ENERGY EFFICIENCY STRATEGIES FOR LOW CARBON DEVELOPMENT AFTER THE 2015 PARIS AGREEMENT

INTERNATIONAL DEVELOPMENT RESEARCH CENTRE

Final Technical Report

March 31, 2017

ECONOLER

In partnership with:

REEEP

ABBREVIATIONS

CARIAA	Collaborative Adaptation Research Initiative in Africa and Asia Program
CPI	Corruption Perception Index
ECCC	Environment and Climate Change Canada
EE	Energy Efficiency
EF	Emission Factor
ESMAP	Energy Sector Management Assistance Program
GAC	Global Affairs Canada
GHG	Greenhouse Gas
HDI	Human Development Index
IBRD	International Bank for Reconstruction and Development
IDRC	International Development Research Center
IEA	International Energy Agency
IFI	International financial institutions
IPCC	Intergovernmental Panel on Climate Change
IPEEC	International Partnership for Energy Efficiency Cooperation
NDC	Intended Nationally Determined Contribution
NRCAN	Natural Resources Canada
REEEP	Renewable Energy and Energy Efficiency Partnership
RISE	Regulatory Indicators for Sustainable Energy
UN	United Nations

TABLE OF CONTENTS

LIST OF TABLES

INTRODUCTION

This final report is part of the tasks carried out in the initial study *Energy Efficiency Strategies for sustainable Development after the 2015 Paris Agreement*. This report describes the outcomes of the work completed by Econoler in this assignment, which started with the signing of the Grant Agreement No. 108278-002 at the end of July 2017 and completed with the submission of this Final Report at the end of March 2017.

This project was completed in partnership with the Renewable Energy and Energy Efficiency Partnership (REEEP) and with funding support from the climate change program at the Canada's International Development Research Centre (IDRC). This project was undertaken to examine how energy efficiency (EE) can play a major role in helping developing countries reduce their greenhouse gas (GHG) emissions and achieve broader development goals.

The overall aim of this research project was to demonstrate to the Canadian government and the governments of the identified countries the value of EE as a promising approach to achieving short-term mitigation goals in line with the Paris Agreement.

The specific objectives were to:

- Inform Canada's decision-makers about EE's strategic contribution to the COP21 objectives and the commitments needed in support of developing countries in developing the most effective approaches to mitigating climate change in the short and medium terms;
- Identify up to ten developing countries to be targeted by such support, by assessing their technical potential, cost-effectiveness, political and institutional situations that could favor the best leverage of EE and enable the highest GHG reductions per dollar invested;
- Identify the most attractive priorities on which to deploy such efforts in each of these countries in terms of sectors (residential, commercial, industrial or institutional) and/or potential technologies (lighting, motors, etc.).

The expected project outputs included:

- At least 4 meetings with Canada's decision-makers;
- At least 2 presentations at international organisations (World Bank, IEA);
- Publication of 1 feature articles in targeted publications;
- Position paper on the opportunity to use EE to achieve Canada's short and medium-term goals established at COP21 in relation to support mitigation actions in developing countries.

This Final Report summarizes the results of the five main project activities conducted, namely the inception phase, the selection of high-impact countries with high potential for EE, the data-gathering about the selected countries, the final position paper for communication purposes, and the dissemination activities.

1 ACTIVITY 1 – INCEPTION PHASE

The inception phase was conducted from August through October 2016 and consisted of a desk review to gather relevant data on EE, namely GHG mitigation potential, the impacts and benefits of EE, especially concerning economic development, the various strategies and best practices for implementing EE. Up-to-date and relevant data was gathered from internationally recognized organizations and international financial institutions, such as the International Energy Agency (IEA), the Intergovernmental Panel on Climate Change (IPCC), the World Bank, the United Nations (UN), the International Bank for Reconstruction and Development (IBRD) and the International Partnership for Energy Efficiency Cooperation (IPEEC), among others.

This review confirmed that EE is recognized as a cost-effective strategy for climate change mitigation. According to the IEA, "realising the economic potential of EE is a central pillar of a cost-effective strategy to mitigate climate change and achieve a peak in global GHG emissions by 2020".[1] In summary, EE has the capacity to reduce global energy demand, cut global emissions by half in the following decades, while contributing to growth in the global economy. The World Bank identified EE as the area of intervention with the greatest potential to achieve overlap between GHG mitigation and local development. There is large untapped potential for EE and such potential also exists in developing countries. Indeed, IPEEC calls for international climate funds to "finance capacity building activities directed towards the creation and strengthening of an enabling environment to catalyse EE investments in eligible countries, namely emerging economies and developing nations."[2]

The data collected was synthesized and presented as part of the First Technical Progress Report in October 2016. This review helped provide a better understanding of EE's value as one of the best approaches to achieving short-term goals in line with the Paris Agreement.

[1] IEA. (2015*). Energy and Climate Change: World Energy Outlook Special Report 2015*. p. 388.
[2] IPEEC (2016), Working Paper.

2 ACTIVITY 2 – COUNTRY SELECTION

The Paris Agreement requires developed countries to support developing countries through financial and technical assistance. EE strategies are among the possibilities to be leveraged with such international support to enable countries to achieve their mitigation goals as well as the transformative, long-lasting institutional changes necessary to create favourable contexts for EE implementation. In this perspective, the second activity of this study served to identify countries where high potential exists for EE. This activity was conducted from August through December 2016.

The criteria for selecting the developing countries where it will be possible to scale up EE were identified based on the following major considerations: (1) where such actions would be the most effective in helping reduce GHG emissions; (2) where the co-benefits will have the biggest impacts on the overall development; and (3) where Canada could play an important role by fulfilling its commitments following the Paris Agreement.

Econoler developed a methodology for selecting high-impact countries where EE can achieve the greatest impact on both economic development and climate mitigation and where the political situation allows for the best leverage of EE per dollar invested. A first selection methodology was presented in the First Technical Progress Report in October 2016 and to stakeholders in the Canadian government (See Section 5.1). The selection methodology was later reviewed and modified. The final selection methodology was presented in the Final Position Paper submitted in March 2017. The approach involved assessing the candidate countries against this final set of criteria and associated indicators:

- Development level
  - World Bank Income Level
  - Human Development Index (HDI)
- Technical criteria
  - Total GHG Emissions
  - Electric Energy Consumption
  - Electricity Production Emissions Factor (EF)
  - Total Energy Consumption
- Interest in and commitment to pursuing EE at the national level
  - Top country leaders of the International EE Scoreboard
  - Nationally Determined Contribution
- Political stability and corruption level
  - Current Sanctions imposed by Canada
  - Corruption Perceptions Index (CPI)

The countries identified as having significant potential for EE were shortlisted. A more detailed discussion about different perspectives on Econoler's selection approach is presented in Section 2.1. The remaining 10 potential target countries were ranked according to an empirical equation to determine the magnitude of the potential impact of EE:

$$EE\ Impact\ = \frac{GHG_{Total}{}^{0.5}\ x\ EF_{Elec}{}^{0.5}\ x\ EC_{Total}{}^{1/3}\ x\ EE_{NDC}{}^{3}}{HDI\ x\ 10^{-6}}$$

Where:

- GHG_{Total} = Total GHG Emissions
- EF_{Elec} = Electricity Emission Factor
- EC_{Total} = Total Energy Consumption
- EE_{NDC} = NDC Score
- HDI = Human Development Index

Five countries from the shortlist were selected for additional research, namely Morocco, Vietnam, Senegal, Ghana, and Burkina Faso. Table 1 presents the selected countries ranked according to the empirical equation results and country-specific data for each indicator used in the selection process.

Table 1: Target Countries and Assessment Results

Country	Rank	Income Group	HDI	GHG Emission (ktCO2eq)	Electricity Use (GWh)	Electricity EF (gCO2/kwh)	Energy Use (Mtoe)	CPI	NDC Score	Empirical Result
Morocco	1	Lower-middle	0.628	80,437	28,385	718	19.0	36	10	32
Vietnam	2	Lower-middle	0.666	310,664	115,283	432	55.0	31	7	23
Senegal	3	Low	0.466	54,185	3,079	637	2.2	44	10	16
Ghana	4	Lower-middle	0.579	107,784	10,583	259	4.7	47	10	15
Burkina Faso	5	Low	0.402	43,910	1,037	490	0.6	38	10	10

2.1 Methodology Discussion

2.1.1 Regulatory Indicators for Sustainable Energy Initiatives

In February 2017, the World Bank published a report entitled Regulatory Indicators for Sustainable Energy (RISE) with the support of the Energy Sector Management Assistance Program (ESMAP),[3] a global fund administered by the World Bank. The RISE initiative will enable the World Bank to provide assistance to borrowing countries that wish to establish baselines in accordance with objectives

[3] Banerjee, S.G., Moreno, A., Sinton, J., Primiani, T., & Joonkyung, S. (2017). Regulatory Indicators for Sustainable Energy: A Global Scorecard for Policy Makers. The World Bank. Available at: http://documents.worldbank.org/curated/en/538181487106403375/pdf/112828-REVISED-PUBLIC-RISE-2016-Report.pdf [Last accessed March 3, 2017].

established under the SE4All sustainable energy initiative and the COP21 Paris Agreement. RISE provides sustainable energy national and regulatory framework indicators for the development of each country relative to the three SE4All pillars - renewable energy, energy access, and energy efficiency – thereby providing countries with a point of reference to elaborate their own policies and regulations.

RISE[4] assigns an overall rank from 0 to 100 to each country, as well as rankings for each pillar. The score ranks advanced countries in terms of sustainable energy development from 67 to 100. Average scores range from 34 to 66, while scores from 0 to 33 represent countries with little or no development. Denmark is best ranked (94), while Canada and the United States are tied for second place (91). Mexico (84), China (81) and Turkey (79) are the best ranked among emerging countries. In Africa, the best ranked country is Kenya (63). The lowest-ranked countries are Haiti (11) and Somalia (5).

The strength of the RISE study consists in the in-depth and comprehensive review of 111 countries (developed, emerging, and developing). EE ranks for each country were determined according to 12 performance indicators and 32 sub-indicators, including national EE planning, efforts to reduce GHG emissions, information sharing and existing EE entities, incentives, as well as financing mechanisms and policies. This elaborate methodology provides an excellent picture of the EE situation across the globe. The results, which will be updated every two years, enable tracking EE development over time and assessing the positive and negative impacts of interventions carried out in each country.

RISE identifies the top-performing countries (developing and developed countries) in each region as well as the top ten high-impact countries for each of the three pillars. These high-impact countries are those that have implemented the most in terms of EE so far and are thus currently deploying significant climate change mitigation efforts using EE. However, the RISE methodology was not necessarily developed to identify countries with the greatest potential for EE implementation and GHG emissions reduction. Conversely, the selection methodology developed by Econoler does identify such countries, but also allows selecting countries according to socioeconomic development potential.

2.1.2 Feedback on Econoler's Methodology

Econoler presented its methodology and preliminary results at the World Bank in November 2016 (See Section 5.2.1). At this presentation, Econoler collected relevant feedback regarding the selection methodology. Overall, participants recognized the value of the work conducted by Econoler and the results achieved, especially since the World Bank also identified Morocco and Vietnam as target countries for EE interventions.

Some participants also provided useful comments and inputs concerning other studies being carried out on EE as well as additional elements to be considered in the next phase of this research project.

[4] RISE.worldbank.org

To help identify the best allocation of limited funds to support EE and maximize the impacts of EE interventions, the following suggestions were made:

- Include more upstream consideration of specific sectors (e.g.: buildings, industry);
- Focus on a specific sector and pursue it in a group of countries (or regionally).

However, Econoler opted for an approach without factoring in sectors to identify countries with interesting overall EE potential; this allows considering the specific realities of each country. As part of the second phase of this project, researching successful mechanisms that are not necessarily sector-specific would be more of interest.

Suggestions were made concerning additional or alternative indicators and selection criteria that could be included in the selection methodology:

- EE activities of international financial institutions (IFIs) to leverage additional EE financing from external sources;
- Projected growth in energy use;
- Heat use;
- Readiness to invest in sustainable energy;
- Existing EE policies;
- Barriers;
- Additional indicators to assess interest in pursuing EE, apart from NDCs, such as indicators included in the World Bank Rise report.

To identify high-impact countries in terms of GHG emissions reduction potential, Econoler decided to focus on technical indicators (GHG emissions, total energy and electricity use, and electricity production emission factor). It was then decided to include most suggestions listed above in the initial scoping work and data gathering activities in each country, as these elements were seen more as providing an overview of the EE situation rather than as criteria to determine EE potential (GHG emissions reduction and socioeconomic development).

In terms of country selection, a sensitivity analysis was recommended to Econoler to identify which countries would remain in the top-ten rank. While developing the empirical equation included in the selection methodology presented above, the sensitivity analysis was conducted, which demonstrated that modifying the multiplication factors mostly affected the ranking order among the top-ten countries (and not more). This is also one of the reasons why Econoler decided not to prioritize any of the top-five countries. Also, factoring in electric energy use instead of total energy use did not change the ranking, but mostly amplified the values of the empirical results. Indeed, these two indicators are closely linked since there is a high correlation between them (correlation factor of R=0.97).

Then, recommendations for potential EE research areas for the next stage of this research project included:

- Specific sectors;
- Mechanisms;
- Barriers;
- Drivers;
- Level of risk.

Econoler noted the discussion on potential research areas as it was in line with Econoler's initial scoping work. Indeed, these elements were considered in the data gathering activity to provide an overview of the energy and EE contexts in each of the five countries (see Section 3). Most of the elements above are now being considered for the next phase of this project and included in the objectives of the unsolicited proposal submitted to the IDRC in March 2017 (see Section 6).

Finally, concluding remarks were made on the importance of collaborating and piggybacking on existing IFI EE funding operations and factoring in implementation issues such as energy prices, energy subsidies, government support for EE projects, hurdle rates, as well as transaction costs to establish needed interventions. Indeed, Econoler and participants agreed that much of the effort concerns removing EE barriers.

3 ACTIVITY 3 – GATHERING COUNTRY DATA

This third activity was carried out from December 2016 through February 2017. Data was gathered in collaboration with partners in the five selected countries to (1) cross-check information used in Activity 2, (2) come to definitive conclusions about the rationale for focusing on some countries rather than others according to their potential to generate the biggest impact on carbon emission reduction with the investment to be made, and (3) provide an overview of the energy and EE contexts in each of the five countries. The information gathered was related to the national EE and GHG reduction objectives, past and current EE initiatives, including legislative and regulatory frameworks, financial mechanisms, programs, internationally funded projects, main market players, and barriers and challenges in implementing EE.

The EE country reviews describing the general situation related to EE, the historical background about what has been done in this field, the national EE targets as well as the planned activities to meet these targets were presented in the Final Position Paper submitted in March 2017. The detailed reports for each country can be found in Appendices II through VI of the Final Position Paper. The country partners involved were:

- Burkina Faso: Mr. Bakary Lingani, P. Eng at the Directorate General of Energy Efficiency
- Ghana: Mr. Ishmael Edjekumhene, Director of the Kumasi Institute of Technology and Environment (KITE)
- Morocco: Mr. Mohammed Berdai, Manager of the Alternative Green Energy And Environment Solutions (ALGEES)
- Senegal: Dr. Amadou Ly and Mrs. Ndèye Rokhaya Sarr, respectively Managing Director and Engineer at the Integrated-Negawatt Energy Services SARL (i-NES)
- Vietnam: Dr. Nguyen Anh Tuan, Director of the Institute of Energy

3.1 Key Findings

The five target countries have very different histories of working on EE, with some having achieved much more than others; however, they all plan on seizing a number of opportunities and undertaking EE with clear targets. The following sub-section presents a summary analysis of the five EE country reviews. More information on each country is presented in Section 4.2 of the Final Position Paper.

3.1.1 Common Trends Among Target Countries

All five countries (hereafter referred to as all countries) are characterized by high dependence on fossil fuels for electricity generation (ranging from 50% in Vietnam to 90% in Senegal), fast growing energy demand (as high as 13% per year in Burkina Faso), as well as lack of energy supply reliability and significant transmission and distribution losses (up to 15% in technical losses without accounting for

fraud and illegal connections). Energy production is an important source of GHG emissions in all countries. It is the single most important source of GHG emissions (between 50% and 60%) in Morocco, Senegal and Vietnam, while it is the second to the agriculture sector in Ghana (40%). In this context, all countries understand the value of EE in terms of demand reduction, energy availability and environmental benefits alongside increased energy production. Indeed, all countries plan to seize a number of opportunities and undertake EE with clear targets despite the limited experience in working on EE for some countries.

So far, efficient lighting, standards and labels, energy audits in energy-intensive industries, and national building codes are key interventions which have been identified as low-hanging fruits and are the focus of EE implementation so far. All countries have invested effort toward efficient lighting in various sectors, most commonly in street lighting, institutions and the residential sector. All countries have established or have almost established a building code. In terms of MEPS and labels, common initiatives target appliances and efficient lighting.

Otherwise, capacity building, energy management, training institutions and industries, as well as general public awareness of EE are important elements that have been part of EE initiatives in all countries so far. In terms of focus areas, reducing the energy intensity in the residential and institutional sectors, as well as in main industries, are common themes among the planned initiatives. Although Burkina Faso's industrial sector is not as elaborate and energy intensive as in the other countries, it has still carried out energy audits in six main industrial enterprises (refrigerated slaughterhouses).

Finally, high potential for EE was noted in all countries. The sectors identified with high potential for EE reduction are: industrial (21% on average); institutional (between 13% and 23%); and residential (10% on average). For all countries, there is still potential remaining for efficient lighting mostly in the residential and institutional sectors. The potential in the industrial and institutional sectors lies mostly in targeting inefficient equipment (ventilation and cooling systems, and motors) and controls. Country-specific potential is further discussed in the following section.

3.1.2 Main Differences Between Target Countries

Particularities distinguish the EE context of all five countries. Electricity and energy consumption vary depending on main economic activities. In Burkina Faso, for example, agriculture constitutes a large proportion of the economy (and represents 88% of GHG emissions). As a result, its industrial sector uses only 10% of the country's final energy consumption. Conversely, its institutional, commercial and residential sectors consume more than three quarters of total energy. This figure is similar in Senegal. Morocco and Vietnam have more diversified economies. They have a greater share of energy used by transportation (approximately 25% for both) and industry (40%).

Legislative and regulatory frameworks greatly vary. The three Sub-Saharan countries have no EE law and fewer EE regulatory frameworks in place, except for building codes (in place or currently being

developed). Still, Ghana and Senegal have adopted, since 2008 and 2011 respectively, regulations to foster phasing out old inefficient technologies such as incandescent lamps and appliances, although enforcement remains a challenge. Ghana also adopted standards and labelling for lighting and appliances nearly ten years ago. Conversely, Vietnam has a much more elaborate legislative framework with includes a number of specific circulars to regulate energy use and EE solutions per sector. This also explains why the country has established specific EE targets per sector and among different industrial subsectors (food processing, steel, cement, iron, plastics, transportation, and beverage for example).

The spectrum of financial mechanisms in place to support EE initiatives and implementation also varies from one country to the other. Vietnam has put in place various EE funds for different sectors, but few incentives for EE are available outside of these funds. Morocco also has a fund in addition to a tax for inefficient cars. Otherwise, the financial mechanisms to support EE are quasi-inexistent, which offers potentially interesting opportunities.

Similar to the legislative aspect, Burkina Faso has no financial incentives in place to support EE. However, it stands out from other countries with a number of initiatives presently under development. Though Econoler identified few EE measures in Burkina Faso, the scoping study revealed an impressive number of EE initiatives under development. Additionally, the country's actual proactivity toward EE is highlighted as well in the RISE report where it was identified among the countries with the most complete coverage of all aspects of national EE planning.[5]

On the other hand, Vietnam is now working on more advanced aspects of EE such as monitoring, project evaluation, and the certification of energy auditors. Morocco also has a law in place on the normalization, certification and accreditation of control laboratories. In terms of more bold initiatives, Morocco has established a training institute for renewable energies and EE to increase the capacity of professionals with the support of international funding.

Overall, each country varies in terms of what has been done in EE in specific sectors (residential, commercial, industrial or institutional) and/or types of initiatives (legislation, financial mechanisms, targets, etc.). Each country also varies in terms of EE gains to be made. This explains the variety of priorities for which to deploy future efforts by sector and potential technologies. The following table presents a summary of the GHG and EE targets in all five target countries.

[5] Banerjee, S.G., Moreno, A., Sinton, J., Primiani, T., & Joonkyung, S. (2017). Regulatory Indicators for Sustainable Energy: A Global Scorecard for Policy Makers. The World Bank. p. 100. Available at: http://documents.worldbank.org/curated/en/538181487106403375/pdf/112828-REVISED-PUBLIC-RISE-2016-Report.pdf [Last accessed March 3, 2017].

Table 2: Summary of Targets in High-impact Countries

Country	Unconditional NDC GHG Target	Conditional NDC GHG Target	Total GHG Target[6]	NDC EE Target[7]	National EE Target
Burkina Faso	0.5%	2.1%	2.6%	21% in residential and tertiary sectors; Gain of 50 Kwh/m^2 in housing.	50% reduction in primary energy intensity to 50 kToe/USD.
Ghana	15%	30%	45%	Double EE in power plants and industrial enterprises.	Lower average electricity intensity (residential and commercial sectors) from 2-2.4:1 to 1.5:1 by 2020.
Morocco	17%	25%	42%	Reduce energy consumption in buildings, the industrial sector and transport by 12% by 2020 and 15% by 2030.	Increase national EE by 12% by 2020 and 15% by 2030.
Senegal	5%	16%	21%	Improve EE in the industrial sector by 5 to 15%.	40% reduction in peak energy demand by 2030.
Vietnam	8%	25%	33%	Qualitative energy efficiency targets.	Reduce 5% - 8% of total energy consumption in the period of 2012 – 2015 compared to BAU. *(objective met)*

The level of donor support is another element which varies for all countries. Some countries have benefitted from a higher number of internationally funded projects (such as Vietnam and Morocco), which reflects the greater number of EE measures that have been implemented so far in these areas compared to Ghana, Senegal and Burkina Faso. Detailed tables of past and current international support for each country are listed in Section 4.2 of the Final Position Paper.

Overall, the results from Activities 1 through 3 were not only the discussion of the benefits of EE in these target countries but also the explanation of the reasons why it would be the best investment to focus on these countries first in order to achieve the COP21 2020 goal related to GHG emission reductions. The potential contribution in these countries can materialize by addressing the specific market barriers found in each country, and including technical assistance into the assessment of successes and best practices related to implementing EE in developing countries. Such research work will be part of Phase 2 of this initial study and is presented in Section 6 of this Final Report.

[6] Compared to BAU by 2030.
[7] Compared to BAU by 2030.

4 ACTIVITY 4 – FINAL REPORT

As part of Activity 4, a final position paper was prepared for communication purposes to present the results of the three specific project objectives (see the Introduction Section). Based on the First Technical Paper (which was first submitted in October 2016), the Final Position Paper was submitted to the IDRC on March 31, 2017.

Section 1 of the Final Position Paper briefly describes the context in which this study is being conducted. Section **Erreur ! Source du renvoi introuvable.** presents the rationale for focusing major efforts on the use of EE as a strategic mechanism to meet COP21 objectives and the NDC commitments to supporting the development of countries by using the most effective approaches to mitigate climate change in the short and medium terms. Section **Erreur ! Source du renvoi introuvable.** addresses the second objective, describes the methodology and key indicators used to select the target countries, and describes the five target countries identified as high-impact countries for EE. Finally, Section **Erreur ! Source du renvoi introuvable.** presents an overview of the various sectors for EE implementation in developing countries, the five target countries' EE context and the priority EE activities for each of these countries.

Erreur ! Source du renvoi introuvable. in the Final Position Paper lists the detailed country data used in the selection process. The detailed reports for each country can be found in Appendices II through VI of the same report.

5 ACTIVITY 5 – DISSEMINATION

Various dissemination activities were conducted at different stages of this project to gather input needed to develop the approach to be adopted for Activity 2 and to communicate the results of the work conducted by Econoler for this project.

In line with the project proposal submitted to IDRC, the dissemination was done through:

- Multiple direct meetings with Canada's decision-makers;
- Presentations at the international level through communications directed at decision-makers at funding organizations and influential institutions;
- Feature articles in targeted publications to reach out to decision-makers in Canada and southern countries
- Final position paper to be shared among various stakeholders and decision makers.

5.1 Meetings with Canada's Decision-makers

5.1.1 Presentation at IDRC

A first contact with Canadian decision-makers was made by Mr. Pierre Langlois and Ms. Myriam Leblanc. A presentation was made by Mr. Langlois at the IDRC office in Ottawa on October 26, 2016. The presentation was co-hosted by Mr. Dany Drouin, Director of the Environment and Climate Change Canada (ECCC) and Mr. Bernard Cantin, Program Leader of the Collaborative Adaptation Research Initiative in Africa and Asia Program (CARIAA) at IDRC.

There were 17 attendees at this presentation from different Canadian organizations, namely Natural Resources Canada (NRCAN), ECCC, and IDRC.

The presentation mainly covered Activity 1 and the first selection methodology proposed in Activity 2. A first list of 20 potential target countries was presented so as to gather inputs and perspectives to help modify and develop the final country selection methodology.

5.1.2 Meeting with Canadian Decision-makers

Several meetings with Canadian decision-makers were held on February 22 and 23, 2017 in Ottawa to share the early findings from this project and hold in-depth discussions more with representatives of NRCAN, ECCC, and Global Affairs Canada (GAC).

- A presentation was made to over 10 experts from NRCAN to present the project and its results. Exchanges were made on the methodology used to identify the countries and the different approaches that could be used to achieve the EE potential in the targeted countries.

- A presentation was made to the GAC officers in charge of the identified targeted countries as well as experts in the environmental fields. A strong interest was shown on the climate change mitigation subject as most of the experts attending have not yet worked in that field. It was especially interesting in the context of the expected inclusion of climate change mitigation activities in the new international action plan review that is expected to take place soon.
- A meeting was held with two experts from ECCC to present our work and discuss their own interests related to EE in their activities.

Follow-up meetings were held with GAC and NRCAN on March 23, 2017 to meet with experts interested in our work who did not attend the February meetings.

5.2 Presentations at the International Level

Three presentations have been planned at the international level as part of this study with four different international organizations, namely the World Bank, the IEA, the IPEEC, as well as the UNEP energy division in Paris.

5.2.1 Presentation to the World Bank

A presentation was made at the World Bank office in Washington D.C. on November 16, 2016, in collaboration with the Energy Efficiency Community of Practice (EE CoP) of ESMAP and the Office of the Executive Director for Canada, Ireland and the Caribbean (with the appreciated support of Ms. Laura Darling). Mr. Pierre Langlois presented the results of our work, namely the unique value of EE as a promising approach to achieving pre-2020 mitigation goals in line with the Paris Agreement and the methodology leading to the selection of five high-impact target countries. The presentation was followed by a discussion on the topic of making a significant contribution to the capacity to better manage climate-change-related risks as well as develop better strategies for adapting to climate change in the long run.

The presentation was chaired by Ms. Martina Bosi, Senior Energy Economist with ESMAP. Opening remarks were also made by:

- Jacob Thoppil, Senior Advisor
- Laura Dorling, Advisor

They are both from the Office of the Executive Director for Canada, Ireland and the Caribbean. The main presentation was followed by comments from the World Bank Group discussants:

- Jonathan Sinton, Senior Energy Specialist, Energy and Extractives Global Practice
- Tom Kerr, Senior Industry Specialist, IFC
- Grzegorz Peszko, Lead Economist, Climate Change Cross-cutting Solution Area

Approximately 20 participants attended. Section 2.1.2 details the feedback provided by participants following the presentation.

5.2.2 Joint Presentation at the IEA and IPEEC

Another presentation was made by Mr. Pierre Langlois on March 28, 2017 at the IEA office in Paris. The presentation was chaired by Mr. Benoit Lebot, Executive Director at IPEEC; 7 experts from the IPEEC and 5 experts from the IEA attended this presentation. On this occasion, meetings were also held to further discuss the work undertaken by Econoler as part of this assignment and discuss the ways to collaborate in the context of Phase 2 of this initiative.

5.2.3 Presentation at the UNEP

A final presentation was made at the UNEP Energy Division office located in Paris on March 29, 2017. The meeting was presided over by Mr. Mark Radka, UNEP Energy Division Energy Program Coordinator and was attended by over 20 experts working in EE and climate change mitigation at UNEP. Interest was expressed to collaborate in the next phase of this project. The methodology was also interesting to the UNEP staff present, who mentioned it could be used to help set targets for future projects.

5.3 Publication of a Feature Article

A feature article has been submitted to the IPEEC and was published in the Newsletter Issue No. 17 on March 31, 2017. This feature article provides a summary of the findings of this study. This newsletter is distributed to a big number of EE market actors and decision-makers interested in EE around the world. A summary of this article and the complete article can be found in Appendix I.

6 CONCLUSION

In conclusion, this project was conducted with the overall aim of demonstrating, to decision-makers in Canada, target countries, and other countries who have pledged significant support to international climate funding, the value of EE as a promising approach to achieving short-term mitigation goals in line with the Paris Agreement.

In line with the specific objectives, this project was able to help generate greater knowledge among decision makers through various meetings with Canadian organizations (IDRC, NRCAN, ECCC, and GAC) as well as three presentations with representatives from four international organizations (World Bank, IEA, UNEP, and IPEEC).

Five high-impact developing countries were identified (Burkina Faso, Ghana, Morocco, Senegal and Vietnam) by assessing their technical potential, cost-effectiveness, political and institutional situations that could favor the best leverage of EE and enable the highest GHG reductions per dollar invested. Econoler has collaborated with EE experts in each of the five target countries to assess the overall EE contexts by reviewing legislative and regulatory frameworks, financial mechanisms, programs, projects and funding, main market players and stakeholders, potential barriers, and priorities. The initial scoping work on the EE context has generated a good overview of past, current and upcoming EE initiatives, as well as better knowledge of existing EE and GHG targets. The information gathered during Activity 1 was also cross checked using the local EE experts' work. Moreover, high EE potential was confirmed in all five countries from the information gathered by local EE experts. This leads to a definitive conclusion about the rationale for focusing on these countries to generate the biggest impact on carbon emission reduction.

Following these results, Econoler liaised with stakeholders and decision makers inside and outside of Canada to promote the results and the process leading to these results and the use of EE as one of the fundamental elements of climate change mitigation initiatives. A position paper and a feature article in the IPEEC Newsletter have been prepared and will be shared broadly:

- In Canada - NRCAN, ECCC, more specially their joint taskforce in charge of the post-COP21 agenda, and GAC representatives of the five targets countries;
- At the international level - decision makers in the target countries as well as through IPEEC and REEEP global networks which extend to a number of developed and developing countries.

Overall, this project has been able to demonstrate not only the benefits of EE in developing countries and more specifically the five target countries, but also why it is the best investment to focus on first to achieve the COP21 2020 goal on GHG emissions reductions. This project has generated interest. As a result, these international organizations have expressed clear interest to collaborate in the next stage of this project.

7 NEXT STEPS

Having obtained the funding from the IDRC and produced the various outputs included in this initial project, Econoler is looking to conduct further in-depth research with national partners in each target country, namely research institutions, universities and think tanks. Based on the preliminary work done in this research project, three of the five developing countries (namely Burkina Faso, Ghana, Morocco, Senegal and Vietnam) identified as potential high-impact countries interested in pursuing EE in their respective NDC will be the focus of this research project's second phase.

Research illustrates how well-designed EE related policies and initiatives can result in substantial GHG emissions reductions. EE opportunities and barriers are well documented, especially using country-specific case studies, but more knowledge is needed on the overall contexts and mechanisms that lead to effective implementation and positive impacts. Even if studies exist on successful EE initiatives in developing countries, knowledge on the reasons for success and how to replicate such experiences from one developing country to another is not well understood and limits replication opportunities.

Therefore, the research focus will be to evaluate how EE best practices established in developing countries could be transferred to other developing countries that have both the significant potential and the preconditions for achieving big EE gains and EE-related benefits. Such an analysis will also be made by taking into account the positive impact in terms of economic development, living conditions improvement, gender equality, climate adaptation, and the environmental benefits that could be gained from such projects. It will create more capacities in targeted countries to implement EE initiatives successfully and provide valuable information on how to replicate such initiatives in other developing countries.

In light of the need for major global EE deployment to achieve international GHG emissions reduction objectives (COP21, COP22), it is essential to draw as much as possible from lessons learned and how to transpose these in other countries to avoid costly mistakes and benefit from already made investments in several countries.

An initial concept note has been submitted to IDRC in late February 2017, discussing the objectives and expected outputs of this second phase. Revised updated versions were sent in the first half of March 2017. The Climate Change program template for unsolicited proposals was completed and submitted at the end of March 2017 and we look forward to further elaborating a research proposal with feedback from the Climate Change team. A list of potential national research partners was also presented in the submissions of the Climate Change program template.

Collaboration with national researchers in the target countries will be favoured, but we will also seek the collaboration of actors in countries where successful projects have been implemented, which will favor South-South exchanges and the development of knowledge more broadly. So far, organizations

contacted in the outreach process have confirmed their great interest in collaborating on this research by offering their knowledge and expertise on the successful projects they have developed and their knowledge of the countries concerned. Research will therefore be important not only to strengthen knowledge for researchers and stakeholders in the target countries, but also for international organizations that support the implementation of initiatives in developing countries.

APPENDIX I
ARTICLE FOR IPEEC NEWSLETTER

Summary

Just before the COP22 was held in Marrakech, the Paris Agreement entered into force. The agreement calls for a shift to a clean, low-carbon economy across the globe. To meet the ambitious climate change mitigation objectives set, we are all challenged to act boldly and rapidly.

The Paris Agreement also requires developed countries to support developing countries through financial and technical assistance. Among the possibilities to be leveraged with such international support, strategies focused on energy efficiency definitely deserve wider application to enable countries to achieve their mitigation goals as well as the transformative, long-lasting institutional changes necessary to create favourable contexts for energy efficiency implementation. According to the International Energy Agency (IEA), energy efficiency is a highly effective tool for achieving low-carbon development and one of the lowest-cost options to reduce GHG emissions. The World Bank also considers energy efficiency an area with tremendous potential for action to achieve both GHG mitigation and local development.

In this context, Econoler (www.econoler.com), a world-leading Canadian consulting firm with over 35 years' experience in energy efficiency, initiated a project in partnership with the Renewable Energy and Energy Efficiency Partnership (REEEP) and funding support from Canada's International Development Research Centre (IDRC), to examine how energy efficiency can play a major role in helping developing countries reduce their GHG emissions and achieve broader development goals.

As part of this project, Econoler developed a methodology to select countries where energy efficiency can have a significant impact on economic development and climate mitigation. This process involved:

- Assessing developing countries against a set of carefully selected indicators related to development level, total annual energy consumption and GHG emissions, interest in and commitment to pursuing energy efficiency at the national level, political stability and corruption level allowing for or hindering the best leverage of energy efficiency per dollar invested;
- Shortlisting countries which were identified as having significant potential for achieving important GHG emission reductions and development gains through energy efficiency; and
- Selecting five countries from the shortlist for additional research, namely Morocco, Vietnam, Senegal, Ghana, and Burkina Faso.

These countries plan to seize a number of opportunities and undertake energy efficiency with clear targets, despite a short history in working on energy efficiency in some cases. Capacity-building, increasing energy efficiency in power generation, residential and institutional sectors, and reducing the energy intensity in main industries are common themes among the planned upcoming initiatives. Based on the findings of this initial research, a second phase is envisaged to examine in detail how these countries can benefit from a comprehensive energy efficiency plan and identify the lessons to be learned from other developing countries that have so far been most successful in implementing energy efficiency initiatives and achieving good results. This project aims to develop a better overall understanding of the barriers and possible solutions related to creating favourable contexts for the optimal implementation of energy efficiency by developing countries to fulfill their Paris Agreement commitments.

Developing countries and energy efficiency potential: Strategies for low-carbon development after the Paris Agreement

The energy sector currently contributes more than two-thirds of total global GHG emissions.[8] The transformation of the global energy system must be at the heart of climate action, and energy efficiency can play a significant role to this end. According to the International Energy Agency (IEA), "realising the economic potential of EE is a central pillar of a cost-effective strategy to mitigate climate change and achieve a peak in global GHG emissions by 2020".[9] The world's total energy use is still growing, yet at a slower pace than before. This growth would have been three times greater if it were not for increased efficiency.[10]

Energy efficiency is gaining momentum as it remains at the centre of international policy discussions. As of 2015, 146 countries had some form of energy efficiency policy and 128 countries had at least one energy efficiency target.[11] In the lead-up to COP21, the G20 developed an energy efficiency action plan and the G8 published a report to support energy efficiency in major economies through IPEEC. Ban Ki-moon, the former Secretary-General of the United Nations (UN), called energy efficiency our best tool, "a tool for all", to promote clean development and poverty alleviation.[12] He launched the Sustainable Energy for All (SE4All) initiative, with one of its objectives being to double energy efficiency globally by 2030. The significance of energy efficiency is also echoed in the Sustainable Development Goal 7 on energy. The mobilisation of a wide range of actors provides no doubt on how energy efficiency can deliver significant economic and environmental gains.

[8] IPCC (2014). *Climate Change 2014: Mitigation of Climate Change.*
[9] IEA (2015*). Energy and Climate Change: World Energy Outlook Special Report 2015*, p.388.
[10] IEA (2015). World Energy Outlook 2015, p.55.
[11] REN21 (2016). *Energy Efficiency*. www.ren21.net/gsr-online/chapter06.php (Accessed on August 16, 2016).
[12] UN (2009). *Secretary-General's Remarks to the General Assembly Informal Thematic Dialogue on Energy Efficiency.* www.un.org/sg/STATEMENTS/index.asp?nid=3931 (Accessed on July 28, 2016).

The 2015 Paris Agreement requires developed countries to support developing countries through financial and technical assistance. Among the possibilities to be leveraged with such international support, strategies focused on energy efficiency definitely deserve wider application. This is because firstly, such strategies involve huge potential for emission reductions and can be deployed rapidly, and secondly, they can help create the favourable contexts required to implement energy efficiency. Indeed, IPEEC calls for international climate funds to "finance capacity building activities directed towards the creation and strengthening of an enabling environment to catalyse energy efficiency investments in eligible countries, namely emerging economies and developing nations."[13]

Another component in the Paris Agreement is to take concrete mitigation actions by 2020. Therefore, bold climate actions need to be taken. In 2015, the world's energy intensity reduction (1.8%) was twice the average rate over the last decade. Despite this encouraging gain, the current pace is still too slow to limit the global temperature rise below 2 °C. An annual energy intensity improvement of at least 2.6% would be required to meet the climate mitigation goals set.[14]

Yet, there is large untapped potential for energy efficiency and such potential also exists in developing countries. Quite often, such potential is not well understood by decision-makers who have pledged climate finance support. And even if they do understand, they still need to identify not only those countries and regions where energy efficiency can achieve the highest GHG reductions per dollar invested, but also the most appropriate and effective mechanisms to be employed.

Econoler, in collaboration with the Renewable Energy and Energy Efficiency Partnership (REEEP), have conducted research to (1) present the case of energy efficiency as a key component of low-carbon development; (2) identify a number of developing countries which have a potential for enabling the best leverage of energy efficiency; and (3) identify priorities for deploying such efforts in these countries.

A driver for low-carbon development

Currently, about one third of global primary energy is being wasted as energy loss.[15] At the same time, more than 1 billion people do not have access to electricity. Reducing the proportion of wasted energy will help not only reduce the energy demand, but also increase the amount of energy available at lower costs than adding new capital-intensive infrastructure. So far, energy efficiency has avoided investing more than USD 1 trillion in electricity generation.[16]

[13] IPEEC (2016), Working Paper.
[14] IEA (2016). *Energy Efficiency Market Report*, p. 17.
[15] IPCC (2014). *Climate Change 2014: Mitigation of Climate Change*, p. 377.
[16] IEA (2016). *Energy Efficiency Market Report*, p. 17.

Among the 20 countries with the biggest deficit in energy access, nine have a population growing faster than the electrification rate.[17] According to the UN, achieving energy efficiency in developing countries will help increase access to energy while supporting their sustainable economic growth and offers an opportunity to tackle a number of socioeconomic challenges together. This is especially interesting for fast-growing economies which hope to offer broader access to energy yet have limited resources. In 2015 already, energy intensity improvements were greater in emerging countries than elsewhere.[18]

In 2012, the non-OECD countries' electricity consumption surpassed that of OECD countries for the first time. In the 10 previous years, the growth of electricity use flattened across developed countries while it more than doubled in non-OECD countries. By contrast, it took 22 years in the 1970s and 1980s for developed countries to double their electricity use.[19] Increased energy consumption is largely a result of growing populations and it is expected to continue, along with rising household incomes, urbanisation and industrialisation.

Delivering electricity to a greater number of people is a driving force for strengthening the reliability and efficiency of energy supply. Higher efficiency allows for the delivery of more energy with the same level of production. In low-income and lower-middle income countries, fossil-fuel-based power generation efficiency is usually low, below 35%[20], which represents a gap as well as an opportunity. Energy efficiency is an essential complement to increasing power generation capacity and reliability; it is a strategy to 'keep the lights on' during periods of rapid economic growth and development.

As demand is being propelled to higher levels, energy efficiency can support a more responsible increase in energy use. Certainly, challenges arise in trying to meet the demand for more energy while minimising climate impacts. But according to the IEA, energy efficiency would be the most effective way to decouple GHG emissions from economic growth, i.e., reducing emissions while maintaining growth. Energy efficiency policies are becoming major drivers of emission reductions and encouraging signs of decoupling are making the case for strong and more sustainable economies. Last year, the global GDP grew by 2.7% while energy demand actually dropped by 0.8%.[21]

The World Bank scaled up its investments in energy efficiency after identifying it as a high-impact intervention sector. Indeed, last year, global investments in energy efficiency were two thirds greater than in conventional power generation.[22] Large gaps exist between available resources and needs, especially in developing countries, but growing interest in energy efficiency helps generate international support.

[17] IBRD, World Bank & IEA (2015). *Progress Toward Sustainable Energy 2015: Global Tracking Framework Report.* p. 66.
[18] IEA (2016). *Energy Efficiency Market Report*, p. 17.
[19] IEA (2015). *Energy Efficiency Market Report*, p. 29 and p. 92.
[20] IBRD, World Bank & IEA (2015). *Progress Toward Sustainable Energy 2015: Global Tracking Framework Report*, p. 12.
[21] IEA (2016). *Energy Efficiency Market Report*, p. 17.
[22] Ibid. p. 15.

As energy is central to society, energy efficiency is closely linked to any energy-related theme, be it jobs, incomes, political security, food security, health, well-being or air pollution. Energy transforms lives. There is then no doubt about energy efficiency's positive impact, beginning with its potential to mitigate GHG emissions.

Climate change mitigation potential

Around the world, most energy is produced by burning fossil fuels. Many developing countries do not have any immediate alternative. It is no secret: energy efficiency is a proven strategy for reducing GHG emissions. It has become the most interesting option to quickly reduce the carbon intensity of energy consumption. Energy efficiency buys time for both the cost of renewables to fall and new technologies to develop.

So far, numerous energy efficiency-related efforts have been made around the world. Mandatory efficiency regulations now cover about a quarter of the global energy consumption.[23] It is estimated that since the 1990s, a total of 6,120 MToe (256 EJ) in final energy use has been avoided through energy efficiency.[24] This represents the additional energy that would have been otherwise consumed if it had not been for energy efficiency improvements. As a result, an estimated 13 Gt of GHG emissions has been avoided since 2000.[25]

Still, about two-thirds of the economically viable potential remains untapped.[26] Power generation could grow by 70% by 2040 and the related emissions would only rise by 13%, leading to global carbon intensity of power generation one-third lower than today.[27] Furthermore, energy efficiency could cut GHG emissions by more than half by 2040.[28] In the short term, efforts in developing countries could avoid 1.7 Gt/yr of CO_{2eq} by 2020.[29] For these encouraging forecasts to materialise, much more energy efficiency efforts must be made. Otherwise, under current policies, only one-third of the economically viable energy efficiency potential could be achieved by 2035.[30]

There is potential across all sectors. The Intergovernmental Panel on Climate Change (IPCC) identified major short-term opportunities in transportation where improvements could reach 50%.[31] The IEA suggests great potential in the buildings sector, potentially accounting for 45% of demand-side avoided emissions in 2040.[32] The industrial sector's energy intensity could be further reduced by 25% by introducing and adopting the best practices and technologies available, particularly in

[23] IEA (2015). *World Energy Outlook 2015*, p. 21.
[24] Ibid. p.17.
[25] IEA (2016). *Energy Efficiency Market Report*, p. 17.
[26] Ibid. p. 398.
[27] According to the New Policies Scenario. [IEA (2015). World Energy Outlook 2015. p. 329.]
[28] IEA (2015). *World Energy Outlook 2015*, p. 408.
[29] UNEP (2016). *First Report of 1 Gigaton Coalition Finds Potential for Further Reductions.* http://web.unep.org/actions-on-renewable-energy-and-energy-efficiency-developing-countries-could-reduce-emissions-17 (Accessed August 15, 2016).
[30] IEA (2014). *Capturing the Multiple Benefits of Energy Efficiency*, p. 33.
[31] IPCC (2014). *Climate Change 2014: Mitigation of Climate Change*, p. 74.
[32] IEA (2015). *World Energy Outlook 2015*, p. 408.

countries where these are not in use.[33] Two-thirds of the world's industrial sector energy is now used in non-OECD countries.[34] Four-fifths of potential savings in material production exists in these countries, which will also account for the majority of intensive industrial-sector energy demand by 2040.[35]

We know much potential exists across developing countries, but where should high-impact actions be taken? Econoler undertook a research project to identify a number of countries where energy efficiency actions can be taken with major overlapping impact on climate change mitigation and socioeconomic development.

Selecting high-impact target countries

In the process of selecting high-impact countries, the following objectives were considered:

- To positively impact national economic development;
- To reduce GHG emissions to contribute to global climate change mitigation efforts;
- To relate to existing interest in pursuing energy efficiency as part of the national action plans and targets;
- To maximise potential energy efficiency benefits where there is political stability and a lower level of corruption.

Our approach involved assessing the candidate countries against a set of criteria and associated indicators to identify a shortlist of countries where energy efficiency actions would generate the greatest impact.

First, two development indicators were considered to eliminate those countries which have already reached a certain level of development based on their country income classification and the Human Development Index (HDI). The World Bank classifies countries as high-, upper-middle-, lower-middle- and low-income, and no high-income economy was considered for the purpose of this exercise. Countries with an HDI above 0.7 were rejected. According to the UN Development Programme (UNDP), countries with an HDI below 0.7 have a medium to low development level. After applying this first set of criteria, 85 countries were identified as countries with high socioeconomic impact potential.

[33] Ibid. p. 81.
[34] IBRD, World Bank & IEA (2015). *Progress Toward Sustainable Energy 2015: Global Tracking Framework Report.* p. 104.
[35] IEA (2015). World Energy Outlook 2015. p. 415.

Subsequently, technical indicators were applied. According to the IPCC, energy metrics provide valuable insights on the potential for energy efficiency improvement and energy demand reduction.[36] Data was gathered on the countries' total GHG emissions, total electricity and energy consumption, and the emission factor from electricity generation. A number of countries were shortlisted according to a minimum level of carbon emissions and electric/energy consumption. It was also established that the threshold emission factor should be at least higher than Canada's (186 gCO_{2eq}/kWh). Therefore, a number of countries were eliminated because of their low potential for tangible energy efficiency impacts, and 38 countries remained as potential target countries.

The level of energy efficiency varies from one country to another across the globe. Some countries are already quite far ahead. Based on a country's current energy efficiency policies and programmes, the American Council for an Energy-Efficient Economy (ACEEE) ranked the top 25 leading countries.[37] Amongst the 38 remaining potential target countries, three are among the top 25 leaders, namely India, Indonesia and South Africa. These three were removed from the shortlist of potential target countries to prioritise countries which could benefit more from external support.

The shortlist was further refined assessing the level of interest in energy efficiency demonstrated by the national government, as shown by the Nationally Determined Contributions (NDCs), which outline the actions a country intends to take under the Paris Agreement. The remaining 35 countries' NDCs were examined to identify those involving energy efficiency. A score of 0 to 10 was assigned according to the importance assigned to energy efficiency and GHG emission reduction. The examination showed that some countries did not set targets, while others stated unconditional and/or conditional targets to receiving financial support. Among the 35 countries, 15 assigned limited importance to energy efficiency or made no mention of energy efficiency at all and were therefore removed from the shortlist.

As for the political criteria, those countries under sanctions[38] and those with a Corruption Perceptions Index (CPI) below 30 were eliminated. The CPI measures the perceived level of corruption in the public sector and provides a score from 0 to 100, where stable democracies with higher levels of transparency have higher CPI values[39].

After this set of indicators was applied, the remaining 10 potential target countries were ranked according to an empirical equation to determine the magnitude of the potential impact of energy efficiency:

[36] IPCC (2014). *Climate Change 2014: Mitigation of Climate Change.* p. 377 and p. 443.
[37] ACEEE (2016). *International EE Scoreboard*. http://aceee.org/portal/national-policy/international-scorecard. (Accessed August 10, 2016).
[38] Sanctions currently imposed by Canada were considered since this work was used to inform a Canadian audience. See: Global Affairs Canada (2016). *Current sanctions imposed by Canada.* http://www.international.gc.ca/sanctions/countries-pays/index.aspx?lang=eng (Accessed on July 10, 2016)
[39] Transparency International (2015). *Corruption Perceptions Index 2015.*

$$Impact = \frac{GHG_{Total}{}^{0.5} \; x \; EF_{Elec}{}^{0.5} \; x \; EC_{Total}{}^{0.3} \; x \; EE_{NDC}{}^{3}}{HDI \; x \; 10^{-6}}$$

Where:

- GHG_{Total} = Total GHG Emissions
- EF_{Elec} = Electricity Emission Factor
- EC_{Total} = Total Energy Consumption
- EE_{NDC} = NDC Score
- HDI = Human Development Index

The equation was developed in a way to assign more weight to certain parameters. Countries with lower HDIs were favoured and more importance was assigned to higher NDC scores. The total amounts of GHG emitted and electricity produced were given a slightly higher weight than the emission factor.

Table 1: Target Countries and Assessment Results

Country	Rank	Income Group	HDI	GHG Emission (ktCO2eq)	Electricity Use (GWh)	Electricity EF (gCO2/kwh)	Energy Use (Mtoe)	CPI	NDC Score	Empirical Result
Morocco	**1**	**Lower-middle**	**0.628**	**80,437**	**28,385**	**718**	**19.0**	**36**	**10**	**32**
Vietnam	**2**	**Lower-middle**	**0.666**	**310,664**	**115,283**	**432**	**55.0**	**31**	**7**	**23**
Senegal	**3**	**Low**	**0.466**	**54,185**	**3,079**	**637**	**2.2**	**44**	**10**	**16**
Ghana	**4**	**Lower-middle**	**0.579**	**107,784**	**10,583**	**259**	**4.7**	**47**	**10**	**15**
Burkina Faso	**5**	**Low**	**0.402**	**43,910**	**1,037**	**490**	**0.6**	**38**	**10**	**10**
Pakistan	6	Lower Middle	0.538	369,735	78,890	425	60.0	30	4	6
Egypt	7	Lower Middle	0.690	295,500	137,591	450	91.0	36	4	4.81
Namibia	8	Upper Middle	0.628	38,049	3,772	197	1.3	53	10	4.76
Togo	9	Low	0.484	22,932	1,000	195	0.7	32	6	0.8
Gabon	10	Upper Middle	0.684	34,571	1,805	383	1.4	34	5	0.7

Four of the five countries selected assigned a high priority to energy efficiency in their NDCs. With an NDC score of 7, Vietnam still finds itself among the five countries with the biggest potential impact due to its high GHG emission and energy consumption levels. Although Pakistan and Egypt also scored high in this respect, these two countries did not set specific energy efficiency targets as part of their NDCs. Although Namibia appeared to be more committed to energy efficiency than Pakistan or Egypt, its lower scores on the technical indicators relegated it to a lower overall rank.

According to the IPCC, the Middle East, Africa and Latin America have high GHG mitigation potential and Asia has the highest absolute reduction potential.[40] Few Asian and Middle East countries were in the final shortlist because their level of development generally tends to be higher. Although low- and lower-middle-income country groups have accounted for a smaller share of the avoided energy use so far, the share accounted for by the lower-middle-income countries keeps increasing and has moved from only 1% in 1991-2000 to almost 10% in 2011-2012.[41]

Next steps

So far, Econoler has collaborated with partners in each of the five target countries to further assess their energy efficiency contexts by reviewing past and current initiatives, including legislative and regulatory frameworks, financial mechanisms, programmes, internationally funded projects, main market players, barriers and priorities. So far, efficient lighting, energy audits in energy-intensive industries, and building codes are some initiatives identified as low-hanging fruits that have been achieved or have almost been achieved in all five target countries. These countries have very different histories of working on energy efficiency, with some having achieved much more than others; however, they all plan on seizing a number of opportunities and undertaking energy efficiency with clear targets. Going forward, Econoler also intends to conduct a comparative study of best practices in developing countries to better understand the most effective approaches, technical assistance and financing mechanisms that can best leverage energy efficiency, address the existing gaps and develop guidelines on what should be done to create favourable contexts to implement energy efficiency and achieve the NDC objectives set.

Overall, energy efficiency remains one of the most cost-effective strategies to rapidly address the need to significantly reduce GHG emissions. The potential impact of energy efficiency is significant across the globe. However, the benefits can only materialise as a result of strong leadership, commitments and efforts from both the global community and national decision-makers. Let's join forces in building this growing momentum and make the best out of this potential.

[40] IPCC (2014). *Climate Change 2014: Mitigation of Climate Change*, p. 434.
[41] IBRD, World Bank & IEA (2015). *Progress Toward Sustainable Energy 2015: Global Tracking Framework Report*, p. 99.

Econoler is a Canada-based international firm actively involved in developing and implementing climate change mitigation strategies and projects in support of Canadian and international initiatives. Econoler has over 35 years of experience in working in more than 130 countries, with 80% of them being developing countries. We have implemented so far over 3,000 EE-related assignments for international financial institutions, bilateral organizations, dedicated environmental funds, governments and utilities. The focus of Econoler's work includes institutional framework, policy and legal framework design, implementation and evaluation, project development, and financing mechanisms.

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