solar Heating and Cooling Programme estimates that around 1 000 solar thermal cooling systems have been installed (IEA SHC, 2013), however investment costs of these systems are in the range of USD 1 600-3 200/kW_{cold}, and thus five- to ten-times higher than standard air-conditioning systems (IEA, 2012b).

A particular advantage of sorption cooling driven by solar thermal is that the time of the highest availability of solar radiation correlates well with the time of highest cooling demand, however the solar thermal cooling systems are not yet cost-competitive with relevant alternatives. An internationally agreed framework for the certification and accreditation of installers is needed to stimulate the market by building customer confidence (Mugnier and Jakob, 2012).

Sources: IEA (2014j), *Heating without Global Warming: Market developments and policy considerations for renewable heat*, OECD/IEA, Paris; IEA (2012c), Plugging the Energy Efficiency Gap with Climate Finance, IEA Insights Paper series, OECD/IEA, Paris; Mugnier and Jakob (2012), “Keeping cool with the sun”, *International Sustainable Energy Review*, Russell Publishing, Kent.

Global market trends

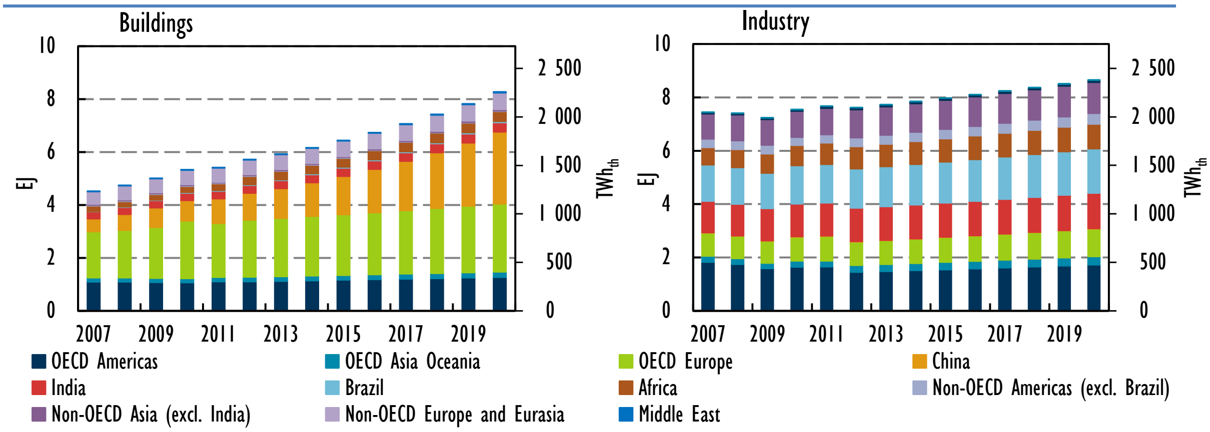
The contribution of modern renewable heat to global energy supply has been rising gradually, and as Figure 29 shows, is expected to continue to do so. In this Figure, Jordan is included within the Middle East and the other **SEMED countries** are included in Africa, while **the ETCs** are included within non-OECD Europe and Eurasia.

In the buildings sector, these modern heating sources now supply some 8.3% of global energy for heating. The contribution is expected to continue to grow slowly driven particularly by policy initiatives in the EU and in China. The sector is dominated by the role of bioenergy but solar energy is playing an increasing role, especially in China. Geothermal also plays an important role in economies where this resource is strong, such as Indonesia.

In the industry sector, renewables (mostly bioenergy) are principally used to produce heat in the biomass based industries, such as the pulp and paper and timber industries. Growth is slow as this sector tends to receive less policy attention. However, there are signs of increasing deployment of renewables in the food industries (where bioenergy and solar can contribute to low temperature heat demand) and for the provision of low temperature heat for remote applications such as in mining and ore processing.

In the **ETC region**, a small number of countries are using renewable energy sources to generate heat. In **Georgia**, heat is generated predominantly from geothermal sources, as well as biofuels and waste in households for heating and cooking (IEA, 2015b). A large number of solar water boiling systems have also been put in place by households in rural areas (IEA, 2015b). In **Moldova**, biofuels including ethanol, rapeseed oil and agricultural waste are used for heating, with 143 biofuel heating systems (29 MW total boiler capacity) installed in public buildings in 126 villages under the Energy and Biomass Project 2011-2014 (IEA, 2015b). Two solar installations have been planned in **Belarus**, each with heat outputs of approximately 160 kW, as well as a geothermal installation with a heat output of 1-1.5 MW (IEA, 2015b).

Figure 29 • Global modern renewable heat production – historical and forecast



Source: IEA (2014b), *Medium-Term Renewable Energy Market Report*, OECD/IEA, Paris.

Barriers to the deployment of renewable heat

The barriers to the deployment of renewable heat technologies are likely to be highly market and technology dependent. For example, there will be very different barriers to deploying solar water heaters in **SEMED countries** compared to deploying geothermal district heating in the ETCs. What follows is therefore a general overview of economic and non-economic barriers to deployment.

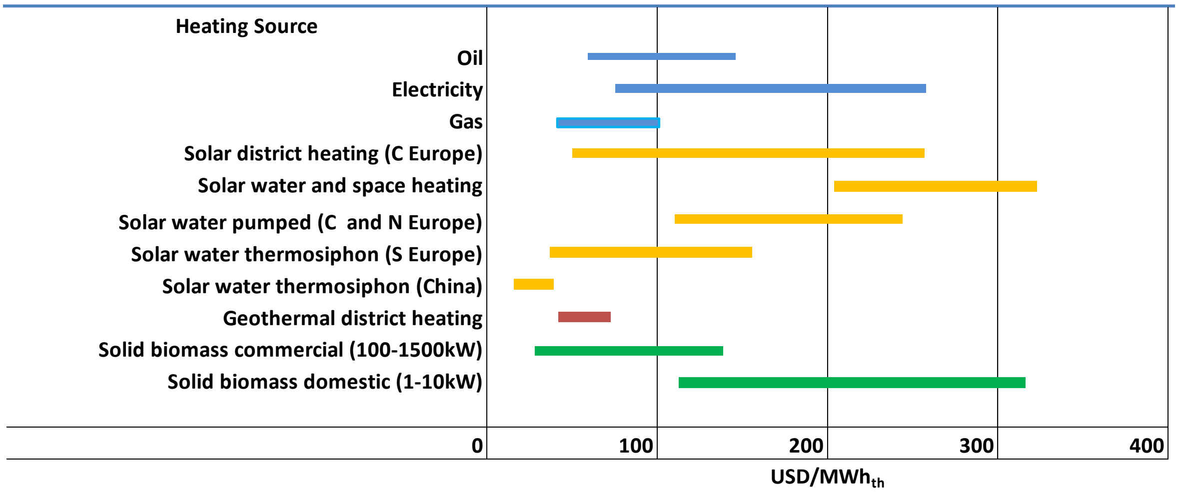
Economic barriers

Like other uses of renewable energy, the practicality and costs of producing heat from renewables depend on resource availability and the costs of related systems. System costs tend to vary widely between even neighbouring countries within regions, depending on the market situation. The costs of the heat produced are therefore highly situation dependent, and need to be assessed on a case by case basis. However, in favourable cases, renewable heat from a number of sources can be cost competitive with alternatives including electricity, gas and fuel oil, as shown, for example, in the buildings sector in Figure 30.

Nonetheless, the cost-competitiveness of a particular technology, at least when it is first introduced into a particular market, can still be the major barrier to deployment. As noted in the previous section on renewable electricity, immature or novel technologies generally start off with high costs which decline as experience grows, as innovation improves efficiency and lowers costs, and as system production is scaled up. Yet even technologies that are mature and cost competitive in some markets are likely to have higher costs initially when they are introduced into new countries, since supply chains for locally produced components or services for installation and maintenance need to be developed. Once a significant and competitive market starts to develop, these costs should come down and converge with international benchmarks, although some market-specific cost differences (such as land or legal costs) are likely to prevail.

Policies that reduce the cost of fossil fuels, for instance through subsidies, are an important barrier that hinders the cost-competitiveness of renewable energy use for heat in numerous countries. Financial support measures for fossil fuels are still very common, particularly in developing countries. Globally, subsidies for fossil fuels were in place in 40 countries worldwide, and reached an estimated USD 544 billion in 2012. The Islamic Republic of Iran ("Iran"), Saudi Arabia and Russia, followed by India, were the countries with the highest amount of such subsidies spent (IEA, 2013g). Redirecting at least part of these fossil fuel subsidies towards the promotion of renewable heat can in many cases prove to be an economically sensible way of financing renewable heat while also achieving policy aims such as increasing energy access for the poorest part of the population, reducing emissions and import dependency.

Figure 30 • Comparison of building sector heating costs



Source: IEA analysis.

Non-economic barriers

Like most renewable technologies, renewable heating involves higher upfront capital investment than fossil fuel technologies. For example, the capital cost of a domestic solar water heater is between five and ten times that of a gas boiler of similar scale. Given the capital intensity of renewable heating systems, a major barrier to deployment is overcoming investors' perceptions of risk, especially in markets where investors will only accept short payback periods.

The range of renewable heating technologies can involve a more diverse set of investors and users than, for example, the renewable electricity sector, including large and smaller-scale industrial heat users, commercial building owners, public sector investors (for example, in district heating plants) and private house owners. Each of these stakeholders has different investment priorities and perceptions of risk. Industrial investors are likely to require a high rate of return on investments which must compete for funds with projects more aligned with core business (such as manufacturing capacity expansion or upgrades), whereas public sector investors may be able to take a longer-term view. Energy service companies (ESCOs) may have an important role to play in large-scale renewable heat solutions for industry and commercial buildings, since investing in and operating energy supply systems is their core business.

It is also important to consider the position of equipment manufacturers and project developers. While users will want to assurance that they will get a good return on their individual projects, project developers and the manufacturing sector will wish to see a longer-term flow of deals or business before investing in market development or in manufacturing capacity.

Aside from barriers associated high upfront capital costs, other non-economic barriers that can inhibit investment include:

- **Technological barriers:** The efficiency and reliability of projects varies for different technologies; for example, for geothermal projects the major risk is associated with the drilling phase (since there may be a failure to find heat at a good temperature). In addition, heat demand can be more elastic than electricity demand, and can change rapidly due to building energy efficiency measures or plant shutdowns. Heat is much more difficult to transport or distribute than electricity, where excess production can access and be sold via the grid. Some renewable heat technologies also require access to secure, sustainable fuel sources (e.g., biomass).
- **Supplier and installer skills deficits:** In immature markets, there is a risk that suppliers and installers may lack the skills to deliver reliable systems and maintain them properly.
- **Regulatory barriers:** There may be uncertainties and costs imposed by complex approval procedures, which introduce uncertainty at the project development stage, or in complex and changing rules about support schemes, planning regimes or other environmental regulations.
- **"Split incentives":** This relates to the ownership structure in the buildings sector, Building owners are often the investors renewable heat technologies, but may not benefit from operational savings in costs or comfort, which accrue instead to the building's tenants (IEA, 2013a).
- **Information barriers:** Particularly in new markets, this refers to the lack of reliable information on, and familiarity with, new technologies. For example, potential users and consumers may not be aware of the opportunities, such as fuel costs savings, provided by these technologies. Financing institutions may also be unaware or unfamiliar, and thus unwilling to provide the necessary financing.

Policies for renewable heat

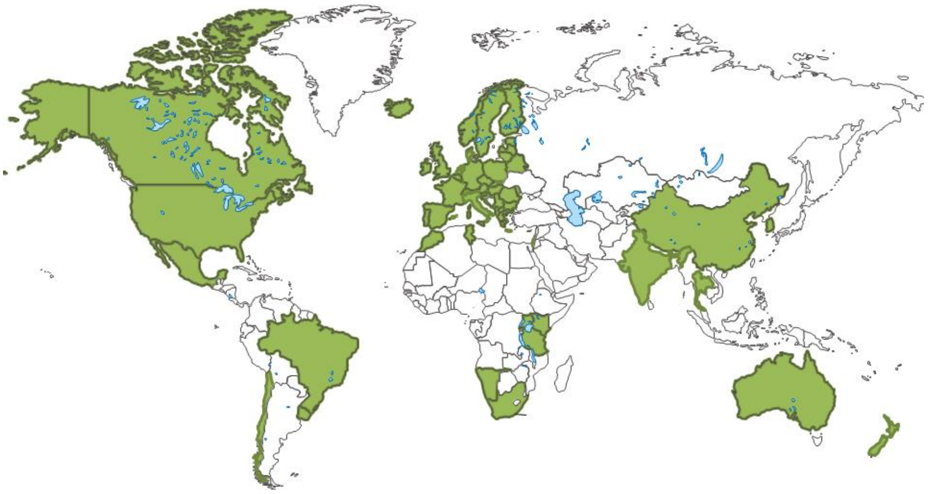
Global status of renewable heat policies

Although there are many benefits to promoting renewable heat use, policies supporting renewable heat have not be as widely implemented as those for renewable electricity. However, renewable heat policies are progressively being introduced in a range of countries and regions, and about 50 countries worldwide now possess dedicated support policies. From the countries under study in this paper, this includes **Tunisia, Morocco** and **Belarus** (Figure 31).

Many of the countries that appear in green in Figure 31 are part of the European Union (EU), where each country is obliged by the EU Renewable Energy Directive to have in place a National Renewable Energy Action Plan, which sets out how the country will meet its mandatory EU target for 2020. The target is based on a proportion of renewables in total final energy consumption, and so includes all three energy sectors (electricity, heat and transport). Each country has included in its plan actions to improve the proportion of renewables in the heating sector.

One striking detail revealed in the analysis of renewable heat policies is that neighbouring countries with similar climatic and resource conditions are taking different approaches to renewable heat and thereby missing some cost-effective opportunities to meet their energy goals. In the **SEMED region** – which has excellent solar conditions that should make solar water heating very attractive to all countries – only **Morocco** and **Tunisia** have programmes encouraging technology uptake. Morocco's Development Programme of the Moroccan Market for Solar Water Heaters (PROMASOL) is a comprehensive, certified system integrating the technical installation and financing of solar water heaters through a combined investment subsidy and bank loan, repayable through the electricity bill (IEA, 2014l). A total of 300 000 square metres of water heaters were installed by 2010, and the goal is for 1.4 million square metres to be installed by 2020 through the "Shemsi" programme, which will be capable of delivering around 1.2 gigawatt hour thermal capacity (IEA, 2014l). Meanwhile, the Tunisian government is seeking to transition households away from water heaters run on fossil fuels to solar water heaters through the PROSOL programme launched in 2005. The shift in consumers' demand from the PROSOL programme reduced Tunisia's fossil-fuel subsidy outlay by USD 15.2 million between 2005 and 2010 and resulted in 251 ktoe of avoided fossil fuel consumption and 715 kt of CO_2 emissions over the life span of the SWH installed (CPI, 2012).

Figure 31 • Countries with targets and support policies for renewable heat



Note: this map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.
Source: IEA/IRENA Joint Renewable Energy Policy and Measures Database, www.iea.org/policiesandmeasures/renewableenergy.

Policies to tackle economic barriers

The principal barrier to investment is often the cost-competitiveness of renewable heat technologies, at least when first introduced into a particular market.

Government intervention to improve the competitiveness of renewable heating systems can be justified when it compensates for issues, which are not reflected in the usual pricing structure (for example, the environmental impacts associated with fossil fuel use for heat, which are often not fully priced in). Government support can also be justified in cases where learning and cost reductions need to be "bought" to bring technologies to the point where they can make a cost competitive contribution to a secure and sustainable energy supply. However, governments should avoid long-term support for expensive technologies with little prospect of competitiveness, and support can be contingent on progress towards cost-reduction targets being made within a certain time, with incentives periodically reviewed and adjusted. Governments can also help "level the playing field" for renewable heating technologies by addressing other issues affecting renewable heat competitiveness, such as subsidies for fossil fuels, fossil fuel prices that don't reflect the negative impacts from carbon and other emissions, and perverse tax regimes.

A number of different policy measures are being taken in different markets to directly provide support for renewable heat by helping to overcome the barrier of high upfront capital costs. These are outlined below.

CO_2 taxes or emissions trading schemes

Placing a price on CO_2 emissions through a tax helps to make renewable heat technologies comparatively more attractive for investors by increasing the cost of fossil fuel heating options (by adding a carbon cost component). CO_2 taxes have been adopted in many northern European countries, and have led to a considerable increase in renewable energy use for heat in buildings and industry in countries like Denmark or Sweden.

Capital grants and rebates

Providing grants and rebates to reduce the upfront capital costs of renewable heat technologies is a straightforward measure to reduce investment costs, and has been the most widely adopted way of providing incentives for investment (e.g. in Austria, Germany and China).

Operating grants or feed-in tariffs

As with FITs for renewable electricity (discussed earlier), these systems support actual renewable energy heat generation by guaranteeing renewable heat generators a price per unit of heat generated. The UK has introduced a version of the feed-in tariff system for renewable heat production, the Renewable Heat Incentive, which provides such revenue support.

Tax reductions/exemptions

These may be available to end users (both in industry and buildings) to reduce investment costs, as is the case in the US, where tax credits for renewable heating equipment were first introduced under the Energy Policy Act of 2005. They can also include exemptions from carbon taxes where applicable.

Soft loans and loan guarantees

Compared to grants, loans can be a low-cost measure for governments to reduce the cost of capital renewable heat because the lender will recoup the cost of the loan over time. Governments can also leverage private sector lenders such as banks to offer loans. In India, for instance, many banks offer soft loans for solar water heaters.

The policy mechanisms above are designed to provide incentives to level the playing field for renewable heat. Another method is to use regulation to compel energy users to use renewable heat technologies. Such measures can be a powerful stimulus to get the technology adopted, but are effective only when technologies are technically mature and implementation costs aren't prohibitive, the requirement is specific, and where adequate enforcement and monitoring systems are in place to ensure that the requirements are fulfilled. Regulating overall levels of renewable heat use can be an effective way to overcome split incentives. Examples of regulations include mandating the use of renewable energy to supply a share of the building's heat, or requiring the use of renewable heat from a specific source (often solar energy).

The most appropriate measures will depend on the technologies involved, their maturity, and the sector. The relative merits and disadvantages of the various systems have been described (IEA RETD, 2010), but it is difficult to produce any meaningful quantitative comparative analysis of the various measures at this point because of the wide variations in capital costs of systems in different markets and lack of comparable data.

Governments can also play a key role in stimulating the RD&D necessary to adapt technologies to markets or to bring forward and demonstrate innovative technologies, which can open up new sectors (e.g. renewable energy use for cooling), or help reduce costs. This support should be accompanied by monitoring and information dissemination programmes, which ensure that lessons learnt are passed on, and that successful projects are promoted to other potential users.

Creating an enabling environment for renewable heat

In addition to policies and regulations designed to directly increase the uptake of renewable heat technologies, a range of supporting measures are often necessary to foster an enabling environment for renewable heat. As with most sub-sectors discussed in this paper, an important step in fostering deployment is to remove regulatory barriers with perverse impacts. For renewable heat this could include having clear and transparent procedures and by streamlining processes for planning and permitting as far as possible, for example, by creating "one-stop shops" for planning applications.

Some key supporting measures specific to the renewable heat sub-sector are discussed below.

Policy certainty through renewable heat targets

In immature markets, there can be a high reliance on policy support to overcome the barriers listed above. The sudden withdrawal of government assistance can cause problems for industry, project developers, and equipment and service providers alike. Providing policy stability and certainty is therefore an essential role for government. Stability can best be achieved through clearly articulated medium and long-term visions for the development of renewable heat as part of the overall national energy plan, with clear targets and with pre-planned milestones and reviews. This gives investors confidence in the government's intentions. Engaging relevant stakeholders in the development of this plan is critical.

Information campaigns

Particularly for relatively immature renewable heat technologies or in markets that have not been exposed to mature technologies, information campaigns that provide clear and authoritative information on resource availability, the economics, and other benefits and potentials of different renewable heat technologies are important. Campaigns pursued by governments in co-operation with industry are a relatively low-cost and vital instrument to facilitate the deployment of renewable heat technologies in the early market phase.

Training and quality assurance schemes

Given the market for renewable heat includes sectors such as households with no technical knowledge, government backed training schemes can help build trust, assuring the market that installers and other service personnel have the necessary skills to properly install renewable heating equipment. Similarly, governments can further boost consumers' confidence in service providers and their products by establishing certification schemes, signalling to consumers that certain products and service providers are of a sufficient level of quality.

Governments can also support the initial growth of the ESCO market, which can later have positive spill-over effects for other sectors by providing energy performance and supply guarantees, as in Austria and Brazil (Solarthermalworld.org, 2013b).

Technology-specific support

Certain renewable heat technologies may require specific support, depending on the fuel type and maturity of the market. For example, governments can support renewable heat from biomass by helping to establish sustainable biomass supply chains, which will ensure the long-term availability of feedstock. For geothermal heating, governments can help manage some of the risks associated with drilling for new heat sources by establishing insurance schemes, as is the case in France and Indonesia (ADEME, 2012).

Once the industry matures, many of these supporting measures can be transferred to industry funding and management. For example, in many established markets for renewable heat, training courses and certification schemes have been established by technology providers to ensure customer confidence and sustained market growth.

Recognising sectoral differences

While many of the issues listed above are relevant to renewable heating in both the buildings sector and industrial applications of renewable heat technologies, there are differences in emphasis among the sectors, which means that tailored approaches are needed for each.

In the buildings sector, institutional issues are likely to play a major role even once renewable heat technologies are established as a cost-competitive alternative to fossil fuels (with or without financial support). Making provision for renewable heat within building codes and regulations, in a way that is integrated with other measures aimed at reducing overall energy demand and emissions from the sector, is important.

It is also clearly better if measures to introduce renewable heat into the buildings sector are introduced as part of an overall portfolio designed to improve building energy use (IEA, 2013a). If the relevant measures are not considered in a co-ordinated way, the result may be counterproductive. For example, a building owner may install an oversized renewable heat source to reduce the building's emissions, when in fact it would be more economical to first reduce overall energy consumption through energy efficiency measures, and then use a smaller renewable heat system to supply the decreased residual heat demand. For this reason, the French building energy code includes requirements on energy sufficiency and supply from renewable energy sources in addition to energy efficiency requirements (IEA, 2013e). The UK Renewable Heat Incentive requires a "Green Deal Assessment" of a house prior to applying for the incentive, to ensure minimum energy efficiency requirements are met (Ofgem, 2015).

In the industry sector, the higher required rates of return on capital, capital availability, and concerns about the risks arising from changes in processes or production volumes are likely to be the major factors that discourage investment. Facilitating the development of ESCOs and helping to develop performance and off-take assurance schemes can be ways of offsetting such concerns, and should be included in policy portfolios aimed at stimulating this sector.

Sound policy principles for renewable heat

A number of studies have looked at current policy experience and distilled some lessons from existing practice (e.g. IEA RETD, 2010, 2015). However, there is a lack of detailed and quantitative policy analysis allowing definitive guidance on policy best practice. It is possible to distil some general principles from existing experience, taking lessons where appropriate from work on analysis of renewables policies more generally:

- Given their technical maturity and potential to provide sustainable energy cost-competitively, renewable heat should be carefully considered in planning energy strategies, particularly in view of its potential contribution to energy security, the environment, economic development and energy access.

- The strategy for development should be based on a systematic analysis of the specific opportunities and technologies most likely to be able to contribute significantly and cost-competitively. The plan, developed with stakeholder engagement, should also examine the specific barriers inhibiting the uptake of the technologies, and this should be used to design effective policy frameworks.
- The policy portfolio should recognise the different investment criteria likely to be applied in the different end-use sectors, and the different ways in which they perceive risks and barriers to investment. A sector-specific approach – distinguishing between industry, the commercial and public buildings sector, and households, is likely to be more successful than a "one-size-fits-all" policy.
- To provide a clear framework, the strategy and associated policy measures should be transparent and provide clear priorities and targets along with milestones and projected review dates. Having a clear policy framework in place allows industry and other potential end users of renewable heating technologies to invest in projects with a sound knowledge of the likely profitability and risk. The resultant growth of the sector will stimulate a competitive equipment and services market and investment in business development and industry capabilities, as well as in innovation. This will in turn lead to cost reductions and allow financial support levels to be reduced.
- A carefully designed and balanced policy portfolio is likely to be more successful and cost effective than an approach which just offers high financial incentives. Where incentives are deemed necessary, these should have the aim of encouraging progressive cost reduction, and so be reviewed regularly.
- Governments can play an important role in mitigating other risks to investors by simplifying and clarifying regulatory frameworks. They can also play a catalytic role in addressing other risks and non-economic barriers – such as developing quality assurance and skills-training schemes and developing information programmes.
- For the buildings sector, measures designed to encourage renewable heating and cooling should be integrated and carefully co-ordinated with initiatives aimed at improving energy efficiency and reducing carbon emissions through building codes and standards.
- In industry, concerns about profitability and the availability of investment funds are likely to be the major concern. Here the promotion of ESCOs and support for performance guarantees can play important roles in stimulating the market.

Renewable transport

The principal options for using renewable energy in the transport sector today involve the use of biofuels. Renewable electricity can also of course contribute when electricity is used to power transport – in rail systems and in the growing market for electric vehicles for road transport. In the future, the combination of low carbon electricity and highly efficient electric vehicles is likely to play an increasingly important role in reducing emissions in this sector. However, this analysis will concentrate on the biofuels sector.

The production and use of biofuels can be a controversial topic, given the interactions between the energy and food and land use sectors. Biofuels can play a useful role in improving energy security and reducing dependence on imports of oil and oil derived fuels but this requires developing a careful strategy that takes into account potential land use and sustainability impacts.

What are the technology options?

Biofuels refers to liquid and gaseous fuels produced from biomass – organic matter derived from plants or animals.

Conventional biofuel technologies include mature processes that are already producing biofuels on a commercial scale. These biofuels, commonly referred to as first-generation, include ethanol produced from sugar and starch-based feedstock (notably corn and wheat). They also include diesel substitutes produced from vegetable oils such as soybean, canol, palm or sunflower oil. Animal fats or used cooking oil can also be used as feedstock. While these oils can be used as untreated raw oils, this can lead to engine problems and fuel gelling, so the oils are usually converted via trans-esterification with methanol to produce biodiesel. Biogas produced by anaerobic digestion of organic materials (including waste streams) can also be used in transport (as well as for electricity production or heating).

Concerns about the sustainability of first generation fuels (explained more below) have led to the development of a range of "advanced biofuels" designed to overcome these concerns by using non-food feedstock (often residues), by having better carbon balances and/or by producing fuels which can be exact substitutes for their fossil fuel equivalents. A wide range of such advanced biofuels (sometimes referred to as second- or third-generation technologies) are being developed, although the processes are still in the research and development, demonstration or early stages of commercialisation This category includes hydro-treated vegetable oil (HVO), which is based on animal fat and plant oil, as well as biofuels based on lingo-cellulosic biomass, such as cellulosic-ethanol, biomass-to-liquids diesel and bio-synthetic gas. The category also includes novel technologies that are mainly in the R&D and pilot stage, such as algae-based biofuels.[21]

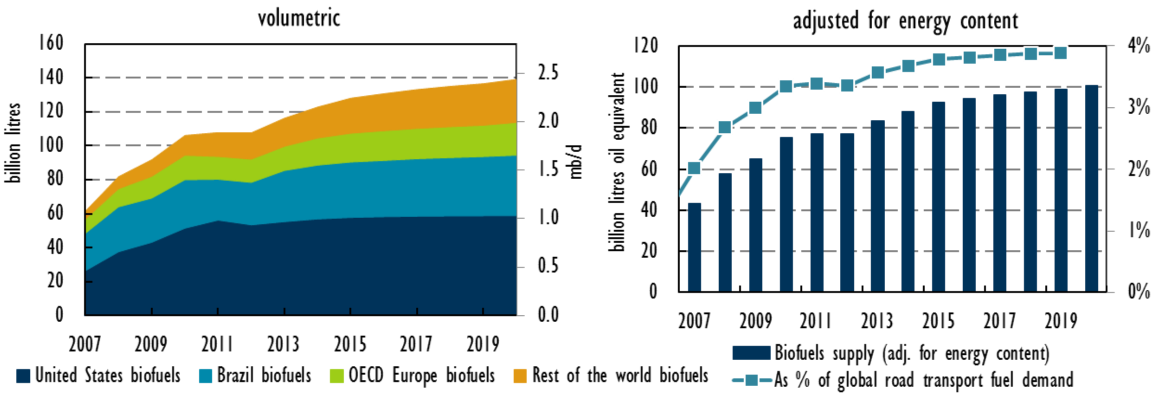
Global market trends

Global production of biofuels rose significantly between 2007 and 2011, particularly because of the growth in corn-based ethanol in the US, the growth of biodiesel in the EU, and continuing growth of sugar-based ethanol in Brazil. In recent years growth has been constrained by a number of factors, including poor feedstock harvests in Brazil, policy uncertainty over the sustainability of biofuels in Europe, and reducing fuel demand and infrastructural issues within the US. However, in 2013 biofuels provided over 3% of road transport fuels. In volumetric terms, global biofuels production was made up of 77% of ethanol (89.6 billion litres) and 23% of biodiesel (26.6 billion litres) (IEA, 2014b).

Slow growth in the sector is expected to continue, as shown in Figure 32. Growth is particularly expected in a number of countries in South East Asia and Africa which depend heavily on oil imports and who have introduced supportive biofuels policies in recent years. Biofuels are expected to provide around 4% of road transport fuel by 2020.

Figure 32 • Global renewable biofuels production – historical and forecast

[21] See IEA (2011d), *Technology Roadmap: Biofuels for Transport* for a fuller discussion of technology developments.



Source: IEA (2014b), *Medium-Term Renewable Energy Market Report*, OECD/IEA, Paris.

Advanced biofuel production has been growing slowly. However, in 2014 a number of new, large-scale plants started production after significant delays in securing funding. Future growth will depend on continued policy support and may be affected by recent oil price reductions.

Countries in the **SEMED region** are not currently producing significant amounts of biofuels, making this type of renewable energy a largely unexploited alternative to the much more abundant fossil fuels in the region (REN21, 2013). However, biofuel projects are currently under preparation by **Egypt's** Ministry of Petroleum, which involves the use of agricultural waste or non-edible plants, such as jatropha, as raw materials for biofuels production (OME, 2011). In the **ETC region**, biofuels power a small amount (0.2%) of transport needs in **Belarus** and the share of biofuels in **Moldova's** energy mix was 4% in 2012 (IEA, 2015b).

Barriers to the deployment of renewable transport fuels

One key barrier to the deployment of renewable transport fuels is concerns around sustainability. Conventional biofuels are mostly made from feedstock which can otherwise be used for food purposes (or produced on land which can produce such crops), and this leads to controversies about the potential for competition between food and fuel crops. In addition, in some cases the net reduction of CO_2 produced when these fuels replace fossil fuels is not very high.

A major barrier to wider deployment of both first and second generation biofuels is a technological factor. Biofuels cannot act as 100% substitutes for fossil fuels in today's vehicle fleets unless the fleets themselves are adapted, as has been done in Brazil and some other countries where bio-ethanol is extensively used. They are therefore usually used as blends, typically 10% of bioethanol or biodiesel blended into gasoline or diesel fuels respectively.

Finally, economic barriers are another major category. This is explained in more detail below.

Economic barriers – costs of renewable transport fuels

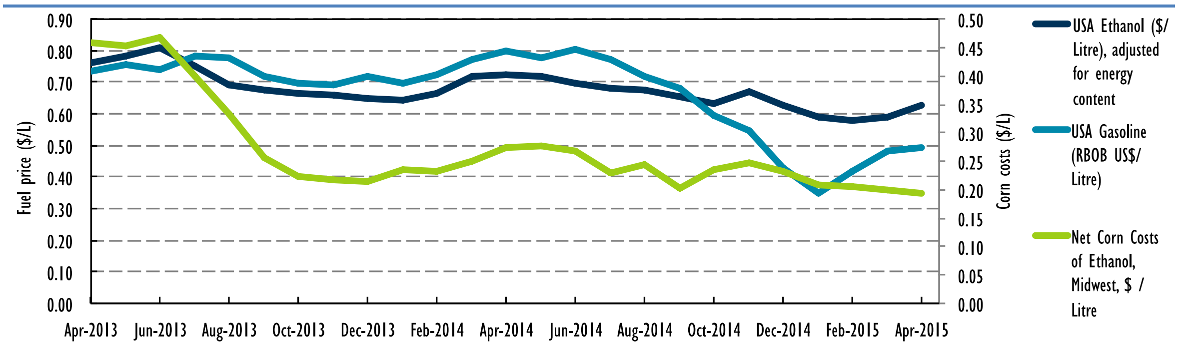
The cost of producing conventional biofuels depends critically on the costs of the feedstock, which can make up 70% of the cost of the finished biofuel. For illustration, Figure 33 compares the cost of corn ethanol production with in the US with that of gasoline prices in the US between 2012 and 2015.

While ethanol has had a broadly similar price to gasoline over recent years, the recent significant reductions in oil prices have has a significant impact on gasoline and diesel prices, and at the current reduced prices for both, ethanol is considerably more expensive than gasoline.

The relative "pump prices" for fuels depend on the relative production costs but are also influenced by other factors, including the rates of duty applied to each fuel. The relative costs can also be affected by measures to subsidise or constrain the price of gasoline or diesel. For example, the price of ethanol in Brazil is influenced by sugar prices, but gasoline prices are periodically insulated from changes to global oil prices, so disadvantaging bioethanol in the market.

The costs of advanced biofuels are generally less influenced by feedstock prices (at least when they are based on residues or lingo-cellulosic crops that are not internationally traded as fuel crops), but the production processes are generally more complex, and so more capital intensive than those for conventional feedstock, with capital costs making up to 50% of the total production costs. Production costs for these emerging technologies are process- and product-specific but typically currently exceed the costs both of conventional biofuels and gasoline, although in the medium term, costs are expected to fall through R&D and experiential learning.

Figure 33 • Production costs of corn ethanol versus ethanol and gasoline spot price in the United States



Source: IEA analysis; IEA (2014b), *Renewable Energy Medium-Term Market Report*, OECD/IEA, Paris; for gasoline and ethanol spot price, FO Lichts.

Policies for renewable transport fuels

Biofuels deployment is heavily policy dependent. The drivers for encouraging biofuels vary from country to country but include energy security, reducing GHGs and providing rural employment. Depending on the relative importance of these drivers, and on the natural resources of the country concerned, a biofuels strategy can be based on indigenous resources – in which case the issues of compatibility with agricultural production and practices needs to be carefully considered. Alternatively, an energy security or GHG reduction-driven biofuels strategy could depend on importing biofuels from countries better endowed with biomass. In these cases, ensuring the sustainability of the fuels (including the associated real overall carbon reduction benefit) via certification is likely to be a priority.

Biofuels policy and regulation tend to focus on three main issues that could affect deployment:

- incentives to overcome any economic barriers to deployment;
- conformity of biofuels produced and used to sustainability requirements; and
- infrastructural and integration issues.

Policies to tackle economic barriers

Since the transport fuels market tends to be highly regulated and the number of the actors in the supply chain relatively limited (i.e. more akin to the electricity than the heating sector), policy measures designed to introduce biofuels generally focus on establishing targets accompanied by a blending mandate that obliges suppliers to incorporate regulated (and often increasing) shares of biofuels in the fuel mix, often complemented with financial support such as tax exemptions. An example of a tax measure is lower rates of excise duty on the biofuels component, which reduces the direct economic impact on suppliers and hence on fuel customers.

The introduction of targets and blending mandates can provide a strong stimulus for deployment when accompanied by measures which either incentivise fuel suppliers to comply with the mandate, or penalise non-compliance.

More than 60 countries worldwide have now adopted such measures, (refer to Annex 3), which of the 15 countries in the ETC and SEMED regions under study in this paper, includes only **Moldova**.

Creating an enabling environment for renewable transport fuels

Of the factors requiring consideration to create an enabling environment for RE&EE policy outlined at Figure 10, two are worth highlighting for renewable transport fuel policy: the sustainability of feedstock (an environmental factor) and the integration of biofuels with existing infrastructure (a technical factor). These are discussed in more detail below.

Sustainability

Considerable effort has been spent on understanding the environmental, economic and social factors that affect biofuels' sustainability. Some of the main factors that should ideally be taken into account within the context of a carefully considered biofuels strategy include:

- the overall carbon savings which are provided when biofuels substitute fossil based transport fuels. The carbon benefits depend on the emissions associated with collecting and processing the feedstock. The carbon impacts of feedstock production – for example, by changing the land use and so altering the soil carbon balance – must also be taken into account;
- the potential competition for crops and land between biofuels and food; and
- other environmental, social and economic issues including impact on water availability.

The Global Bioenergy Partnership was formed to co-ordinate international efforts in this field. The partnership has identified 24 indicators, covering each of the three sustainability pillars (environmental, economic, social)[22], which should be taken into account when formulating biofuels strategies. Alongside this, the FAO has developed the Bioenergy and Food Security (BEFS) Approach, a methodology supporting countries develop evidence-based policies from country level data and cross-institutional dialogue to ensure that bioenergy development fosters both food and energy security, and contributes to agricultural and rural development in a climate-smart way.

While a system of blending mandates in itself does nothing to ensure that the fuels used meet particular standards for overall GHG saving or comply with other sustainability standards, additional criteria can be included. For example the EU's Renewable Energy Directive sets a requirement for each country to meet 10% of its transport energy needs by renewables by 2020. However only fuels that meet a minimum GHG reduction criterion of 35% can count towards the target, with the threshold due to increase to 50% in 2017. Qualifying fuels must not be produced on land that has a high biodiversity value or high carbon stock. Biofuels based on waste or other non-food feedstock are further encouraged because they can count twice towards the 10%

[22] See for example www.globalbioenergy.org/fileadmin/user_upload/gbep/docs/2011_events/12th_TF_Sustainability_WashingtonDC_17-20_May_2011/GBEP_List_of_Indicators.pdf

target. Further measures to constrain biofuels based on feedstock which are also food stuffs and to limit impacts from indirect land-use change are under consideration fuels.

Integration

There is a limit to the extent that conventional biofuels such as bioethanol and biodiesel are compatible with existing vehicle fleets, for example, once the level of bioethanol in gasoline exceeds 10 – 15%. This "blending wall" can constrain biofuels use at high levels. Such constraints can be overcome. For example in Brazil, cars are adapted to be able to run efficiently on a wide range of bioethanol/gasoline mixtures ("flex-fuel" vehicles – FFVs). However, such infrastructure changes need to be initiated in advance of such limits being reached, and may need to be encouraged via policy and regulations – for example, by requiring retailers to provide high level biofuel blends such as E 85, by encouraging the development of suitable infrastructure, or by providing tax incentives for FFVs, and by negotiating with vehicle suppliers to extent vehicle warranties to provide cover when high biofuel blends are used.

Sound policy principles for renewables in transport

Developing sound strategy and policy for renewables in transport is complex since the subject cuts across a number of policy areas including energy, transport, environment, rural development, agriculture and land use. It is therefore extremely important that any such policy approach is developed jointly with relevant government agencies and in consultation with a wide range of industry and NGO bodies. Below are some further guiding principles.

- The use of biofuels or other renewable sources must be an integral part of the overall transport energy strategy, complementing efforts on energy efficiency. While biofuels are unlikely to play a large role in **SEMED countries** in the near term due to the current priority of establishing an effective public transport system, they should certainly be borne in mind for the medium to long-term policy mix.
- The strategy must be based on a careful assessment of nationally available biomass resources and the potential to produce crops for energy purposes, bearing in mind the wider implications for food security and land use policy. Such an approach is equally important where there is an apparent opportunity to produce biofuels for exports. Guidance on such assessments is available from the FAO and the IEA (see FAO, 2010; IEA and FAO, forthcoming).
- Biofuels mandates have proved an effective way of stimulating demand for biofuels, but must be linked to realistic penalties for non-compliance and designed so that they are progressively introduced at a pace compatible with the development of the supply side and infrastructure.
- The strategy needs to ensure that the principles of sustainability are respected and that suitable and enforceable sustainability assurance schemes are put in place.
- The strategy needs to take into account the likely blending constraints imposed by infrastructure and the nature of the vehicle fleet, or take steps to evolve the fleet to be able to accommodate higher levels (e.g. by promoting the uptake of flex-fuel vehicles)

Concluding remarks on renewable energy

As stated in the introductory and enabling sections of this paper, RE provides considerable potential to support a wide range of national priorities, but for this reason, to be effective and sustainable, it is important that a country's renewable energy strategy and policies form an integrated part of its overall energy planning.

In recent years, the **SEMED countries** under study in this paper have made considerable strides in the area of RE policy, as shown in Table 2 below. **Morocco** in particular has developed a range of policy tools and institutions that could serve as examples for others in seeking to increase the market penetration of RE technologies. The **SEMED countries** could benefit from continuing to augment and adapt their RE policy support portfolio and to ensure consistent enabling conditions, such as the removal of fiscal support measures for fossil fuels.

The potential for RE in **ETCs**, such as wind and solar in **Mongolia** to name but one example, is significant—and largely untapped. Policy developments in **Kazakhstan, Azerbaijan, Georgia** and **Moldova** are notable, particularly primary legislation for overall RE targets and licensing/permitting to encourage investment. The same cannot be said for secondary, supporting legislation and there is little concrete evidence of increasing RE technology deployment beyond isolated instances. Aside from small hydro, the renewable energy market in the region remains nascent, due largely to competitive pricing from other energy sources and an absence of clear and enforceable rules for grid modernisation and integration.

Further interventions will be required to address these barriers in the ETC region. Target actions could include national RE strategies with quantitative targets; fair market and grid access and predictable remuneration for renewable generators; clear and transparent permitting procedures and a supporting institutions for implementing and monitoring; consistent and comprehensive primary and secondary legislation; a minimisation of contradictory support policies for fossil fuels; and modernisation of network and transmission systems to allow for grid integration of renewables.

Table 2 • RE policy types in the ETC and SEMED regions

Country	Public Financing		Regulatory Policies						
	Capital subsidy, grant or rebate	Tax incentives	Public investment or loans	Public competitive bidding	Feed-in tariff	Utility quota obligation	Net metering	Tradable renewable energy certificate	RE Target
Morocco	✓	✓	✓	✓					✓
Egypt	✓	✓	✓	✓	✓	✓	✓		✓
Tunisia	✓	✓	✓				✓		✓
Jordan	✓	✓	✓	✓	✓		✓		✓
Armenia			✓	✓	✓				✓
Azerbaijan			✓	✓					✓
Belarus		✓	✓		✓				✓
Georgia			✓	✓					✓
Kazakhstan	✓	✓			✓			✓	✓
Kyrgyzstan	✓	✓	✓			✓			
Moldova		✓	✓		✓				✓
Mongolia			✓	✓	✓				✓
Tajikistan					✓				✓
Turkmenistan									
Uzbekistan			✓	✓					

Source: IEA (2015b), Energy Policies Beyond IEA Countries: Eastern Europe, Caucasus and Central Asia, OECD/IEA, Paris; IEA/IRENA Joint Policy and Measures Database (2015), www.iea.org/policiesandmeasures/renewableenergy/index.php; REN21 (2013) Interactive Map Country Profiles, http://ren21.net/REN21Activities/InteractiveMap.aspx.

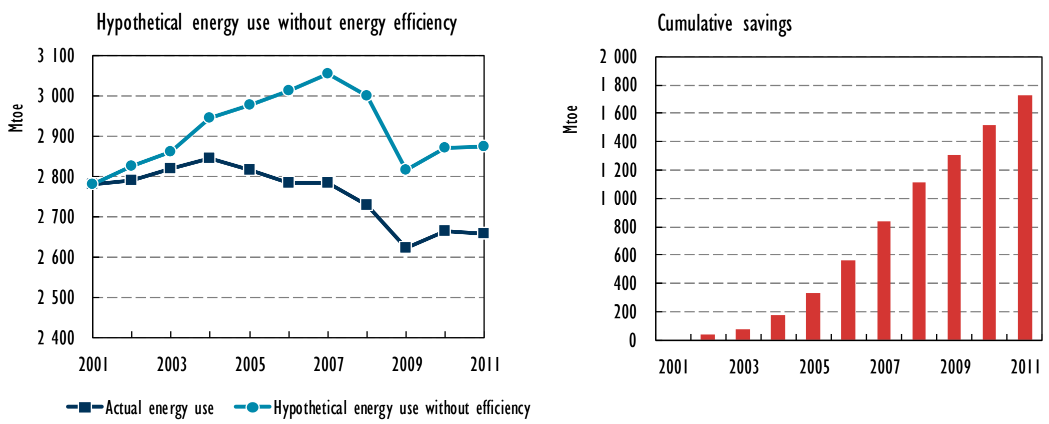
Policy options for supporting energy efficiency

Overview – market outlook, benefits and barriers

Energy efficiency refers to increasing levels of service per unit of energy. Something is more energy efficient if it delivers more services for the same energy input, or the same services for less energy input. For example, when a compact florescent light (CFL) bulb uses less energy (one-third to one-fifth) than an incandescent bulb to produce the same amount of light, the CFL is considered to be more energy efficient.

The principal value of EE is that it reduces the energy, and therefore cost, required to fuel our economies (see Box 6). Figure 35 illustrates the significance of EE improvements and energy savings by showing hypothetical energy use in 18 IEA countries over a decade if EE measures had not been applied, compared with actual energy consumption. After 2005, the actual energy used versus hypothetical energy consumption without efficiency is divergent by at least 100 Mtoe. The difference is staggering. Cumulative savings by 2011 reached more than 1 700 Mtoe, which demonstrates real impact of efficiency measures.

Figure 35 • Hypothetical energy use without efficiency and cumulative efficiency savings for 18 IEA countries



Source: IEA (2014d), *Energy Efficiency Market Report 2014*, OECD/IEA, Paris.

This recognition of the value of avoided energy use has led to the identification of EE as the "first fuel" and "the surest energy supply that exists" (IEA, 2014e). Harnessing economically viable EE investments would facilitate a more efficient allocation of resources across the global economy, with the potential to boost cumulative economic output through 2035 by USD 18 trillion (IEA, 2014e). Further information on the benefits of energy efficiency can be found in Box 6.

The IEA *Energy Efficiency Market Report 2014* estimates that investment in energy efficiency markets worldwide in 2012 was between USD 310 billion and USD 360 billion, which is larger than supply-side investment in renewable electricity, or in coal, oil and natural gas generation, and around half the size of upstream oil and gas investment. Investment in energy efficiency is distributed unevenly across countries and energy-consuming sectors (buildings, domestic appliances, transport and industry). This unequal distribution of resources and funding for EE sometimes results from prioritising funding for sectors with the least efficient technologies, or where funding for EE projects is provided by investors with vested interests in particular sectors.

While investment in EE is substantial, more than USD 13 trillion of cumulative energy efficiency investment is still required to enable the energy sector to make the necessary contribution to limit future global warming to 2°C (IEA, 2014f).

Energy efficiency finance is expanding and innovating, with new funding approaches and business models; there is a notable expansion in funding for development aid projects, as well as in the use of funding vehicles such as energy service companies (ESCOs) and on-bill financing mechanisms (IEA, 2014d), which demonstrates great strides for deployment of EET. Notable multilateral EE financing initiatives include the International Finance Corporation (IFC) and GEF's Commercializing Energy Efficiency Finance (CEEF) program, which provides guarantees of up to 50% of the loss from loan defaults, and EBRD's Sustainable Energy Financing Facilities (SEFFs), which mobilises groups of local financial institutions to lend to small and medium-sized borrowers.

The market potential for energy efficiency is growing significantly in OECD non-member economies, particularly in the transport sector. Nonetheless, greater efforts are needed to improve data collection in order to support policy makers, company decision makers and others to develop stronger policies and programmes and to identify and better exploit market opportunities (IEA, 2014d).

Box 6 • Multiple benefits of energy efficiency

While the direct economic and energy conservation benefits of energy efficiency are well-known, a growing body of evidence shows that energy efficiency can deliver a broad range of economic and social benefits to many different stakeholders, beyond the traditional focus on energy demand reduction. Broadly, energy efficiency can have benefits for economic and social development, energy system efficacy, environmental sustainability and productivity. Investors tend to under-account for these benefits, and thus energy efficiency measures can be under-valued in the market.

The multiple benefits of energy efficiency include, but are not limited to: improved energy security; enhanced energy delivery; lower energy prices; macro-economic development; improved industrial productivity; improved health and well-being; poverty alleviation; employment generation; improved local air pollution; reduced GHG emissions; more efficient resource management; reduced public expenditure on energy and increased tax revenues; increased disposable income for individuals, households and enterprises; and increased asset values for property with higher energy performance.

Energy cost savings from energy efficiency measures can stimulate a "rebound effect" in which expected energy demand reductions are not achieved because lower energy costs stimulate increased energy consumption and general expenditures that counteract the technical potential savings. However, the multiple benefits approach reveals that the advantage of the rebound effect is that the goods and services acquired are of great value to society. That is, when energy savings are counter-balanced by increased consumption, spending or investment that results in health benefits, poverty alleviation, improved productivity or reduced supply-side losses, then the rebound effect created can be viewed as a net positive outcome, amplifying the benefits of energy efficiency intervention.

By adopting the multiple benefits approach to energy efficiency, policy makers are better able to capture the true potential of energy efficiency measures as a mainstream tool for both social and economic development.

Source: IEA (2014j), *Capturing the Multiple Benefits of Energy Efficiency*, IEA/OECD, Paris.

Barriers to overall energy efficiency and policy responses

EE policies have not been adopted as widely in the **SEMED** and **ETC regions** as in some others. Box 7 lists a range of specific barriers to the update of EE in the **ETC** and **SEMED regions**. In addition to these barriers, general barriers to uptake of EE apply in each sector (buildings, appliances, etc) and these are discussed under sections on sectoral policy options.

Box 7 • Barriers to improving energy efficiency in SEMED and ETC countries

Regulatory and institutional:

- subsidised energy prices;
- lack of integration of energy efficiency strategies within the broader policy framework of economic development;
- absence of national EE targets;
- absence of a dedicated agency to manage rollout of EE programmes and low capacity for enforcing regulatory policies, such as building energy codes;
- difficulty establishing a government segment under which the management of particular sectors' energy efficiency policies and measures are placed (e.g. transport);
- cumbersome administrative and regulatory requirements;
- need for enhanced institutional coordination across sectoral ministries;

Financial and market:

- need to provide a stable stream of funding for energy efficiency policies;
- lack of capital for infrastructure projects such as street lighting and public buildings;
- low private sector capacity to identify, develop and implement energy efficiency projects;
- for energy-importing countries, energy price volatility (when prices are lower, there is less incentive to invest in EE or to use energy efficiently);
- investment barriers such as weak rule of law, inconsistent regulatory practices, unfamiliarity with international business norms, strict controls of foreign exchange flows, weak intellectual property protection or poor transparency;

Technical and infrastructure:

- transmission and distribution energy infrastructures that favour supply-side policies;
- insufficient data and monitoring of supply, demand and energy saving potential;
- low capacity for manufacturing or servicing energy efficient products, including vehicles, appliances, efficient lighting and equipment;
- lack of accredited equipment testing laboratories;

Social:

- very rapid energy demand growth, well over 5% in some countries;
- lack of awareness of energy efficiency benefits and existing opportunities on energy efficiency technology deployment, e.g. lack of awareness-raising activities to influence lifestyle factors;
- lack of skilled human capacity, including lack of knowledge of policies for EE measures within business and commercial sectors; and

Environmental:

- demanding climatic conditions.

Sources: adapted from IEA (2014l), *Energy Efficiency Policies for the SEMED-Arab Region: An energy efficiency* experts' roundtable report, OECD/IEA, Paris; IEA (2015b), *Energy Policies Beyond IEA Countries: Eastern Europe, Caucasus and Central Asia*, OECD/IEA, Paris; IEA (2014m) 'Workshop Highlights' from Expert Workshop: Policy Best Practices for Accelerating the Deployment of Low-Carbon Energy and Climate Technologies, 23 September 2014, IEA, Paris

Comprehensive national energy efficiency strategies

IEA analyses suggests that a cross-cutting national energy efficiency plan, that takes account of wider energy and economic objectives, includes measurable energy savings targets, and is accompanied by an adequately resourced agency responsible for implementation and monitoring, can provide a solid foundation for supporting EE improvements. Sound methods and institutions for energy data collection and analysis are related key components for rolling out EE programmes and measuring energy savings.

Most countries under study in this paper could benefit from enhanced attention to developing comprehensive national EE strategies. Of the 15 countries examined, several have national energy efficiency strategies but could benefit from including much more detail on policies and sectoral targets linked to national targets. It is also notable that with varying units of measure and timelines, comparison across targets in these regions is difficult. Regional leaders include Morocco, with its National Energy Efficiency Strategy linked to a 12% energy savings target by 2020, and Kazakhstan, with its Energy Efficiency Program 2020 linked to a 25% decrease in the energy intensity of GDP by 2020.

Governance arrangements

A comprehensive energy efficiency policy framework affects any sector of the economy where energy is used. Given the scale of the policy issue, it is important that institutions are established to manage cross-sectoral coordination and integration of EE policies into broader government goals. Concerning institutional arrangements, **Tunisia, Morocco** and **Moldova** are notable for the existence of a dedicated institution for energy efficiency (and in some cases also for RE), while in most other countries, responsibility for EE rests predominantly with an overarching ministry. Indeed the IEA's recently published study of energy policy in the **ETCs**[23] notes that energy efficiency governance remains vague in most countries in that region. It further notes that a clear definition of the role of local governments in energy efficiency policy implementation and the placement of a dedicated public authority in charge of energy efficiency policies and measures, with the authority to oversee the implementation of government policies, could greatly contribute to ensuring that energy efficiency is a strategic priority and could provide for the need for greater coordination (IEA, 2015b).

In addition to an overarching energy efficiency action plan, experience suggests a range of distinct policy measures that target particular energy-using sub-sectors and cross-cutting issues. Through wide-ranging consultation and analysis, the IEA developed 25 key policy recommendations for energy efficiency (EEPR) in 2008 with an updated analysis in 2011. These recommendations include policies to cost-effectively increase energy efficiency by establishing market signals to motivate effective action, accelerate the introduction of new technologies, and strengthen and enforce minimum energy performance standards (MEPs) for appliances, lighting, equipment and building energy codes. It is important to note that these so-called recommendations were designed as a set of policy guidelines or tools, which inevitably need to be prioritised and adjusted according to national circumstances.

What follows is a focus on policies for supporting improved energy efficiency in transport, buildings, appliances and lighting, and industry respectively. The guidance set out here is based on the IEA's 25 EEPR and other analyses, but considering also the circumstances of the **SEMED** and **ETC regions**.

[23] This report covers the ETCs excluding Mongolia, but including Ukraine.

Buildings

Global market trends

Buildings are the largest energy-consuming sector, accounting for 31% of final energy consumption globally (and 40% in IEA member countries), and 8% of direct energy-related CO_2 emissions from final energy consumers (IEA, 2014a). Despite the recent global economic stagnation, which led to severe retraction in the buildings sector in several countries, buildings energy consumption continues to rise globally (IEA, 2014a). If indirect upstream emissions attributable to electricity and heat consumption are taken into account, the sector contributes about one-third of global CO_2 emissions (IEA, 2014a). The residential sub-sector remains the largest consumer of energy at a global level, and the non-residential sub-sector has increased its share since 1990, especially in emerging economies. Globally, space heating and cooling account for the largest end-uses of energy in buildings at over one-third of buildings' energy use, increasing to 50% in cold climates and over 60% in the residential sub-sector in similar climate conditions (IEA, 2015a). The buildings sector in the **SEMED region** is one of the fastest growing (after transport), as a result of rising populations, increased urbanisation, and household energy consumption that matches or exceeds GDP growth. Regional analysts have forecast 25 million new housing units will be constructed over the next 15-20 years, requiring new building investment of as much as EUR 250 billion (IEA, 2013c).

Given the large share of energy consumed by buildings, it is crucial that the energy performance of this sector is improved to ensure long-term global energy security. Buildings are complex systems with a variety of distinct, but interacting, dimensions: building envelopes and windows, heating, ventilation and air conditioning systems, interior lighting and behaviour of users. As a consequence, a multi-dimensional, holistic energy policy package is required to respond to the complexity of buildings and integrate the various factors that influence their energy consumption (IEA, 2013e).

Data on the global buildings EE market are difficult or expensive to obtain in developed countries and are often not available in emerging markets, however the IEA market assessment suggests that Canada, the EU and the United States have made the most progress in deploying energy efficient building envelope component technologies (IEA, 2013f). Further support is needed for market development of efficient building materials and systems: for example, particularly inefficient materials such as single, clear, glazed windows should be replaced with a minimum of double-glazed, low-e windows, or upgraded with window attachments (IEA, 2013f). These recommendations for building materials are applicable globally and are relevant to the **ETC** and **SEMED regions** after national standards are set.

High impact options for improving buildings' EE

Because buildings are complex systems, measures implemented as a "package", targeting multiple parts of the system simultaneously, will be most effective. The following options are commonly used to deliver significant efficiency gains in buildings:

- **Retrofits:** Full building retrofits achieve the most substantial energy savings with retrofits of typical European apartment buildings for example, shown to result in energy savings between 80-90%, or 30-50 kilowatt hours per square metre per year.[24] The EBRD's experiences financing building retrofits in Ukraine indicated that successful investment and involvement

[24] From the Prefabricated Systems for Low Energy Renovation of Residential Buildings study, part of the EBC project of the IEA (IEA, 2013d).

can result from policy changes that prepare the market for investment, which can alleviate barriers to implementation (EBRD, 2014).

- **Deep renovation:** This involves transforming typical building renovation to result in deep reductions in energy consumption of at least 75% and limits in energy consumption for heating, cooling, ventilation, hot water and lighting of 60 kWh/m^2/year (IEA, 2013f; GBPN, 2013). Deep renovation of inefficient existing buildings leads to considerable reductions not only in energy consumption but also in capital costs for heating, ventilation and cooling (HVAC), as upgrading all major end-use equipment and building envelope components together allows synergies that enable smaller heating and cooling systems to be used (IEA, 2013f).
- **Zero-energy buildings:** Zero-energy or very low-energy building policies aim to encourage construction of new buildings that consume zero or close to zero net energy or even produce a net surplus. Such policies are not widespread yet and market development is needed to help move niche building products into the mainstream, including in developing markets, through economies of scale and more cost-efficient production processes (IEA, 2013f).
- **High performance building envelopes:** The building envelope consists of the parts of a building that form the primary thermal barrier between interior and exterior. Measures to improve building envelope performance result in high levels of comfort, natural lighting and ventilation, and low energy use for heating and cooling (IEA, 2013f). Table 3 provides examples of policy options, taking account of economy, climate and construction type.
- **District heating and cooling (DHC):** DHC involves connecting multiple energy consumers to cost-effective, environmentally optimal heat sources through a piping network, which can be more efficient than individual heating systems. Combined heat and power plants, biomass, geothermal, passive systems, or recuperating industrial waste heat are among the low-carbon sources for DHC.
- **Multifunctional heating and cooling:** Integrating multifunctional heat pumps into low-energy house designs is an efficient way to treat several building functions simultaneously, including dehumidification. Recent policies enacted in Europe, Japan, and the United States aim to reduce CO_2 emissions strategies that include heat pumps, which will play an important role in reducing barriers to deployment and supporting wider market adoption (IEA, 2013d).

Table 3 • Building envelope technologies according to economy, climate and construction type

Type of economy	Climate	Technology	
		New construction	Retrofit
		Insulation, air sealing and double-glazed low-e windows for all buildings[25]	
Developed	Hot climate	· Architectural shading · Very low-solar heat gain coefficient (SHGC) windows (or dynamic shades/windows) · Reflective walls/roofs · Advanced roofs (integrated design/BIPV) · Optimised natural/mechanical ventilation.	· Exterior window shading and dynamic glass/shading · Reflective roofing materials and coatings · Reflective wall coatings · Window film with lower SHGC · New low-SHGC windows.

[25] The IEA recommends a minimum performance for all new windows globally to meet the performance of double glaze low-e with low-conductive frames and climate-optimised SHGC. Air sealing is needed for any building that will have heating and cooling provided. Insulation is needed for all applications, renovation is more challenging but possible, especially for roofs in all climates.

	Cold climate	· Highly insulated windows · Passive heating gain (architectural feature /dynamic glass/shades) · Passivhaus-equivalent performance through architectural (ecological) design principles.	· Highly insulated windows · Low-e storm or interior panels · Insulated shades and other insulating attachments (low-e films) · Exterior insulating wall systems · Interior high-performance insulation.
Developing	**Hot climate**	· Exterior shading and architectural features · Low-SHGC windows · Reflective roofs and wall coatings · Optimised natural/mechanical ventilation.	· Exterior shading · Reflective coatings (roof and wall) · Low-cost window films · Natural ventilation.
	Cold climate	· Highly insulated windows (possibly double-glazed with low-e storm panel) · Passive heating gain (architectural feature) · Optimised low-cost insulation and air sealing.	· Low-e storm or interior panels · Insulated shades and other insulating attachments (low-e films) · Exterior insulating wall systems · Cavity insulation, lower-cost (*e.g.* expanded polystyrene) interior insulation.

Notes: BIPV = building-integrated photovoltaic. Passivhaus, an advanced residential building programme that calls for very high levels of building envelope performance, has gained significant momentum in Europe and is active globally (see www.passiv.de/en/index.php).

Source: IEA (2013f) *Technology Roadmaps: Energy Efficient Building Envelopes*, OECD/IEA, Paris.

Barriers to energy efficient buildings

Barriers to successful implementation of energy efficiency technologies in buildings include split incentives between tenants and landlords, lack of awareness of efficient technologies, absence of qualified "green" technicians and high initial investment costs (IEA, 2011c). For example, one of the key reasons for a lack of progress in energy efficiency in **Kyrgyzstan** appears to be the issue of social acceptability of energy pricing for electricity and heat at levels that reflect their true costs, as both the government and consumers assume heat and power to be a public good that should be provided free, and thus electricity and heat tariffs remain heavily subsidised (IEA, 2015b). This is likely the case for other countries in the **ETC region** also.

Some examples of barriers are provided in Table 4, taking account of varying stages of technology maturity.

Furthermore, the rebound effect discussed in Box 6 above is evident from the experiences of the building sector, for example while heating per unit of floor area is becoming more efficient, continued growth in floor area per capita in residential buildings across all regions is driving up overall demand (IEA, 2014a).

A regional initiative to overcome these barriers in the **ETC region** is INOGATE-EE's Energy Savings Initiative in the Buildings Sector (ESIB) programme[26]. ESIB programme activities include policy analysis, technical training and capacity building, and demonstration projects in ETCs to test the viability of building EE technologies.

[26] INOGATE is an energy technical assistance programme funded by the European Union that cooperates with 11 Partner Countries to support a reduction in their dependency on fossil fuels and imports, improve the security of their energy supply and mitigate overall climate change.

Table 4 • Technology maturity phase, market barriers and policies for buildings

	R&D		Voluntary demonstrations, deployment, diffusion			Mandatory
Technical maturity	**Basic & applied research**	**Field evaluation**	**Initial market introduction**	**Limited sales**	**Mature market**	**Standards and building codes**
Barriers	Lack of private-sector investment.	Safety codes, consumer expectations, and integration concerns.	High cost, lack of information, reliability, higher risk.	Reluctance by policy decision makers, high cost, etc.	Entry into mainstream marketing programmes, split incentives.	Political will of governing body, sufficient data set to convince.
Policies	Competitive R&D sponsors, collaborative research, technology procurement.	Field studies of prototype, model homes, responsibility for any human health impacts.	Award of excellence, detailed case studies, extended warranties, loan guarantees.	Tax credits, utility incentives, financing, volume purchases	Distinction labels, modest incentives, financing, education.	Minimum efficiency standards and practices.

Source: IEA (2013f), *Technology Roadmaps: Energy Efficient Building Envelopes*, OECD/IEA, Paris.

Policies for energy efficient buildings

The most advanced building energy efficiency policies are designed within a holistic energy policy package that considers economic and environmental national priorities and goes beyond the building itself to include land-use policies, MEPS and labelling schemes for buildings, building components, equipment and appliances. It is important to promote the alignment of energy performance requirements considered in different policy instruments. For example, the **Tunisian** building energy code illustrates the alignment of MEP requirements set in a building energy code with those set in a buildings energy labelling scheme (IEA, 2013e).

Public and financial community awareness of the economic, comfort and health benefits of low energy buildings can assist with accelerating deployment of EE technologies. Supporting measures should therefore include public information campaigns and programmes to accelerate adoption rates (IEA, 2013f). For example, media campaigns, information sessions, publications, educational seminars and other information dissemination approaches have been adopted in **Belarus**, with more than 110 conferences, seminars and exhibitions being held in 2012, resulting in relatively high public awareness of energy efficiency (IEA, 2015b). Several activities to raise energy savings awareness have also been implemented in **Azerbaijan** under the INOGATE framework with the collaboration of the Ministry of Industry and Energy (IEA, 2015b). IEA analysis has also found that while **Moldova's** Energy Efficiency Fund and the Moldovan Residential Energy Efficiency Financing Facility are effective in promoting energy efficiency, public awareness of the benefits of energy savings and the availability of incentives for energy efficiency improvements is insufficient. Thus in order for households, businesses and industry to be able to fully reap the benefits of the existing incentives and self-initiate participation in energy savings, more should be done to raise awareness (IEA, 2015b).

To achieve deep energy efficiency improvements in the buildings sector, cohesive and consistent policies that take account of wider economic and social priorities can help to move the entire market forward (IEA, 2013g). Ideally, an integrative EE buildings policy approach would incorporate the elements set out below.

Mandatory building energy codes and MEPS

Effective building energy codes consist of a set of mandatory requirements designed to reduce the energy consumption of buildings. Building energy codes have been instrumental in reducing the overall energy consumption of the residential buildings stock over the last twenty years in IEA member countries (IEA, 2013e). In the **SEMED region**, building energy codes for residential, commercial and government buildings have been mandatory in **Egypt** since 2006 and in **Jordan** minimum EE specifications for public and residential buildings have been mandatory since 2008. In the **ETC** region, **Kazakhstan** and **Tajikistan** have recently mandated minimum energy performance standards for a range of building types.

There are two main approaches to the design of building codes. First, the prescriptive approach involves setting MEP requirements for each component of the building (windows, walls, and heating and cooling equipment). This has been mandatory in **Tunisia** for public and residential buildings since 2008 and minimum performance specifications for hospitals and hotels are under preparation (IEA, 2013c). Second, the performance approach involves setting energy requirements for a building's overall energy consumption (IEA, 2013e). The recommended approach is for codes to be performance-based with minimum technical/prescriptive criteria for components and well adapted to local conditions and market barriers (IEA, 2013f).

Policies should be designed taking into account the following recommendations:

- All new buildings as well as buildings undergoing renovation should be required to be covered by energy codes and meet MEPS that aim to minimise life-cycle costs (IEA, 2011c).
- Energy codes and MEPS should be enforced, regularly strengthened and take a holistic approach that includes the building envelope and equipment (IEA, 2011c).
- Financial incentives should be used to ensure energy performance criteria are met (IEA, 2014a).
- Policies should target the performance of building envelopes, promote heat-pump technology and prohibit the use of electric resistance heaters as the main heating source (IEA, 2014a).
- Building energy codes should require that roof/attic insulation that meets the latest standards – including proper air and duct sealing if applicable – is installed when roofs are replaced.
- Investments in developing the knowledge and skills of installers, designers and inspectors should be made to improve the sophistication of the construction industry (IEA, 2013f).
- In addition to provisions that target energy efficiency improvement, advanced building energy codes include requirements associated with (a) energy sufficiency (measures to reduce the amount of energy needed to operate and maintain a building); (b) supply from renewable energy sources; and (c) minimum energy performance that takes into account long-term economic and energy security considerations (IEA, 2013e).

Policies for improving the energy efficiency of existing buildings

A package of policies to improve the energy efficiency of existing buildings should emphasise significant improvements to building envelopes and systems during renovations. These policies are examples that can provide **ETCs** and **SEMED countries** with guidance on implementation of national targets, once set. The most effective policies include:

- an ambitious timeline and renovation rate for cost-effective reduction of the energy consumption in existing buildings;
- MEPS for the building as a whole, including key building-envelope components and energy-using systems, to be met during renovations;

- measures to aid building owners and occupants to improve energy efficiency in existing buildings, such as:
  - energy audits, energy ratings and certification schemes;
  - incentives to encourage investments in long-lasting building envelope and system improvements, and increased market penetration of new high-efficiency products;
  - training and other measures to improve the quality and reliability of building retrofit services;
  - information on financing options; and
  - a strong commitment by governments to improve the efficiency of public-sector buildings (IEA, 2011c).

To date, evidence of policy measures for existing buildings in **ETC** and **SEMED countries** is scant.

Building energy labels or certificates

Building energy performance labels or certificates that provide information to owners, buyers and renters are key to providing decision makers in the buildings industry and the property marketplace with objective information on a given building, either in relation to achieving a specified level of energy performance or in comparison to other similar buildings (IEA, 2011c). Building labels and certificates can also help to address the common market barrier of "split incentives" whereby there is little incentive for the person constructing the building to invest in high-performance energy efficient alternatives because they will not be paying the utility bill (IEA, 2013g). Certification can be applied to both new and existing buildings, and can be mandatory or voluntary. The certificates usually take one of two forms:

- a positive label demonstrates whether a building meets a specified standard (such as the Passive House Standard), or
- a comparative label allows comparison with other buildings (such as the Home Energy Rating System (HERS) Index and many European certification schemes), which often includes advice on how to improve energy efficiency to obtain a better energy rating (IEA, 2010b).

A key lesson learned from countries that have implemented voluntary energy and environmental building certification schemes is the need to ensure that energy certification schemes are adaptable enough to evolve with expected and unanticipated developments in the future. Delivery of a robust, accurate and cost-efficient certification scheme depends on many supporting mechanisms including:

- validated assessment procedures;
- training for assessors;
- quality assurance procedures; and
- technology and administration systems to coordinate and maintain these functions (IEA, 2010b).

Policies for improving the performance of building components and systems

By establishing policies to improve the energy efficiency performance of critical building components, such as windows and HVAC systems, the overall energy performance of new and existing buildings can be improved. Accordingly, a package of policies to this end should:

- improve the overall energy performance of windows and other glazed areas through a policy package that includes:

    - performance-based requirements or guidelines that identify the maximum share of glazed area that is appropriate for specific building types;
    - MEPS for windows and other glazing that minimise life-cycle costs;
    - a requirement for window and glazed-product manufacturers to provide performance labelling based on standard test protocols and certified product testing;
- reduce energy demand from HVAC systems through a policy package that includes:
    - MEPS for HVAC systems that are designed to minimise life-cycle costs;
    - a requirement for HVAC product manufacturers to provide energy efficiency labelling and further energy efficiency information for their products;
    - information and training for building designers, owners and others to ensure that HVAC systems are appropriately sized, installed, tested and maintained so as to maximise building energy performance at least life-cycle costs; and
- promote energy management and control systems to reduce energy consumption and better target energy-saving opportunities (IEA, 2011c).

Policies for net-zero energy consumption in buildings

Ideally, a country's policy and wider enabling environment should be supportive and encouraging of the construction of buildings with net-zero energy consumption, including through the use of initiatives to make such buildings commonly available in the market (IEA, 2011c). Such policies should include:

- targets for market share of net-zero energy consumption buildings in all new construction by 2020; and
- the use of net-zero energy consumption buildings as a reference for mandatory MEPS in future updates of building codes (IEA, 2011c).

It should be noted that the construction of net-zero energy buildings are not within reach of every country in the near term, including arguably many within the scope of this study. Having said this, successful examples from developing countries do exist, including India, Brazil and Panama. The experience of Brazil highlights the importance of tailoring the implementing policy framework to the economic, cultural and climatic context, which may differ starkly from conditions in other countries (Pacheco and Lamberts, 2013). While new building construction and refits in the **SEMED** and **ETC** regions are more likely to focus on EE improvements in the near-term, the construction of net-zero energy consumption buildings would be an admirable a long-term policy goal.

Creating an enabling environment for energy efficient buildings

Monitoring and compliance of building codes

A critical factor for effective implementation of building energy codes is compliance-checking and enforcement, however building energy codes often face complex institutional and policy landscapes. Several factors make the implementation of building energy codes difficult especially in countries with lower institutional and human capacities, as may be the case in some of the **ETCs** and **SEMED countries**, including:

- fragmentation of the buildings sector into multiple stakeholders with limited resources and, sometimes, conflicting interests;
- misalignment of energy requirements with other policy instruments (such as land-use policies and labelling schemes) that affect the buildings sector; and

- a lack of technical expertise and knowledge of buildings science.

To facilitate compliance, it is essential to develop and harmonise testing, ratings and certification of building materials, and to improve the knowledge base (IEA, 2013f). One way to increase compliance rates is to strengthen the capacity of sector specialists by providing training, and conducting awareness-raising campaigns and demonstration projects, particularly when introducing building energy codes for the first time (IEA, 2013e). This is an area in which countries in both the **ETC** and **SEMED countries** could benefit, including arguably by way of assistance from international or regional organisations, or bilateral aid. By way of example from another region, the USAID Vietnam Clean Energy Program focuses on energy efficiency in the building sector and improves the capacity of counterparts in the Socialist Republic of Viet Nam's ("Vietnam") Ministry of Construction and energy efficiency centres to acquire, manage, analyse, and use energy data for decision making (USAID, 2014).

Reform of the district heating sector

The district heating sector has a very high energy savings potential in the **ETC region**, where district heating infrastructure is aged and current pricing policies fail to provide sufficient funds for regular system maintenance and required upgrades. For example, district heating is one of the least efficient energy systems in **Kyrgyzstan** due to ageing infrastructure, and accordingly, the IEA *Eastern Europe, Caucasus and Central Asia (EECCA) Energy Policy Review* (2015) recommends the government consider restructuring the sector with more use of alternative fuels and efficient technologies, including the use of co-generation boilers, installation of individual meters and the replacement of ageing pipeline networks (IEA, 2015b). Sector management of district heating has also become fragmented in many ETCs as, in most cases, it remains under local governance structures (IEA, 2015b).

Financial and fiscal support, utility supply obligations, emissions trading, interconnection measures and capacity building all play crucial roles in the enabling environment to support and promote DHC (IEA, 2013d). However, before these more advanced policies are enacted, one of the first key measures is to reform prices for heat, by removing subsidies. Experience has shown that policies to remove heat subsidies are generally effective only when accompanied by investments in metering and heat-control systems, and by the introduction of billing systems based on the actual consumption of individual households (IEA, 2015b).

Therefore the key to maximising energy savings potential in the district heating sector lies in fundamental and all-embracing sector reforms, which should address at least the following:

- moving tariffs to full cost recovery levels;
- installing of metering and heat control systems;
- removing all forms of subsidies from this sector (moving it to targeted social subsidy schemes for the most vulnerable); and
- firm obligations for system upgrade and rehabilitation by the system operator (IEA, 2015b).

Countries in the **ETC region**, where there are large potential efficiency gains to be realised from district heating, are in various stages of implementing such reforms. **Tajikistan** has been slowly increasing heat tariffs in recent years, from negligible levels. **Moldova's** national regulator approved a new methodology in 2012 for district heat tariffs, designed to increase investment to the sector and the new Law on Heat is currently awaiting parliamentary approval. In contrast, **Kyrgyzstan** has no concrete plans to increase tariffs to a cost recovery level because of public opposition related to concerns about impacts on disadvantaged segments of the community (IEA. 2015b).

Appliances and lighting

Global market trends

Significant improvements in energy consumption for lighting, cooking and appliances are possible today using existing, cost-effective technologies. While many governments have a portfolio of successful energy efficiency policies for buildings and industry, the complex and fast growing market of appliances and electrical equipment poses new challenges for policy makers (IEA, 2013d). Residential appliances and equipment represent one of the fastest-growing energy loads, fuelled by the increasing variety of new appliances placed on the market to provide end uses such as recreation and communication (IEA, 2011c).

Regulatory policies appear to deliver significant gains in reducing electricity consumption of electrical equipment. For example, mandatory energy performance requirements and labels have proven to be a highly cost-effective policy tool for encouraging the reduction of average energy consumption in equipment without reducing consumer choice or triggering sustained increases in prices (IEA, 2010c). Voluntary policies have also underpinned significant progress towards more efficient appliances and equipment. However, in many cases energy savings achieved have been eroded by larger dwellings, larger refrigerators, brighter spaces and improved comfort (IEA, 2014a), again demonstrating the rebound effect discussed in Box 6.

An emerging issue is wasted energy from appliances in "network standby" mode, whereby network-enabled devices continue operating a low-power mode that is more complex than regular standby as they maintain capability to resume applications via a network connection. Globally, it is estimated that these devices waste 400 TWh of electricity per year (IEA, 2014i). Existing policies and procedures for stand-alone standby (e.g. as used for televisions) are not directly transferable to deal with energy waste from "network standby". While some elements of that policy framework provide opportunity for implementing the foundation to support long-term changes, governments must address network standby consumption through revised policy instruments (IEA, 2014i).

Barriers to energy efficient appliances and equipment

Key barriers preventing energy users from making decisions that take into account the energy efficiency of appliance equipment purchases and use include information failures (e.g., where consumers can't access information on the long-term energy and monetary savings associated with efficient appliances), and split incentives (e.g., when landlords purchase appliances without regard for efficiency as it is tenants who benefit from energy savings.

Policies for energy efficient appliances and equipment

The most common methods of overcoming the barriers above are regulations to remove inefficient appliances from the market (through mandatory MEPS and phase-outs) and measures that direct consumers towards highly efficient products by providing clear information on products' energy use (for example, labelling). These and other policies are discussed in more detail below.

Mandatory MEPS and labels for appliances and equipment

Promoting widely available energy efficient products through voluntary and mandatory labelling has been the best-known and longest-running policy in the appliances and equipment sector. Standards and labelling programmes are market interventions that aim to ensure that services and products use less energy than the market would have otherwise delivered. Standards generally take one of two forms: either as MEPS applying to every individual product, or as an average efficiency requirement spread across the range of products sold by a particular supplier (IEA, 2010c). Energy efficiency labels are informative labels affixed to manufactured products that describe the product's energy performance (usually in the form of energy use, efficiency or energy cost), which enable consumers to have more energy efficient purchasing choices (IEA, 2010c).

The key benefits of standards and labelling programmes are that they:

- can lead to large energy savings;
- can be very cost effective;
- require change in the behaviour of a manageable number of manufacturers rather than the entire consuming public;
- treat all manufacturers, distributors, and retailers equally; and
- provide measurable energy savings that are comparatively easy to quantify and verify (IEA, 2010c).

The IEA has estimated that if it were not for the implementation of policy measures such as energy labelling, voluntary agreements and MEPS, electricity consumption in OECD countries in 2020 would be about 12% higher than is now predicted (IEA, 2010c). The savings potential beyond OECD countries is harder to quantify at the present time but likely to be even greater.

Some progress is being made with MEPS in the **SEMED region**. For example, **Morocco** has enforced the application of Moroccan standard NM 14.2.300 for the labelling of electrical products and household appliances (IEA, 2014l). **Egypt** and **Tunisia** have mandatory energy performance standards for refrigerators and air conditioners. In the **ETC**, **Tajikistan** has passed the Law on Energy Efficiency and Energy Saving, which provides the legislative framework for the introduction of energy-efficient appliances and technologies, including provisions for mandatory energy audits and requirements for buildings and household appliances. However, secondary legislation and mechanisms for the implementation of the new law are still under consideration (IEA, 2014b).

Mandatory energy performance requirements and labels are more effective when complemented with a package of measures that accelerate the transformation of the appliance market towards high-efficiency products. Such measures include those outlined below.

Phase-out of inefficient lighting products and systems

Lighting represents almost 20% of global electricity consumption (IEA, 2011c). This level of consumption could be substantially reduced for the same level of lighting service were less energy wastage occurring from the use of inefficient lighting technologies, a lack of adequate controls, a failure to make better use of natural daylight, and wide variations in recommended lighting levels. Throughout the world, incandescent lamps remain the most common source of lighting in the residential sector, accounting for 30% of global lighting electricity consumption with an average of 20 incandescent lamps per household in IEA member countries (IEA, 2006).

Inefficient lighting products (including inefficient ballast, lamp, lamp housing, fixture and lighting controls) should be phased-out as soon as technically feasible and economically viable, by:

- adopting lighting quality, reliability and MEPS for new and existing lighting products (IEA, 2011c) for example performance criteria should allow 50% of fixtures to have greater than 100 lumens/watt; and
- supporting the development, use and regular updating of international test standards and measurement protocols to enable performance comparisons and benchmarking for traded

products, to reduce industry compliance costs and to support national policy requirements (IEA, 2011c).

Bans of energy inefficient lighting such as inefficient incandescent lamps (IIL) including incandescent and halogen light bulbs is highly recommended as it has been effectively implemented in many countries (IEA, 2014a). While energy inefficient lighting has not been banned in **Morocco**, energy labelling of lamps is mandatory, and a programme aiming to generalise the use of compact fluorescent lamps (CFLs) in public buildings has been launched. In the residential sector, a plan to install 22.7 million low-energy light bulbs by 2012 was launched in 2010, to be carried out by electricity providers selling CFLs financed by low-interest loans from international organisations to the end user (IEA, 2014l). In **Egypt**, the National Energy Efficiency Action Plan targets 2020 for the phase-out of incandescent lights and introduces MEPS and mandatory labels for CFLs. In **Tunisia**, the target date for phase-out of incandescent lights was 2013. For the most part, the **ETC region** lacks systematic national policies however **Kazakhstan** has introduced an incandescent lighting phase-out as part of its Energy Efficiency Program 2020. In other ETCs, small-scale projects exist, such as some of those supported in the industrial and buildings sector by the **Moldovan** Sustainable Energy Financing Facility (with the support of the EBRD), or the 2015 decision to replace 100,000 lamps in the city of Tbilisi, **Georgia** with LED products.

Meanwhile, improved lighting systems design and management should be promoted via the national enabling environment by ensuring that building codes promote the use of natural light and include MEPS for lighting systems. Further measures include information and training directed at architects, builders, owners and managers (IEA, 2011c).

Market transformation policies for appliances and equipment

Studies show that while the product price often increases initially following the introduction of an energy performance standard, it generally drops very shortly thereafter (IEA, 2010c). Therefore government incentives generally assist manufacturers bring super efficient products to market, rather than consumers to purchase them. Incentives and other measures to support the introduction and uptake of new technologies and high-efficiency appliances and equipment can include financial incentives, procurement programmes, endorsement schemes and other market-support measures focused on the most cost-effective, energy efficient products available.

Creating an enabling environment for energy efficient appliances and equipment

Test standards and measurement protocols for appliances and equipment

The effective implementation of energy efficiency policies for appliances and equipment relies upon the use of accurate energy performance measurement standards and protocols as national energy efficiency policy objectives will be undermined by energy measurement standards that fail to reflect actual energy use and/or provide a true in-use efficiency ranking of equipment. Product test standards and measurement protocols should therefore be regularly updated and align national policies with the development and use of international test standards and measurement protocols in order to assist performance comparisons and benchmarking for traded products, and to reduce industry compliance costs (IEA, 2011c). For example in **Belarus** 129 technical regulations were developed from 2007–2010, with more than 80 harmonised with international and European requirements, based on the Programme for Developing the System for Technical Regulation, Standardisation and Conformity Attestation in the Field of Energy Saving (IEA, 2015b).

In **SEMED countries**, stricter appliance standards for air-conditioners will be a more important "quick win" than BECs. Unlike the Gulf States, where summer temperatures are very high or **ETCs** where winter is very cold, the **SEMED countries** have relatively mild seasons, however due to the increasing popularity of air-conditioning and low electricity prices, the tendency is to buy cheap and inefficient appliances. Saudi Arabia has tackled this issue by requiring minimum energy performance of air conditioners, and it would be prudent for **SEMED countries** to make this a policy priority.

Factors that enable effective MEPS

Ideally, the stringency of mandatory MEPS and label schemes will be regularly updated across the full spectrum of appliances and equipment, taking into account proven international practices. It is recommended that policies should:

- prioritise MEPS and labels for appliance and equipment types that are likely to result in the largest energy, economic and environmental benefits, taking into account likely future sales of new and replacement units, the introduction of new technologies, and emerging issues such as network-connected appliances and equipment (IEA, 2011c);
- allocate resources to monitoring compliance, verifying accuracy of claimed performance and enforcing mandatory MEPS (IEA, 2011c);
- include incentives/high tariffs to promote progress and compliance (IEA, 2014a);
- establish performance metrics on total electricity use per square metre, with all loads considered (IEA, 2014a); and
- include a mechanism that allows for re-scaling as product performances improve over time (IEA, 2013g).

International engagement

As appliances and equipment are traded internationally, there is value in collaborating with other countries to harmonise MEPS. International harmonisation can lead to benefits for both government (by reducing the need to regulate from scratch) and manufacturers (by reducing the compliance burden). There are also international collaboration efforts and global dialogues that aim of to increase the demand for and trade in efficient appliances and equipment and provide invectives and awards for manufacturers of super-efficient products (IEA, 2011c).

Industry

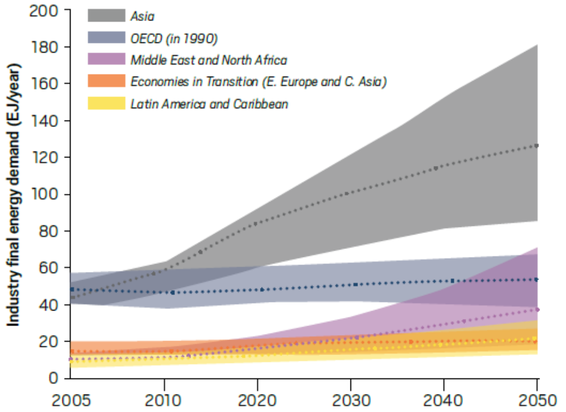
Global market trends

Industrial energy use accounts for roughly one third (28% excluding blast furnaces and coke ovens) of global final energy demand (IEA, 2012a). Global industrial energy intensity in 2012 was 12% lower than in 2000, partly due to the addition of efficient capacity[27] (IEA, 2015c). However, there remains significant potential to decrease energy consumption in the industrial sector, with many opportunities underexploited, both in the target regions and globally. For example, in 2014, applying best practice technologies could have yielded energy savings of 26%, 24% and 21% respectively in the global pulp and paper, chemicals and petrochemicals, and iron and steel

[27] Industrial energy intensity is a ratio of industrial energy use to industrial value-added. As such, improvements to energy intensity may reflect a combination of efficiency improvements, structural changes to the economy and changes in raw materials and products used in production.

sectors (IEA, 2014a). Figure 36 shows projected industrial energy use to 2050, with significant increases in the Middle East and North Africa, which includes the **SEMED countries** in this study.

Figure 36 • Projected increases in industrial energy use by region

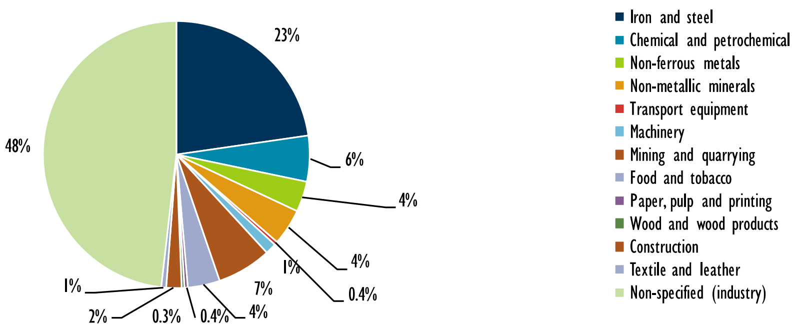


Notes: colored bands represent the 5th to 95th percentiles of more than 100 baseline scenarios included in IPCC's Fifth Assessment Report, with the dotted line showing the median scenario for the region.

Source: data from IPCC WGIII (2014), obtained from the International Institute for Applied Systems Analysis database.

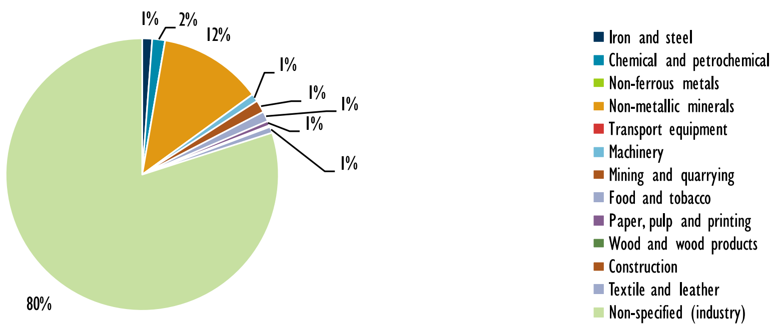
Source: Institute for Industrial Productivity (IIP) (2015) *The Role of Industry in Forging Green Cities*, Washington, DC, USA

Figure 37 • Energy consumption by industrial sub-sector in the ETC region



Source: IEA (2014), *CO2 Emissions from Fuel Combustion*, OECD/IEA, Paris.

Figure 38 • Energy consumption by industrial sub-sector in the SEMED region



Source: IEA (2014), *CO2 Emissions from Fuel Combustion*, OECD/IEA, Paris.

Industry is the largest energy consuming sector in the **ETC region**, accounting for 34% of total final energy consumption (Figure 6) and second largest behind transport in the **SEMED region**, at 26%, (Figure 12).

While the major energy consuming sectors globally are iron and steel, chemicals and petrochemicals, non-ferrous metals, non-metallic minerals, and paper, pulp and print, the key energy-consuming industrial sub-sectors in the **SEMED** and **ETC regions** vary, as shown in figures 37 and 38 above. In the **SEMED region** industry is concentrated into a small number of energy intensive sectors, predominantly non-metallic minerals. However, it should be noted that there is a very high proportion of industrial energy-use classified as "non-specified" in both regions which suggests the quality of the data might be poor and reinforces the need for improved data collection processes.

Barriers to energy efficient industry

There are specific challenges to the widespread uptake of best-available technologies (BATs) in the sector that require government and industry to work together to develop responses.

Energy-intensive industries are particularly exposed to impacts on competitiveness in environments where energy prices are volatile and divergent, and may be apprehensive about policies that threaten their access to cheap sources energy, such as the phasing out of electricity subsidies. Non-price barriers such as "split incentives" can occur in industrial firms when energy management procedures and equipment procurement are not aligned. Some energy efficient equipment can have high upfront capital costs, which can be prohibitive for firms seeking short payback periods on capex investments. In addition, several factors such as stock capacity turnover, fluctuation of raw material availability and skills deficits can slow down the process of introducing or shifting to BATs in this sector.

Policies for energy efficient industry

Much of the potential to save energy in the industrial sector can be captured through policies for promoting use and optimisation of energy efficient industrial equipment and systems, and improving overall efficiency through energy management (IEA, 2011c).

Typical policies that target industrial energy efficiency include: regulations and voluntary agreements that directly compel actions; economic policy instruments such as taxes and tax incentives, directed financial support (e.g. subsidies and loans) and differentiated energy prices that seek to influence the cost-effectiveness of technical actions; and informational policies, which help to establish a favourable environment for industry to implement EE actions (IEA, 2011e). Market-based instruments such as emissions trading schemes and energy efficiency obligations targeting the industrial sector (such as India's Perform, Achieve Trade Scheme) are other policy tools to incentivise the uptake of BATs.

Effective policy mixes should also include information campaigns and capacity building programmes. Information can be shared through a variety of means such as written materials, networking workshops and dissemination of case studies. Public recognition of companies that have demonstrated best practice can be another effective way of encouraging actions in this sector (IEA, 2012a).

The ensuing sub-sections provide guidance on particular policy options for improving industrial energy efficiency, namely energy management programmes, regulatory tools for industrial equipment and systems, and incentives. Box 7 points to key IEA recommendations on best available technologies and practices for the iron and steel, cement, and chemicals and petrochemicals sector, while Box 8 discusses opportunities for improving efficiency in the agribusiness sector, drawing on FAO analyses.

Energy management programmes

Energy management programmes (EnMPs) are government-led initiatives to promote effective energy management systems (EnMSs). The latter are a means by which organisations continuously monitor and identify the actions required to improve their energy performance, and establish the systems and processes necessary to achieve operational control and continual improvement of energy performance (IEA, 2012a). As well as empowering individual firms to make energy efficiency improvements on a particular site, EnMSs can also be used to collect data for benchmarking and performance comparisons between sites, nationally and internationally. EnMSs can be effective tools to enable energy efficiency improvements, but in most countries they are still voluntary (IEA, 2014a).

When a government is designing EnMPs, investing sufficient time and resources in the planning stage can help to avoid future challenges and problems. The most successful energy management programmes are those that are integrated within the wider policy framework, taking into account the following design elements:

- support systems to boost implementation;
- methods for monitoring progress and evaluating results;
- possibility for a piloting phase to ensure that the most appropriate programme design and supporting measures are selected; and
- to maintain effectiveness, the set-up of programmes may need to be periodically revised, and experiences gained can be used to expand the scope to include new sectors or types of enterprises (IEA, 2012a).

Generally speaking, it is recommended that governments adopt EnMPs that require large, energy-intensive industry, and encourage other industrial energy users, to conform to ISO 50001[28] or an equivalent energy management protocol (however, see below qualifier regarding the important role of SMEs in the ETC and SEMED regions). Actions to deliver cost effective energy savings should be implemented, and industry should periodically report on their efforts (IEA, 2011c). It is recommended that energy management measures include:

- identifying and assessing energy saving opportunities by benchmarking, measuring and documenting energy consumption;
- implementing actions to capture identified energy-saving opportunities; and
- publicly reporting the energy-saving opportunities identified and the actions taken to capture them (IEA, 2011c).

Regulatory tools

Regulatory tools can be used in several ways to improve industrial energy efficiency. Governments can adopt MEPS to regulate inefficient equipment out of the market. The IEA recommends that MEPS should be implemented for electric motors and other categories of industrial equipment such as distribution transformers, compressors, pumps and boilers (IEA, 2011c).

[28] International Organisation for Standardisation developed the ISO 50001, which specifies requirements for establishing, implementing, maintaining, and improving an energy management system.

Regulation can also be used to require industrial entities to audit their operations on a regular basis, so as to identify energy efficiency opportunities and to insist that entities. Governments can also regulate to ensure that industry uses best available technology before licensing new industrial plant.

Incentives

Given the high upfront capital costs of some energy efficient industrial equipment, regulatory measures above are often more successful if implemented alongside financial incentives to promote installations of high-efficient equipment and the design and operation of energy efficient industrial systems and processes (IEA, 2011c). Governments can encourage investment in energy efficient industrial equipment and process technologies by putting in place targeted financial incentives such as tax incentives for energy efficient investments in industry (in particular for SMEs). An example of a tax incentive is accelerated depreciation, whereby the tax rules are changed so that energy efficient industrial equipment depreciates faster, reducing the payback period on such equipment for industrial facilities.

Examples of countries in this study implementing such policies are limited. In the **SEMED** region, **Morocco** stands out for providing tax incentives for the use of high-efficiency industrial equipment through accelerated depreciation. In the **ETC region**, **Kazakhstan**'s Energy Efficiency Program 2020 includes a portfolio of measures targeting industrial energy efficiency, including minimum standards for industrial equipment (for example, electric motors), and generous subsidies for conducting energy audits and implementing energy management systems.

Creating an enabling environment for energy efficient industry

An enabling environment for industrial energy efficiency should take the specific challenges of each industrial sector into consideration, by creating long-term policy and market strategies that are co-ordinated internationally that support low-carbon industrial production.

Policy makers should also be aware of opportunities for integrative policy interventions such as in the industry and waste sectors where technologies are available to reduce energy use in manufacturing facilities while also cutting the flow of waste and pollution in urban areas. For example, the high density of urban energy demand and the proximity of industry to other end users in some cities, makes it possible to recycle lower-grade heat and other waste energy from industrial operations in the form of clean district heating and cooling services (IIP, 2015).

Where information barriers exist, for example on the optimisation of energy efficiency in the design and operation of industrial processes such as electric motor-driven, hot water and steam, and cogeneration systems, these can be overcome through supporting measures such as, training initiatives, audits, technical advice and documentation, and system-assessment protocols (IEA, 2011c).

Importantly, an integrative policy framework for this sector also includes the removal of energy subsidies, internalisation of environmental costs, and ready access to financing (IEA, 2011c). This last issue is particularly important and is discussed in more detail below.

Access to finance

Due to the barriers around capex investments discussed earlier, ensuring access to loans for energy efficient equipment upgrades is important for many industrial firms. Unfortunately, despite the relatively low risk, lenders have tended to be slow to provide such financial products. One strategy is for governments to help foster private finance of energy efficiency upgrades in industry through risk-sharing or loan guarantees with private financial institutions and enabling the market for energy performance contracting (IEA, 2011c).

Other institutions are also increasingly offering assistance to increase flows of finance for energy efficiency. From 2010-2015, the EBRD, together with the United Nations Industrial Development Organization (UNIDO) with funding from the GEF, carried out a market transformation project addressing the lack of availability of finance for energy efficiency investments in GHG-intensive industries in Russia. The two-pronged approach adopted involved:

- building the capacity of local lenders, including financial intermediaries such as energy service companies (ESCOs), to access risks and returns associated with energy efficiency projects; and
- increasing the capacity of industries to develop bankable energy efficiency projects according to a defined methodology based on EnMSs.

Energy efficiency services for small and medium-sized enterprises (SMEs)

While the SME sectors of **SEMED countries** and **ETCs** are still developing in terms of contributions to national employment and GDP, the number of SMEs in both regions is growing: in **SEMED**, SMEs comprise 95% of private enterprises (totalling some 12 million SMEs) in **ETC**, 96.5%[29] (OECD, 2013b; OECD, 2012b). SMEs often face specific barriers to implementing energy efficiency actions and may require tailored policy interventions[30]. EnMPs and EnMSs should thus include specific measures to promote energy efficiency in SMEs. Such measures may include:

- a system for ensuring that energy audits, carried out by qualified engineers, are widely promoted and easily accessible for all SMEs;
- provision of high-quality and relevant information on proven practice for energy efficiency that is appropriate to each industrial sector; and
- energy performance benchmarking information that can be easily used by SMEs and structured to allow international and within economy comparisons (IEA, 2011c).

Supporting measures for EnMPs

EnMPs are more effective when the enabling environment includes target setting policies, voluntary schemes, negotiated agreements to reduce energy demand or GHG emissions, promotional aid, as well as financial and regulatory incentives (IEA, 2012a). Government support may include financial incentives (such as tax relief), reward programmes, ease of access to information (best practice, exchange and co-operation schemes, networking, implementation guidelines, etc.), and technical tools (support to carry out energy audits, development of technical energy profiles, benchmarking tools and so on) (IEA, 2012a).

Appropriate resources and supporting mechanisms, including assistance, capacity building and training, as well as provision of tools and guidance during the implementation stage, are also necessary for the success of energy management protocols (IEA, 2012a). If EnMPs are rolled out progressively across industrial sub-sectors, experiences gained from implementation in earlier stages should be built upon in later stages.

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[29] This data includes the regional definition 'Eastern Partner Countries', which includes Armenia, Azerbaijan, Belarus, Georgia and the Republic of Moldova.

[30] For example, a survey of UK SMEs indicated that specific issues faced by SMEs included a tendency to seek shorter leases to maximise flexibility and poor record keeping on energy performance (DECC, 2014).

Box 8 • IEA recommendations on best available technologies (BATs) and best practices (BPs) for the iron and steel, cement, and chemical and petrochemical sectors

Iron and steel sector

BATs and BPs include: improving the energy and environmental performance of existing production routes by enhancing process integration; optimising the use of process gas streams; and carbon capture (in direct reduced iron and smelting reduction processes) (IEA, 2015c).

Cement sector

BATs and BPs include: using dry-process kilns with six-stage preheaters and precalciners instead of wet-process kilns; Increased co-processing of alternative fuels such as biofuels and waste (being careful to balance trade-offs between use of alternative fuels or materials and energy efficiency); waste heat recovery systems and clinker substitution. Potential future technologies include carbon capture and storage (IEA, 2015c).

Chemical and petrochemical sector

BATs and BPs include: improving the energy and environmental performance of existing production routes by enhancing process integration; increasing the recovery of waste heat; switching to low-carbon fuels; and recycling. Potential future technologies currently under development include catalytic cracking (IEA, 2014a).

Source: IEA (2015c), Tracking Clean Energy Progress, OECD/IEA, Paris; IEA (2014a), Energy Technology Perspectives, OECD/IEA, Paris.

Transport

Global market trends

The IEA estimates that the potential energy savings achievable in the transport sector globally could amount to 30 exajoules (EJ) per year by 2030—or the equivalent of the current annual oil consumption of the European Union (IEA, 2014a).

The wider MENA region is the fourth-largest regional market for new and used vehicles and the transport sector in the **SEMED** region is the largest in terms of energy consumption (as shown in Figure 12), while land-based transport accounts for 76% of total sector energy use globally (IEA, 2014g; IEA, 2014d), which sets the focus for this section. While passenger vehicle ownership is levelling off in OECD countries, demand in OECD non-member economies is still projected to increase by a further 90% between 2011 and 2020 (IEA, 2014d). In fact, transport is largest and the fastest growing energy consuming sector in the **SEMED-Arab region**, and no other region in the world has a transport sector that is more energy intensive (IEA, 2014g).

The vehicle markets in **ETC countries** are rapidly growing and often dominated by imported second-hand cars, with a sizable share of large engine and fuel inefficient vehicles. The exception to this trend is **Uzbekistan**, which has a well-developed full cycle of vehicle production, supplying local and neighbouring markets.

Box 9 • Improving energy efficiency in the agrifood sector

The food sector currently accounts for around 30% of the world's total energy consumption. High GDP countries use a greater portion of this energy for processing and transport whereas in low-GDP countries, cooking consumes the highest share (FAO, 2012). The agrifood sector in both the **ETC** and **SEMED regions** is particularly important.

The many important linkages between energy and food security are often overlooked, however the use of renewable energy technologies including bioenergy, and increased energy efficiency can result in multiple benefits in terms of food availability, food utilisation and nutrition and food stability, in addition to the general benefits of EE&RET such as reduced GHG emissions (FAO, 2014a). Such benefits are best harnessed by transforming the food chain to incorporate more low-carbon energy systems (including renewable energy), greater energy efficiency, providing greater access to modern energy services for development, and at the same time supporting the achievement of national food security and sustainable development goals (FAO, 2012).

Energy conservation and efficiency improvements can be achieved in several ways at all stages along the food chain, and can either result in direct savings through technological or behavioural changes or indirect savings through co-benefits derived from the adoption of agro-ecological farming practices (FAO, 2012).

Integrated food energy systems (IFES) involve food and energy being produced in parallel on farms to meet both energy and food needs. IFES offer a range of opportunities for fulfilling the three key objectives of energy-smart food systems: greater energy efficiency, increased use of renewable energy and improved energy access (FAO, 2011). Policy approaches to improving energy efficiency in the agrifood sector should bear in mind that:

- Energy efficiency improvements in primary production must be made by applying agro-ecological practices and locally adapted technologies (FAO, 2014c). Producers in **SEMED countries** and **ETCs** countries may be faced with financial constraints to adopt improved energy efficient technologies, such as precision farming, irrigation monitoring, improved boat propeller designs, transport logistics using global positioning satellite (GPS) light emitting diodes, heat exchangers and variable speed electric motors among others. Thus options must consider the balance between efficiency measures, projected energy costs and the need to improve energy access and affordability (FAO, 2012).
- The energy efficiency of end-use devices should be increased, such as improved cooking stoves or efficient irrigation devices (FAO, 2014c). However, experiences with introducing energy efficient cooking stoves highlight the importance of introducing such devices with sensitivity towards local cultures and habits and providing assistance with capital investments such as through micro-finance (FAO, 2011).
- Both the direct and indirect energy used by food systems at each stage in the supply chain and the potential energy produced by these systems should be carefully considered to maximise the sustainable production of both food and energy feedstock, as long as relevant practices and technologies are locally devised and adapted (FAO, 2011; FAO 2014c). In some cases, indirect energy inputs to agriculture represent the largest share (e.g. energy to manufacture fertilisers).
- Greater energy efficiency in crop cultivation, irrigation and fertiliser use, as well as the storage and refrigeration, transport and distribution and preparation of food is required to make food systems energy-smart (FAO, 2011). Notably, potential for energy efficiency gains exist at different stages of the livestock value chain, i.e. feed production, processing and transport, feed distribution, milking, product storing, processing and others (Gerber et al., 2013). In particular, anaerobic digestion is a technology that can support higher energy efficiency in livestock production by recovering energy from animal wastes.
- Promoting and facilitating knowledge transfer and capacity building is key to fostering deployment of new technologies in agrifood chains, and should be a priority of policies addressed to farmers and/or technology users.

Approximately one-third (1200 Mt per year) of food produced is lost or wasted, at various stages in the supply chain, which equates to a loss of around one third of the total final energy consumed by the whole food chain. The energy embedded in food can be saved by reducing food losses and waste by improving harvesting techniques, storage facilities, transportation, infrastructure, packaging and market systems in addition to consumer awareness and education of smallholder farmers (FAO, 2011).

It is recommended that the following specific policies are set within the broader constellation of policies designed to reduce energy use in the transportation and industrial sectors:

- the introduction of freight truck fuel economy standards and payload limits;
- minimum energy performance standards (MEPS) for machinery, such as electric motors, refrigerators, water boilers, that is used in food systems;
- energy performance labels on domestic appliances;
- vehicle speed restrictions;
- packaging recycling regulations; and
- higher charges for landfill disposal of organic wastes (FAO, 2012)

Source: FAO (Food and Agriculture Organization of the United Nations) (2014a), *Walking the Nexus Talk: Assessing the Water-Energy-Food Nexus in the Context of the Sustainable Energy for All Initiative*, FAO, Rome; FAO (2014b), "Agro-Industry Development", www.fao.org/3/a-i4281e.pdf (accessed 10 March 2015); FAO (2014c), *Evidence-Based Assessment of the Sustainability and Replicability of Integrated Food-Energy Systems: A Guidance Document*, FAO, Rome; FAO (2012), Energy-Smart: Food for People and Climate Issue Paper, FAO, Rome; FAO (2011), *Policy Brief: the Case for Energy-Smart Food Systems*, FAO, Rome.

Barriers to energy efficient transport

IEA analyses suggest that one of the key barriers to increasing transport energy efficiency is the long lifespan of vehicles, with vehicle stocks tending to turn over every 10 to 15 years, essentially "locking in" a level of efficiency over the lifespan of the fleet. This means for existing vehicles, efficiency gains are more likely to occur through changes in usage, rather than changes to the vehicle fleet (IEA, 2012c).

Barriers to improving the efficiency of new vehicles include market failures, information gaps and the higher upfront costs associated with more innovative technologies (IEA, 2012d).

Policies for energy efficient transport

Improving energy efficiency in the transport sector is a complex challenge as policies must not only address the technical efficiency of vehicles, tyres and fuels, but also driver behaviour and travel demand.

At the level of vehicle production, development and deployment of more efficient vehicles requires increased capital investment, including R&D, testing, production, supply chain optimisation and marketing of new vehicles. Additionally, vehicle components, such as raw materials, computing systems and vehicles parts, can benefit from improved energy efficiency measures. Supporting EE capital investment in vehicle production directly corresponds with national efficiency requirements (or lack thereof), which highlights the importance of standards. Increasingly stringent national efficiency standards (including but not limited to fuel efficiency standards) produce EE benefits throughout the production chain.

Given the impracticality and cost of improving the efficiency of existing vehicles, policies tend to focus on improving the efficiency of the new entrants to the vehicle stock (IEA, 2012c). An integrated approach to improving new vehicle energy efficiency typically combines three policy elements that are shown to be effective in addressing the above barriers: mandatory vehicle efficiency standards, financial incentives, and labelling. More detailed guidance is provided below.

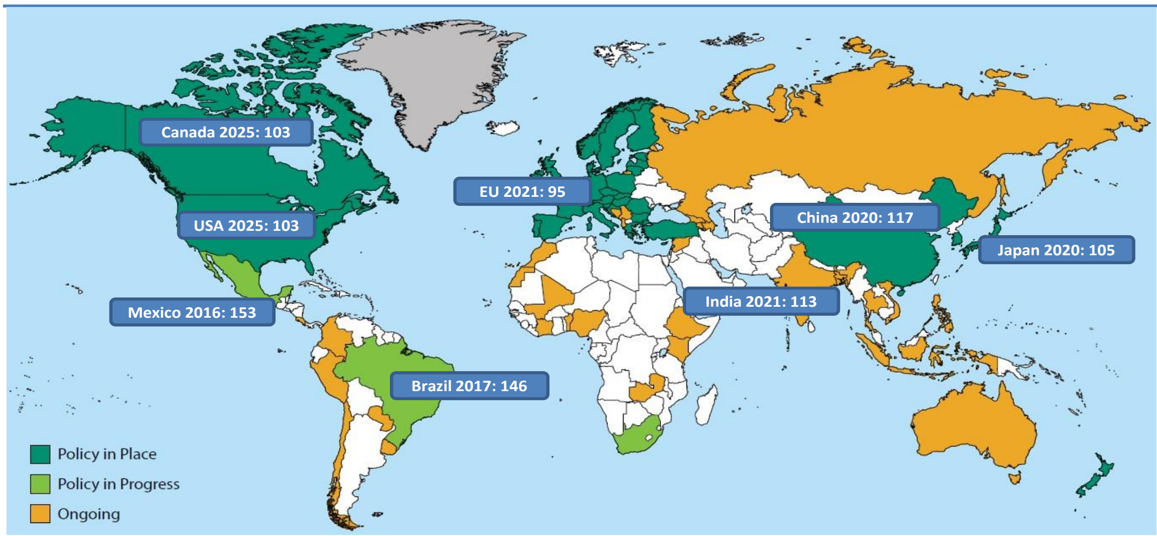
Mandatory vehicle efficiency standards

Mandatory vehicle efficiency standards (also known as fuel economy standards) are a regulatory tool that governments can use to require a minimum standard of efficiency for all vehicles available on the market. Standards tend to be expressed as a maximum permitted amount of fuel consumption or level of CO_2 / particulate emissions over a given distance.

Figure 39 demonstrates the varied global progress in the adoption of fuel economy standards policies, Vehicle fuel economy standards now cover 70% of the global passenger light-duty vehicle (LDV) market and will drive the market for more energy efficient vehicles in the next five years (IEA, 2014d). New standards are estimated to lead to energy efficiency investments of USD 80 billion annually out to 2020 and will save between USD 40 billion and USD 190 billion in fuel costs (IEA, 2014d).

For passenger cars, regions with regulations in place show annual improvement in fuel economy of around 2.6% since 2005. Non-regulated markets lag behind, mostly due to a shift of preference towards bigger and more powerful vehicles as consumers' personal income has increased. Globally, the average fuel economy of cars has improved by 2% per year since 2005. This is considerable though it is nonetheless below the 3% per year that would be needed to for this sector to realise its full contribution to 2DS (IEA, 2015c).

Figure 39 • Fuel economy standards, announced and enacted targets in CO_2 per km



Note: this map is without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.
Source: IEA (2015c), *Tracking Clean Energy Progress,* OECD/IEA, Paris.

Vehicle fuel economy standards may be the single most important energy efficiency policy for the **SEMED** and **ETC regions**, especially for energy-exporting economies. It is the only transportation sector policy that can have an impact on the price and market distortions created by fossil fuel price subsidies (IEA, 2014g). Accordingly, its regional relevance and potential energy savings are both very large.

In spite of the high demand for vehicles and the fact that transport is the highest energy consuming sector in the **SEMED region** (Figure 12), none of the four countries under examination has yet enacted vehicle fuel efficiency standards. Three countries in the **ETC region** (**Armenia, Azerbaijan** and **Georgia**) have implemented fuel economy standards. A number of other countries in the region are in the process of putting higher fuel efficiency standards in place, resulting in the replacement of the dated vehicle fleet in these markets (IEA, 2015b).

According to the 25 EEPR, transport policies should include regularly updated fuel-efficiency standards for road vehicles (IEA, 2011c) that:

- introduce and regularly strengthen mandatory fuel-efficiency standards for light-duty vehicles;
- establish testing procedures for measuring fuel efficiency of heavy-duty vehicles and adopt fuel-efficiency standards for those vehicles; and
- harmonise or increase the comparability of vehicle fuel efficiency test methods.

Nonetheless, global experience as well as regional conditions suggest that implementing vehicle fuel efficiency standards in the **SEMED** and **ETC regions** will be challenging for the following reasons:

- consumer preferences for larger cars with big engines (weather, long distances and population demographics make it difficult to create demand for smaller, less powerful vehicles);
- a preponderance of older vehicles;
- compatibility of transportation fuels with high-efficiency gas and diesel engines;
- lack of automotive manufacturing infrastructure in general; and
- lack of fuel economy testing infrastructure.

On the positive side, there have been significant advancements in fuel economy standards in the countries or regions where vehicles are dominantly manufactured, such as Europe, Japan, China, Korea, and the US. This may have knock-on effects in **ETC** and **SEMED** by way of the second-hand and new vehicle markets (IEA, 2014g) and by encouraging more stringent standards. For example, **Morocco** restricts the import of second hand vehicles greater than a certain age in order to reduce inefficient fuel consumption. Similar tariff measures could be introduced in other countries of the **SEMED** and **ETC regions** to encourage not only newer but also more fuel efficient vehicles.

Incentives and labelling

In addition to mandatory fuel economy standards, the IEA suggests that government oversight of vehicle efficiency should ideally cover measures such as labelling, incentives and taxes to boost vehicle efficiency and accelerate the market penetration of new efficient vehicle technologies (IEA, 2011c). Measures could include:

- vehicle fuel economy labels, which provide information that empowers consumers to make decisions about vehicle purchases with full knowledge of their efficiency;
- vehicle taxes to encourage the purchase of more fuel-efficient vehicles by making inefficient vehicles comparatively more expensive; and
- incentives such as tax breaks for very low CO_2-emitting and fuel-efficient vehicles. **Kazakhstan** offers tax breaks for hybrid vehicles.

The scope of policies to these ends are vast, ranging from a hands-off approach to voluntary programmes to strict mandatory regulations (IEA, 2010d). Moreover, governments can support improved vehicle fuel efficiency by liaising with manufacturers to stimulate the technological growth of vehicles with high efficiency, as well as prioritise imports of vehicles with higher efficiency.

Regulations for fuel-efficient non-engine components

Ideally, measures directed at vehicle efficiency should also cover non-engine components. Measures to reduce the negative impact on fuel efficiency of vehicle components such as tyres and air conditioning systems are often excluded from vehicle fuel-efficiency testing and requirements, and thus may need to be adopted in addition to engine components (IEA, 2011c). To improve the performance of non-engine components, governments can:

- adopt new international test procedures for measuring the rolling resistance of tyres, and establish labelling and maximum rolling resistance limits for road-vehicle tyres;
- adopt measures to promote proper tyre inflation levels, which should include mandatory fitting of tyre-pressure monitoring systems on new road vehicles; and
- introduce energy efficiency requirements for air-conditioning systems and include the energy efficiency of such systems in fuel-economy testing.

Governments can also facilitate the production of more efficient components by setting minimum standards that technologies must meet (i.e. high efficiency air conditioners), thus creating demand for new, fuel-efficient vehicle components.[31]

Creating an enabling environment for energy efficient transport

An enabling environment for efficient transport must take into account the relationship between fuel prices and vehicle use. Quite simply, vehicle users are more likely to purchase more efficient vehicles and change their driving habits if fuel prices are higher. Therefore, as with other sectors, the removal of subsidies for conventional vehicle fuels is a primary supporting measure in this sector.

If the aim is also to incentivise the use of low or no-tailpipe emissions vehicles, policy makers should consider the need for adequate infrastructure (for example, electric vehicle charging stations) to encourage uptake.

Governments often play a strong role in supporting innovation within technological sectors, including within the automobile industry. Supporting measures to encourage innovations in vehicle and vehicle parts manufacturing, include reducing the bureaucratic requirements or "red tape" faced by technology entrepreneurs and removing barriers to importation of materials needed in the production process.

Institutional factors are also important in supporting an enabling environment for energy efficient transport. Transport energy efficiency policies should be clearly assigned to a dedicated agency. This is a problem in the **ETC region**, where it is often difficult to establish a government segment under which the management of transport sector energy efficiency policies and measures is placed.

Finally, as one of the most effective ways of reducing the energy intensity of the transport sector is to encourage users onto more efficient modes of transport, an enabling environment should

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[31] Another means of improving vehicle efficiency is through government programmes to encourage eco-driving, namely, the operation of a vehicle in a manner that minimises fuel consumption and emissions, through measures such as optimising gear changing, avoiding vehicle idling, avoiding rapid acceleration and deceleration, driving at efficient speeds, reducing weight by removing unnecessary items from the car, and reducing wind resistance by removing roof attachments (IEA, 2010d). This issue is not further explored in this paper as it is not related to fostering the market for EE technologies.

include measures to improve the availability of transport options. This is discussed in more detail below.

Transport system efficiency

The potential of improved public transportation is very large in the urbanised areas of the **SEMED** and **ETC regions**. **Morocco** has already adopted tramway systems in Rabat and Casablanca. To help encourage its development, governments can adopt policies that support or directly provide for the planning, construction, and operation of public transport infrastructure. There is a widening array of public transport modalities and business models that can be financed and built at relatively low costs (IEA, 2014g). Enabling environments should be designed to increase the overall energy efficiency of national, regional and local transport systems and promote shifts of passengers and freight to more efficient modes. To achieve these objectives, governments can adopt transport policies that ensure:

- users pay the economic, environmental and energy security-related costs of the transport system;
- transport infrastructure is built and maintained to support the most energy efficient, economically efficient and environmentally benign modes;
- urban and commercial development planning takes into account the likely implications for transport and energy demand; and
- adoption of electric vehicles (EVs) is supported by removing EV vehicle taxes, providing financial subsidies or, alternatively, increasing tax on fuel for conventional vehicles.[32]

Concluding remarks on energy efficiency

As noted at the outset of this section and in an earlier part of this paper, the opportunities for enhanced energy efficiency in both the **SEMED** and **ETC regions** is immense and the potential benefits considerable. The **ETC region** remains highly energy-intensive, reflecting continuing inefficiencies in energy use in all sectors and consumer behaviour, as well as climatic and structural economic factors, and the implications of the power infrastructure inherited from the Soviet era. There is considerable potential for energy savings in all sectors in the **ETC region**, particularly in district heating, electricity generation and networks, industry and buildings. In **SEMED countries**, further attention could be given to the transport, buildings and lighting sectors, particularly for vehicle efficiency and fuel efficiency standards, with transport being the largest energy-consuming sector in the wider MENA region.

Barriers to the achievement of enhanced energy efficiency in both regions include lack of dedicated agencies to co-ordinate end-use data collection and in turn, lack of specific energy efficiency targets and ability to monitor progress. Of the fifteen countries examined, the majority have national energy efficiency targets of some sort although these vary in ambition and there are still some without any targets at all (**Jordan, Georgia, Mongolia** and **Turkmenistan**). Of the countries with targets, many do not necessarily have comprehensive strategies in place to achieve their aims, with some having implemented overarching legislation without detailed secondary legislation (e.g., **Tajikistan**). **Morocco** (SEMED) and **Kazakhstan** (ETC) emerge as a regional leaders, with ambitious targets linked to comprehensive strategies. Concerning

[32] The Global Fuel Economy Initiative (GFEI), which emerged in 2009 through partnership between the Fédération Internationale de l'Automobile (FIA) Foundation, the IEA, the International Transport Forum and UNEP, has set a goal to make all light-duty vehicles (LDVs) worldwide 50% more fuel efficient than in 2005 by 2050. GFEI acknowledges fuel taxation as an important signal that governments can send consumers to support increasing EE standards in the transport sector

institutional arrangements, **Tunisia**, **Morocco** and **Moldova** are notable for the existence of a dedicated institution for energy efficiency (and in some cases also for RE), while in most other countries, responsibility for EE, as well as the necessary data collection and analysis, rests predominantly with an overarching ministry, which can impact the effectiveness of meeting targets.

An important enabling factor that could help improve energy efficiency in all countries is energy price reforms. In both the **SEMED** and **ETC regions**, transport fuel, heating and electricity remain subsidised. As these subsidies are lifted (which is progressively occurring in countries such as **Morocco**, **Tajikistan** and **Moldova**), price signals should result in a behavioural response, which will enhance the efficacy of EE policies and programmes.

The above analysis has set out a proposed suite of measures to support energy efficiency improvements but the realities of national circumstances in most of the countries in the target regions would suggest a prioritised approach to developing national energy efficiency policy. Drawing on a range of IEA and other analyses, Table 5 provides suggestions as to target areas for EE policy action in **SEMED** and **ETC regions** in the near term, appreciating of course the degree of applicability will vary from country to country.

Table 5 • Suggested priority areas for energy efficiency policy action in ETC and SEMED regions

Sector	Action
Cross-cutting	
1	Ensure a well-equipped institutional mechanism for collating national energy efficiency data
2	Establish a robust, comprehensive national energy efficiency action plan or strategy
3	Establish and resource an independent energy efficiency agency, and focus on timely and effective implementation of policies
4	Promote funding and incentive mechanisms
5	Raise public awareness on EE gains and the real cost of electricity
6	Progressively remove energy price subsidies
Buildings	
7	Improve the energy efficiency of existing buildings through a detailed timeline for retrofits/renovations, MEPS and incentives to encourage investments in the building envelope
8	Implement building codes and building energy certification schemes for new and existing buildings
9	Modernise district heating (ETC) and cooling (SEMED) systems
Industry	
10	Introduce EnMS (mandatory energy audits and energy management protocols) for industry, including dedicated, adapted programmes for improving energy efficiency in SMEs
11	Require MEPS for industrial equipment and introduce incentives and labelling systems to foster market development of EE technologies
Transport	
12	Clarify ministry/agency with responsibility for transport sector efficiency
13	Implement vehicle efficiency standards for new and second-hand vehicles
14	Develop labelling, tax and incentive measures to boost the market for energy efficient vehicle technologies
15	Improve public transportation systems
Lighting and Appliances	
16	Establish MEPS for major consuming appliances and equipment
17	Establish a national appliance labelling system supported by a compliance system

18	Phase out energy in-efficient light bulbs
19	Roll out efficient street lighting (SEMED)

Conclusion

In spite of the many benefits that can accrue from enhanced deployment of RE&EET, in many instances, their potential remains unrealised and policy intervention will be necessary for maximising the possibilities for deployment.

With regard to renewable energy, this paper has highlighted that in recent years, the **SEMED countries** have made considerable strides. In future, it would be valuable for these countries to continue to augment and adapt their national RE policy support portfolios and to ensure consistent enabling conditions, such as by removing fiscal support measures for fossil fuels. In the **ETC region**, the renewable energy market remains largely nascent, despite considerable resources in a number of countries, and will require further government effort to remove a range of barriers, such as subsidised fuel prices, the absence of secondary supporting legislation and outdated power infrastructure. Target actions could include the development of national RE strategies with quantitative targets, measures to foster fair market and grid access and predictable remuneration for renewable generators, minimising contradictory support policies for fossil fuels, and modernising network and transmission systems to allow for grid integration of renewables.

Barriers to the achievement of enhanced energy efficiency in both regions include lack of dedicated agencies to coordinate end-use data collection and in turn, lack of specific energy efficiency targets and ability to monitor progress. In the **ETC region**, there is considerable potential for energy savings in all sectors, particularly in district heating, electricity generation and networks, and buildings. In **SEMED**, further attention could be given to the transport, buildings and lighting sectors. In both regions, a logical starting point within industry may be SMEs given the high proportion of industry in both regions that comprise this category of company.

While national circumstances will determine the right policy mix, experience suggests that the specific policy measures set out in this paper can be highly effective if implemented and supported correctly. The paper also points to the fact that while sound RE&EE policy design is crucial, there is also a need for a wider enabling framework and for RE&EE policies to be situated within wider national and economic objectives.

Bearing in mind that it is not likely to be possible for countries within **SEMED** and **ETC** to roll out multiple sub-sectoral policies simultaneously, the steps in Figure 40 are suggested for possible action in the near term. The recommended steps commence with a focus on data, given the need for enhanced data collection efforts in all countries under study.

In closing, it is worth noting that considerable opportunities exist for regional and international cooperation to support RE&EET development and deployment. Such collaboration can provide an opportunity for sharing knowledge and capacity and for enhancing access to investment/financing for clean energy. A range of collaboration options are summarised in Table 6.

Figure 40 • Recommended steps for near term action

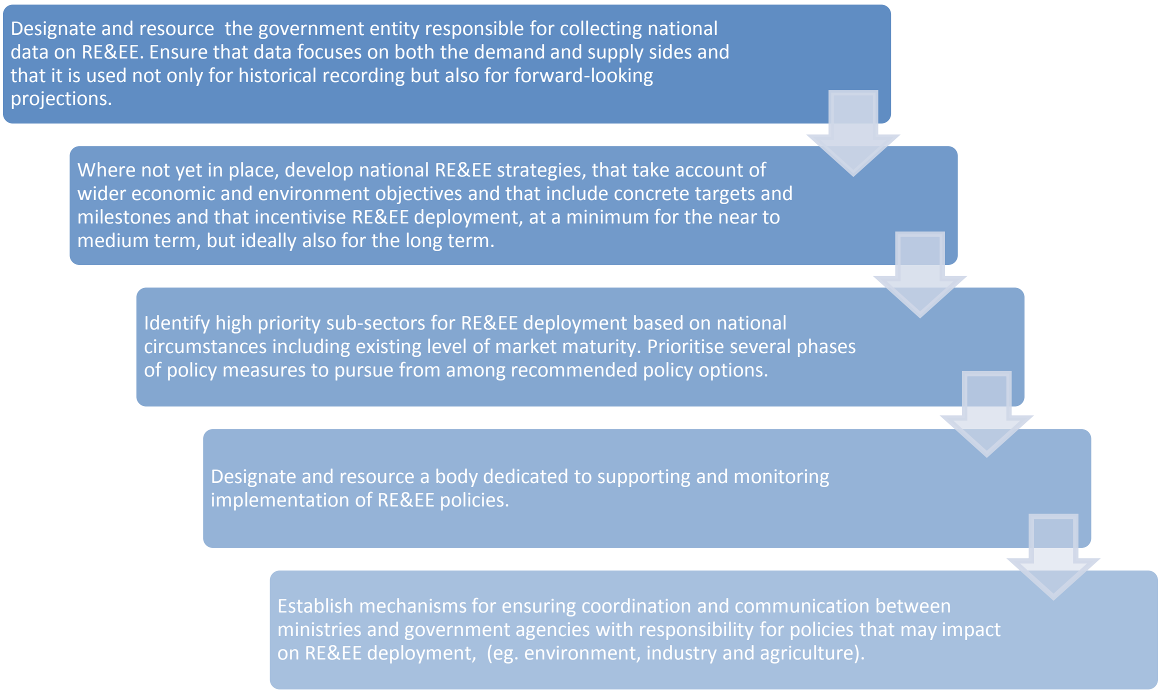

Table 6 • Opportunities for regional collaboration on low-carbon energy technologies in the SEMED and ETC regions

	Membership			Scope		Activity				
	Regional		Global	Energy Efficiency	Renewable Energy	Capacity Building	Policy dialogue	Analysis	Implementation	Provides finance
	SEMED	ETC								
Regional Center for Renewable Energy and Energy Efficiency (RCREEE)	✓			✓	✓	✓	✓			
UN Economic and Social Commission for Western Asia (UNESCWA)	✓					✓	✓		✓	
League of Arab States (LAS)	✓			✓	✓	✓	✓	✓		
Union for the Mediterranean (UfM)	✓			✓	✓	✓	✓			
United Nations Economic Commission for Europe (ECE)	✓			✓	✓	✓	✓			
European Bank of Reconstruction and Development (EBRD)	✓	✓		✓	✓	✓	✓	✓	✓	✓
The Eurasian Development Bank (EDB)		✓						✓		✓
The Eastern Partnership		✓		✓	✓		✓			
The Baku Initiative		✓		✓	✓		✓			
The United Nations Industrial Development Organisation (UNIDO) and the Dubai Supreme Council of Energy (DSCE)		✓		✓	✓	✓	✓			
European Investment Bank (EIB)	✓	✓		✓	✓					✓
Central Asia Sustainable Energy Programme (CASEP)		✓		✓	✓	✓	✓			✓
UNFCCC			✓	✓	✓	✓	✓	✓		
IEA			✓	✓	✓	✓	✓	✓		
IRENA			✓		✓	✓	✓	✓		

Source: IEA (2014h), *Mapping Multilateral Collaboration on Low-Carbon Energy Technologies*, OECD/IEA, Paris; IEA (2011), *Deploying Renewables: Best and Future Policy Practice, Renewable Energy Markets & Policies Series*, OECD/IEA, Paris.

Annex 1: Policy framework checklist

Building on the enabling environment section of this paper (rather than on the specific RE&EE policy recommendations that follow in the subsequent two sections), the below checklist is designed to assist those interested in assessing the domestic policy landscape of a country and the degree to which its policy framework and institutions may support an environment for deployment of RE and EET. It is particularly designed with developing countries in mind. The questions in the checklist are broadly clustered around the same categories as those identified as enabling elements (and inversely as potential barriers) for RE&EET deployment.

Assessment may have a focus on the following elements:

- adequacy of the policy tools applied to the national circumstances;
- national priority areas and sectors for low-carbon energy;
- links to sustainable development and other development goals; and
- level of reporting/comprehensiveness of the results of policy measures.

Table 7 • Policy framework checklist

Category	Indicators
Technical, infrastructure and innovation	• What is the present ability of the national transmission and distribution grids to incorporate RE? Does the country/region have specific plans or targets for modernising its grids, integrating renewables to the grid, deploying electric vehicles (EVs), etc.? • Does the country/region have technology roadmaps for RE or EE deployment or for its electricity grids (e.g. for generation, transmission, distribution)? • Is energy demand in the country increasing, decreasing or remaining stable? • What are the country's support mechanisms for innovators or entrepreneurs?
Financial and economic	• What near- and long-term investments are planned for the energy sector? • How are RE/EE projects funded? Is there sustained financial support (e.g. a "revolving fund") or single-project financers? • What are the RE/EET projects currently underway? Can they be scaled up or replicated? • What is the current and projected future electricity generation mix? • What are the dominant local energy resources? • How is the electricity system operated and how are the roles for operation distinguished (e.g. between the transmission system operator versus distribution system operator)? • How well does country's local market structure facilitate off-grid or small-scale development of projects? • What are the priority sectors for EE roll-out programmes (e.g. those consuming the most energy)? • What type of support (financial, technical or logistical) for RE/EE projects is provided by out-of-country sources? • What trends are having/likely to have an impact on the electricity market in the project implementation timeframe (e.g. demand growth, supply deficit, ageing infrastructure, public sector investment or electricity sector restructuring)?
Public policy	• What is the level of residential energy access? • What are the key socio-economic priorities that might be supported by the deployment of RE and EE? • How do RE/EET projects support national priorities (e.g. job creation, domestic energy supply, improved resource management)? • How are the Millennium Development Goals being addressed by the country and how can RE/EET projects be integrated to support such international goals (note likely to change to Sustainable Development Goals later in 2015)? • Is there a coherent energy strategy? Are all relevant government ministries or agencies involved? • Do national energy strategies and actions plans support further deployment of RE and EE? • Does the country/region aim at higher shares of RE in the electricity mix? Does a dedicated

	policy framework and target exist? • Does the country /region aim at EE gains? Does a dedicated policy framework or sectoral targets (e.g. for the residential sector) exist? • Do national EE standards (e.g. transport/vehicle fuel standards; appliance standards; EE building codes) exist? • Does the country/region have industrial policy goals for given technologies? • What local policies exist specifically to spur off-grid activity? • Does the country subsidise energy (i.e. fossil fuels)?
Social	• What is the level of stakeholder engagement in RE/EET policy planning? • Is public consultation a required part of RE/EE project development? • Are there programmes in place for raising awareness of RE&EE possibilities? • What are the strengths of the existing workforce in the country/region and how can these strengths be harnessed to support RE&EET deployment?
Regulatory and institutional	• Is there a national regulatory agency to support EE? • Is there a national regulatory agency to support RE? • Have adequate personnel resources proportionate to the scale of national/regional ambition been allocated within the key bodies to implement relevant policies and regulations? • Does technical capacity exist in the country/region to roll out EE programmes? • Does a national statistical body collect data on RE and EE? • Are regulatory permitting procedures for RE and EE projects well understood and executed? • Are there government-supported financial incentives in place to support the uptake of RE/EET? • What are the country's mechanisms for reporting and evaluating the effectiveness of an energy project? • Have national business plans and clean energy value chains been developed?
Environmental	• Does the country/region have low-carbon emission/CO_2 reduction targets? • Has the country conducted a national GHG inventory? • Do existing policies or targets for RE/EE support other policies for resource management (e.g. water and agriculture policies)? • Has a cost-benefit analysis been conducted to factor in cross-sector benefits of RE/EET deployment (e.g. improved air quality, efficient water use, rural access to off-grid RE)? • Have policy makers assessed the benefits of an integrative policy framework for resource management?

Annex 2: Barriers to RE and EE and possible responses

	Barrier to RE/EE	Response
Technical, infrastructure and innovation factors	Lack of affordable or suitable EE technologies	Industry formation
	Measuring savings	
	Capacity to identifying and implementing EE projects	Creating EE delivery agencies
	Lack of skilled personnel	Education and training
	Project performance risk	
	Intermittency of some RE sources	Facilitate cross-border trade in electricity
	Low capacity for manufacturing, servicing or testing energy efficient products	Establish energy data collection capacity
	Inflexibility of energy system to integrate/absorb RE technologies	
	Weak power grids and insufficient grid connections	Require grid companies to guarantee the purchase of a minimum amount of energy from RE, and prioritise grid expansion as a priority area of action
Financial and economic	Perceived risk	Public sector procurement
		Guarantee facilities
	Transaction costs	Audit requirements
		Project preparation facilities
	Low capacity within the financial sector	
	Lending terms (period, interest rate, collateral requirements)	
	Access to financing	Revolving funds
		Public-private partnerships
	High upfront capital costs	Conditions to establish industry confidence in reasonable return
	Investment uncertainty due to financing the deployment of RE technologies is politically embedded in the public budget	Support systems that are not financed from the public budget (e.g. FITs and certificate systems) increase regulatory certainty.
	Import duties on clean energy equipment	
	Energy price subsidies	Progressively reduce energy price subsidies
	Agency problems, when benefits are split amongst several parties (e.g., renter-occupied housing), reducing the motivation to act	Mandatory standards for technologies to be used
	Project size	
	Failure of costing methods to include social and environmental costs	Stable and long-term signals that reward low-carbon generation appropriately
		Rewarding the energy security benefits that renewables bring by decoupling costs from fossil fuel prices
		Level the playing field for independent power producers (IPPs) and state-owned enterprises (SOEs) in order to tackle market rigidities that favour fossil-fuel incumbency in the electricity sector.
Social	Lack of awareness	Appliance labelling
	Asymmetrical information	Information-sharing
	Consumer indifference	Awareness and education campaigns

	Adverse effects from the removal of fossil-fuel subsidies	Targeted redistribution programmes, such as social safety nets, cash transfers, and life-line subsidies for the poor
Regulatory and institutional	Energy tariffs that discourage EE investment	
	Institutional bias	Ensuring supportive rather than conservative institutions are in place
	Split-incentives	
	Complicated, slow or non-transparent permitting procedures	Streamlining administrative procedures
Environmental	Unintended negative impacts of energy goals	Environmental sub-sectors should not only be consulted when determining goals, but should also be included in implementation planning

Source: IEA (2013c); IEA (2011a); OECD (2014); IEA (2014m).

Annex 3: Main targets and support policies for liquid biofuels

<table>
<tr><th>Targets and quotas</th><th>Support scheme</th><th>Other support/ specific requirements</th></tr>
<tr>
<td>Regulatory frameworks:
• European Union Renewable Energy Directive (RED): 10% renewable energy in transport by 2020
• US RFS2: blending mandates for different categories of biofuels
• Canada: Federal renewable fuel standards; blending mandates for biofuels
• Moldova: target for 10% of transport fuelled by biofuels by 2030 under the National Energy Strategy</td>
<td>Tax incentives on retail sales of ethanol:
Argentina, Australia, Austria, Bulgaria, Czech Republic, Denmark, France, Germany (only ethanol exceeding quota and E85), Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Romania, Slovakia, Slovenia, Spain, Sweden, Japan, Korea, New Zealand, Thailand, United States (eight states).</td>
<td>Sustainability requirements for biofuels:
European Union: all biofuels used to meet RED 2020 target need to be certified for compliance with sustainability criteria defined in the RED.
Switzerland: tax exemptions for renewable fuels meeting environmental and social standards.
US: specific life-cycle emissions reduction standards under RFS2.</td>
</tr>
<tr>
<td>Biofuel mandates and targets for key producers:
<table>
<tr><th>Country</th><th>Biodiesel</th><th>Ethanol</th></tr>
<tr><td>Argentina</td><td>10%</td><td>5%</td></tr>
<tr><td>Brazil</td><td>6% (7% in 2015)</td><td>18-25%</td></tr>
<tr><td>China*</td><td>-</td><td>10%</td></tr>
<tr><td>Canada**</td><td>2%</td><td>5-8.5%</td></tr>
<tr><td>Indonesia</td><td>10%</td><td>3%</td></tr>
<tr><td>Thailand</td><td>7%</td><td>-</td></tr>
<tr><td>Colombia</td><td>10%</td><td>8-10%</td></tr>
<tr><td>India</td><td>5%</td><td>-</td></tr>
<tr><td>Australia*</td><td>2%</td><td>5%</td></tr>
<tr><td>Philippines</td><td>5%</td><td>10%</td></tr>
<tr><td>United States</td><td colspan="2">36 billion gallons of biofuels by 2022</td></tr>
<tr><td>European Union</td><td colspan="2">10% renewable energy in transport by 2020</td></tr>
</table>
</td>
<td>Tax incentives on retail sales of biodiesel:
Argentina, Australia, Canada (Quebec, Nova Scotia), Austria, Belgium, Bulgaria, Czech Republic (different exemptions for 5% and higher-than-31% blends), Denmark, France, Germany, Hungary, Ireland, Italy, Latvia, Lithuania, Poland, Romania, Slovakia (limited to 5% blends), Slovenia (limited to 5% blends), Spain, Sweden, Japan (B100), Korea, New Zealand, Thailand, United States (six states).</td>
<td>Incentives for infrastructure development:
Some European Union member states have grant programmes for biofuels distribution infrastructure.
A number of US states provide incentives for new biofuel infrastructure.
Sweden: large retail stations must sell fuel from renewable sources.
Thailand: retail stations selling E20 receive financial premium.</td>
</tr>
<tr>
<td></td>
<td>Tax credits:
US: tax credit for cellulosic ethanol and other qualifying advanced biofuels.</td>
<td>RD&D programmes:
European Union: funding available through Seventh Framework Programme, NER 300, Horizon 2020.
A number of countries provide research, development and demonstration (RD&D) funds to support the development of new biofuels, as well as feedstock and supply chains.</td>
</tr>
<tr>
<td></td>
<td>Production-linked payments:
Canada.</td>
<td></td>
</tr>
</table>

Note: *in some provinces; **federal: 5% ethanol, 2% biodiesel; up to 8.5% ethanol in some provinces. E85 = blend of 85% ethanol and 15% gasoline; B100 = pure biodiesel; RFS2 = Renewable Fuels Standard 2. For further information, refer to IEA Policies and Measures Database: www.iea.org/policiesandmeasures/renewableenergy.

Source: IEA analysis; Bahar, H., J. Egeland and R. Steenblik (2013), "Domestic incentive measures for renewable energy with possible trade implications", OECD Trade and Environment Paper No. 2013/01, OECD Publishing, Paris.

Acronyms, abbreviations and units of measure

Acronyms and abbreviations

2DS	*Energy Technology Platform* 2°Celsius Scenario
6DS	*Energy Technology Platform* 6°Celsius Scenario
ADEREE	Agency for Development of Renewable Energy and Energy Efficiency of Morocco
ANME	National Agency for Energy Conservation of Tunisia
BAT	Best available technology
BEC	Building efficiency code
BEFS	FAO Bioenergy and Food Security Approach
BTL	Biomass-to-liquids
CFL	Compact fluorescent light
CO_2	Carbon dioxide
CfDs	Contracts for Difference
DHC	District heating and cooling
DSCE	Dubai Supreme Council of Energy
EBRD	European Bank for Reconstruction and Development
EEPR	Energy efficiency policy recommendations
EEMR	*Energy Efficiency Market Report*
EDB	Eurasian Development Bank
EnMP	Energy management programme
EnMS	Energy management system
ESCO	Energy service companies
ETC	Early transition countries
ETS	Emission trading scheme
EU	European Union
EV	Electric vehicles
FFV	Flex-fuel vehicle
FINTECC	Finance and Technology Transfer Centre for Climate Change (EBRD)
FIT	Feed-in-tariff
FAO	Food and Agriculture Organization
GDP	Gross domestic product
GEF	Global Environment Facility
GFEI	Global Fuel Economy Initiative
GIZ	German Federal Enterprise for International Co-operation
GHG	Greenhouse gas
HERS	Home Energy Rating System Index
HVO	Hydro-treated vegetable oil
HVAC	Heating, ventilating and cooling

IEA	International Energy Agency
INOGATE	EU funded energy cooperation programme for countries in Eastern Europe, Caucasus and Central Asia
IRENA	International Renewable Energy Agency
IRESEN	Institute for Research in Solar and New Energies of Morocco
JREEEF	Jordan Renewable Energy and Energy Efficiency Fund
LAS	League of Arab States
LCOE	Levelised cost of electricity
LDV	Light-duty vehicle
MASEN	Moroccan Agency for Solar Energy
MENA	Middle East and North Africa
MEPS	Minimum energy performance standards
MTRMR	*Medium-Term Renewable Market Report* of the IEA
LED	Light emitting diode
NREA	New and Renewable Energy Agency of Egypt
OECD	Organisation for Economic Cooperation and Development
PPA	Power purchasing agreement
RCREEE	Renewable Energy and Energy Efficiency
RED	European Union Renewable Energy Directive
R&D	Research and development
RD&D	Research, development and deployment
RE&EET	Energy efficiency and renewable energy technologies
RETD	Renewable energy technology deployment
RPS	Renewable portfolio standards
SE4All	Sustainable Energy For All
SEMED	Southern and Eastern Mediterranean
SME	Small and medium sized enterprises
SWH	Solar water heaters
TGC	Tradable green certificate
TPES	Total primary energy supply
UNECE	United Nations Economic Commission for Europe
UNIDO	United Nations Industrial Development Organisation
UNESCWA	UN Economic and Social Commission for Western Asia
VRE	Variable renewable energy
WACC	Weighted average cost of capital

Units of measure

BCM	Billion cubic metres
EJ	Exajoule
Gt	Gigatonne
Gtoe	Gigatonne of oil-equivalent
GW	Gigawatt
kW	Kilowatt
ktoe	Kilotonne of oil equivalent
Lumen	unit of luminous flux
TWh	Terawatt hours
Mtoe	Megatonne of oil equivalent

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