Smart Policies and Programs as Critical Drivers for Greater Energy Efficiency Investments

Analytical Manuscript

John A. “Skip” Laitner
Benoît Lebot
Matthew McDonnell
Meagan Weiland

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Contents

What is purpose of this report?

With a greater emphasis on energy efficiency and energy productivity, this report represents an effort to evaluate the scale of policies and programs, and resulting market activity, that will be necessary to reduce the cost of energy expenditures throughout the world economy. It highlights key trends associated with global energy expenditures over roughly the next 33 years, or through the year 2050. It provides an initial framework for understanding the magnitude of investments and outlays for energy efficiency improvements that are most likely to enhance the performance of the global economy.

What is the scope?

The report lays out evidence on the future of energy costs and their impact on the global economy. The intent is to provide insights from which national and local officials, and their constituents, can develop approaches that might lead to a comprehensive energy efficiency market – one that will boost the performance of a more productive, robust, and sustainable economy over the long-term.

What geographies does the report cover?

The report broadly covers the residential, commercial, and industrial sectors of the global economy, with a particular focus on developing economies. There are cases where the authors rely upon data from various agencies as the International Energy Agency (IEA), the Organisation for Economic Cooperation and Development (OECD), the U.S. Energy Information Administration (EIA), and other public sources. The economic assessment and recommendations are generally focused on member and non-member nations of the OECD.

Who is it for?

The report is intended primarily for officials and business leaders within the G-20 nations. It provides insights into how that community might engage with public and private sector stakeholders to create a more energy-efficient and more robust economy over the period 2018 through 2050. The report will also be of interest to the energy sector, other government and business partners, as well as the current 7.5 billion residents of the world.

What methodology was used?

Three forms of evidence were used in this report. First, the assessment draws on international data for the world economy, and also for the member and non-member nations of the OECD. It provides a global estimate of the likely magnitude of energy expenditures (absent new policies or unexpected market dynamics). It highlights the major trends and the likely costs and benefits of business-as-usual (BAU) trend through 2050. It then compares what we call an Energy Innovation Scenario that represents a possible investment path which OECD and non-OECD member nations might follow. Second, the assessment draws on a review of possible financial mechanisms to enable a more robust and sustainable economy. Finally, it draws upon a wide range of interviews, analytical critiques, and literature reviews conducted during the period August 2017 to January 2018.

Who are the authors?

The underlying research tasks, analysis, and writing of the report were carried out by a team associated with Economic and Human Dimensions Research Associates in collaboration with the International Partnership for Energy Efficiency Cooperation (IPEEC). The larger framework of this analysis was provided by IPEEC's Benoît Lebot. The assessment and economic modeling was undertaken by John A. "Skip" Laitner. The review of financial mechanisms was provided by Matthew T. McDonnell and the review of programs, policies, and best practices was written by Meagan Weiland. Additional research was provided by Ryan Keller.

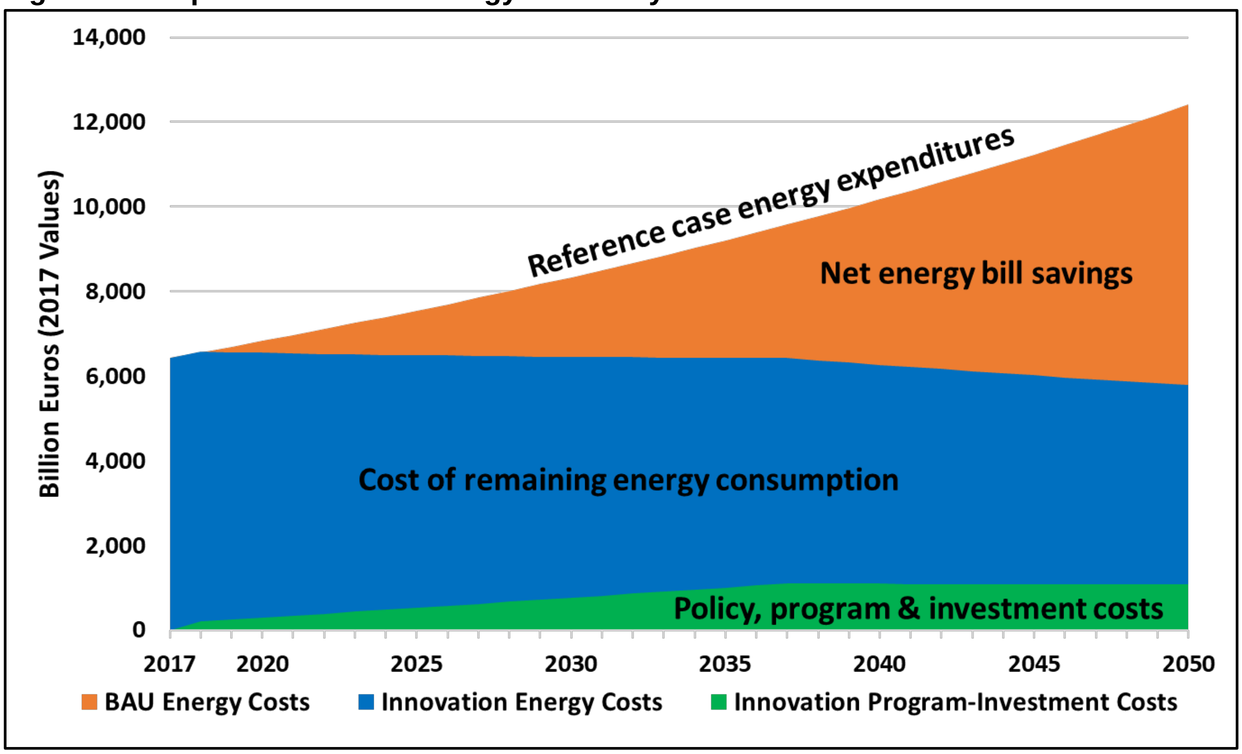
Disclaimer

Executive Summary

In 2017 businesses, households and government enterprises throughout the global economy spent an estimated €6.4 trillion to meet the many demands for various energy services. Current projections suggest the present scale of annual expenditures may nearly double to €12.3 trillion by 2050 (with all costs expressed in real 2017 values; see, Laitner 2017). Although the global economy derives important benefits from the purchase the many energy services, the inefficient use of energy also creates an array of costs and constraints that burden our social and economic well-being.

Yet, there is good news within the countless energy markets throughout the global economy. Whether improved lighting in homes and schools, transporting people and goods to new places they might need to be, or powering the many industrial processes within any given nation, there are huge opportunities to improve the productive use of energy in ways that reduce total economic costs. And those same energy efficiency upgrades can also reduce greenhouse gas emissions that drive climate change, as well as lessen other impacts on both people and the global environment. As this manuscript suggests, however, it will take an adequately funded set of smart policies and effective programs to drive the optimal scale of energy efficiency investments. Figure ES-1 below highlights the scale of policy and program costs which, in turn, catalyze the productive investments necessary to reduce overall costs of energy.

Figure ES. Impact of a Global Energy Efficiency Innovation Scenario



The key insight? An efficiency-led investment strategy can save the global economy an average €1.9 trillion in avoided energy costs annually—even after the policy, program and investment costs have been paid. But without the foundation of smart policy and program investments to drive this result, the net energy bill savings is likely to be substantially less than shown here. The more detailed discussion of these key ideas follows.

I. Introduction

In 2017, the 7.5 billion people within the global economy spent more than €6.4 trillion to meet their combined needs for energy services. Current projections suggest the present scale of expenditures may nearly double in real terms to €12.3 trillion by 2050 (Laitner 2017). The many payments made each day or each month, both now and into the future, will enable a growing population to cool and light their homes, drive to work, listen to music, or simply watch television. For some the payments may simply provide the fuel necessary to cook their food. For others, the disbursements will power their many business enterprises. Purchases of electricity will enable access to the Internet, as well as filter and purify the water that is delivered to local homes, schools, and businesses each and every day.

Although the global economy derives important benefits from the use of the many energy resources, the inefficient use of energy also creates an array of costs and constraints that burden our social and economic well-being. For example, the incomplete combustion of fossil fuel resources releases massive amounts of pollutants into the air. The current mix of energy resources used to support worldwide economic activity will also result in 4-7 million people who will die prematurely, and hundreds of millions more who will become ill from exposure to air pollution (Jacobson et al. 2017). The International Monetary Fund (IMF) suggests that pollution damages from burning fossil fuels are immense, on the order of $3-4 trillion per year (Coady et al. 2015). The International Energy Agency confirms the scale of the health and air pollution problem (IEA 2016). In addition, the inefficient use of energy in 2017, according to the U.S. Energy Information Administration, also dumped another 34.5 gigatonnes of carbon dioxide into the atmosphere (EIA 2017). This contributes to an acceleration of global climate change.

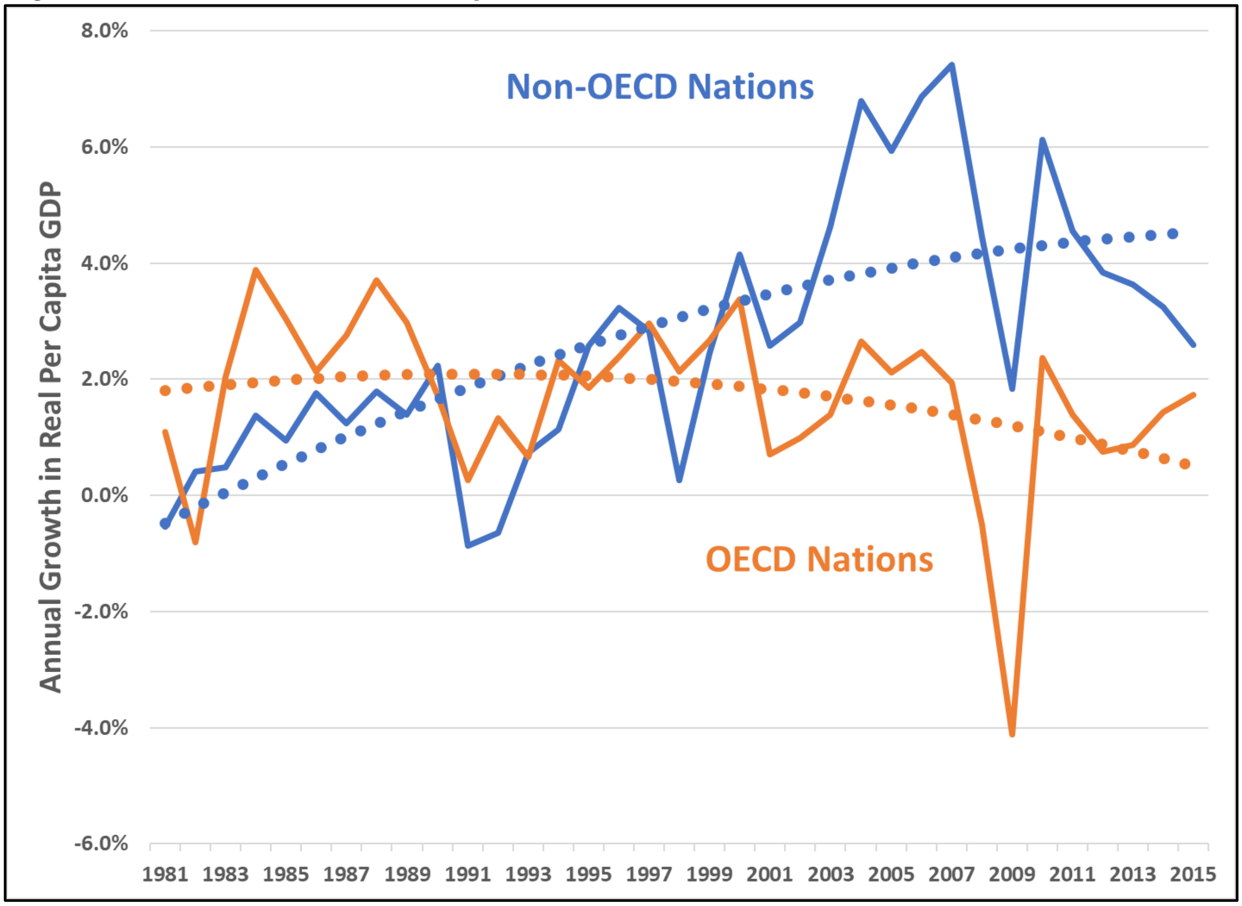
There is little question that the production and use of energy holds great financial value for worldwide markets. On the other hand, a 2014 report, also published by the IEA, noted that the inefficient conversion of energy imposes an array of costs which can weaken or constrain the development of a more robust economy (Campbell, Ryan et al. 2014). German physicist Reiner Kümmel and his colleagues studied the economic process and noted that the economic weight of energy is significantly larger than its cost share (Kümmel 2013). Research by economist Robert Ayres and his colleague Benjamin Warr (2009) documented that improvements in both the quality and efficiency of delivered energy services may be the critical factor in the growth of an economy. They further suggested that a greater level of energy efficiency may be one of the primary drivers that support meaningful technological progress. Indeed, sustained technological progress may come only with extensive upgrades in a region's overall energy efficiency.

For very similar reasons, the global economy may be at a crossroads. As detailed in a variety of recent studies, it turns out that worldwide, the economy may only be 16 percent energy-efficient (Laitner 2017, based on Ayres and Warr 2009, Laitner 2015, and Voudouris and Ayres et al. 2015; see also, Blok et al. 2015). Said differently, of all the high-quality energy resources consumed within the international community, an estimated 84 percent is wasted. As already indicated, we see a lot of that waste in the form of air pollution and carbon dioxide emissions. Other wastes may include fly ash from power plants and the disposal of industrial chemicals. Yet, the inefficient use of energy also creates serious economic and competitive challenges for the economy should it continue the current and inefficient patterns of energy production and consumption.

So, whether concerns about fuel or energy poverty, energy security, or global climate change, there is an increasing emphasis on, and review of, the role that energy plays within any given national or regional economy. And while there are large opportunities to promote the more efficient use of energy and other resources, the mere existence of an opportunity does not guarantee a positive outcome. In short, the more productive use of energy and resources won't automatically happen. *It will take purposeful effort, guided by smart policies and programs, to drive the necessary activities and investments that to achieve optimal, large-scale benefits.*[1]

But how to do things differently? How to accelerate the more productive use of energy resources—at sufficient scale—over the next three decades or so? In the sections that follow, we briefly explore what we call the "economic imperative of energy efficiency." We then examine the magnitude of the effort and the investments that will be essential to elevate the performance of the global economy. We especially focus on, and review the likely scale of, the policies and programs that will be required to support that level of transition. Finally, we offer a brief survey of financial tools that can stimulate a sufficient level of investments even as they also provide funding for needed policies and programs.

Figure 1. Recent Trends in Per Capita GDP



Source: International Energy Agency (IEA) data (December 2017).

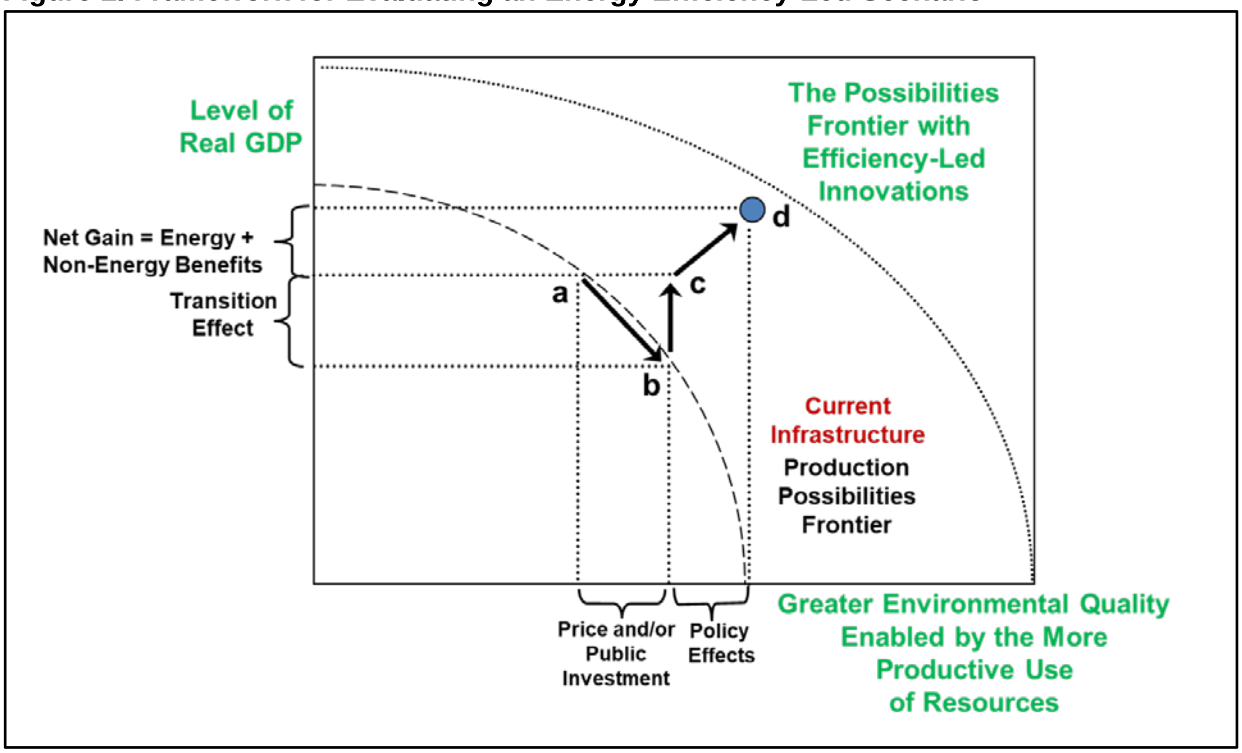
[1] As the term is used here, "at scale" generally means a reduction of energy use by 40 percent or more over a projected level of consumption by the year 2050. Examples of scenarios which achieve that scale of reduction can be found in European Climate Foundation (2010), Laitner et al. (2012), Teske et al. (2017), and Metropolitan Region of Rotterdam and Den Haag (2017). It might be worth noting that, as an update to an earlier study (Laitner et al. 2012), Nadel (2016) found that 13 efficiency specific measures in the United States, if pursued aggressively, would reduce 2050 energy use by 50 percent relative to then currently predicted levels. But as he also noted, achieving those energy efficiency savings would require an expansion of energy efficiency efforts well-beyond business-as-usual.

II. The Economic Imperative of Greater Energy Efficiency

The world economy sits at the crossroads of both challenges and opportunities. On the one hand, the global economy shows signs of a lagging performance—weakened by the inefficient use of resources. Over the period 1990-2008, for example, the volume of Gross Domestic Product (GDP) per inhabitant within the world community—a useful proxy of economy-wide productivity—grew at a reasonable rate of 2.0 percent per year. Over the next 9-year period through 2017, however, per capita GDP has weakened somewhat, dropping to 1.4 percent (EIA 2017). It is a mixed story, however, depending on whether we are looking at the 35-member nations of the Organisation for Economic Co-operation and Development (OECD), or whether we examine other emerging economies, the so-called non-OECD countries. Figure 1 compares the per capita GDP of the OECD and non-OECD nations over the past 35 years.

While real per capita GDP of the developing nations (non-OECD countries) since 1980 continues to improve, the rate of improvement in the last few years may be diminishing. More critically, it appears the rate of improvement will continue to deteriorate by one percentage point or more. While that does not sound like a big deal, if a nation drops from a GDP growth of 3 percent down to 2 percent, that means its real income could be nearly 30 percent smaller by 2050. Following a more precipitous pattern, the OECD nations have gone from a robust 2.0 percent average growth rate, now trending downward towards 1.0 percent or less (IEA 2017). Indeed, a long-term OECD forecast from 2017 to the year 2050 points to a similarly weakening growth rate (OECD 2014). Among the key reasons for a possible slumping economic well-being is the continued inefficient use of energy and other resources (Laitner 2017, building on Ayres and Warr 2009, Kümmel 2011 and 2013, Voudouris et al. 2015, and Ekins et al. 2017).

Figure 2. Framework for Evaluating an Energy Efficiency-Led Scenario



Source: John A. "Skip" Laitner (February 2018).

Figure 2, above, provides a conceptual framework that helps place an energy efficiency-led Innovation Scenario into a useful perspective. While we cannot know, at this time, the scale of eventual investments, nor the actual impact of what we might call a “purposeful effort” to stimulate a more productive use of energy and other resources, we can offer a positive general explanation of how multiple benefits are likely to emerge through such investments.

With their very hectic and busy work and travel schedules, many business and political leaders understandably do not have the time to think through how the economy might be operating across the larger dimensions of climate and energy policies. And typically, the assumption might be made that the global economy is already on what is called a production frontier at point “a” in the Figure 2 diagram above. Limited by the current market structures, and given available technologies and the larger social needs, it is assumed that any change to satisfy a demand for either greater energy efficiencies or reductions in greenhouse gas emissions, must likely result in a downward shift to point “b” on this graphic illustration.

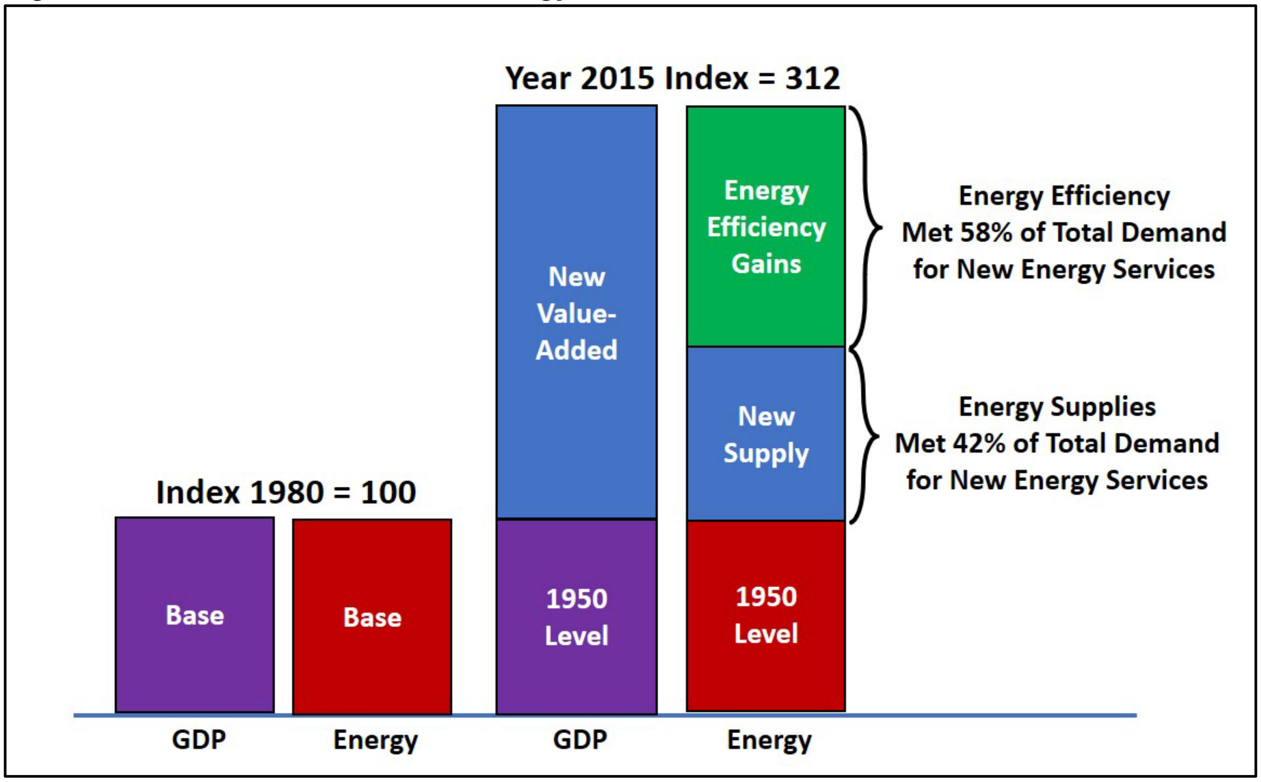
As the shift from point “a” to point “b” is interpreted, an economy might achieve some mix of productivity improvements. And there might also be some reduction in greenhouse gas emissions. But given current technologies and infrastructure, the assumption is that any environmental improvement must surely come at the cost of a reduction in personal incomes and national GDP. Yet, we can also imagine that an Innovation Scenario—catalyzed by set of policies, programs and incentives—yes, may initially or temporarily shift the economy to point “b.” Nonetheless, that first shift or movement may also create a productive transition that lifts the economy from point “b” to point “c” as the result of cost-effective improvement in energy and other resource efficiencies, even as the economy remains at a relatively stable level of GDP.

At some point in time—perhaps within a two or three-year period—the various energy and non-energy benefits that result from an array of incentives and policy initiatives can boost the performance of the economy to a higher-than-expected level of performance. Although not drawn to scale in Figure 2, the migration from point “a” to the eventual point “d” might represent a 40 percent reduction in energy requirements per unit of GDP. The net energy savings, together with a transition to a 100 percent renewable energy system might, in turn, stimulate a significant boost in net jobs gains and GDP.

Equally critical, the Innovation Scenario can become a way to catalyze an enhanced push of the production frontier so that markets and future technologies are encouraged, developed and implemented to the long-term benefit of the economy. Yet, equally important is understanding that the “movement to” and the “outward movement of” the production frontier can provide a sustainable basis to ensure a more robust growth in per capita GDP. Indeed, that may be among the more important outcomes of an efficiency or productivity-led Innovation Scenario. The OECD is sufficiently concerned about lagging future productivity worldwide, including both developed and developing economies, that it released a special study on this topic (OECD 2015).

But there is good news in all of this. First, there is an increasing number of studies suggesting that energy and resource efficiency can build a more robust and sustainable economy. Notwithstanding its concern for a potentially lagging productivity, for example, a later OECD report noted that low-greenhouse gas emission pathways, including investments in renewables and energy efficiency upgrades, could stimulate long-run economic output by up to 2.8 percent, on average, across the G20 countries in 2050 (OECD 2017). Moreover, the United Nations Environment Program (UNEP) has suggested that the smarter use of energy and other resources can add $2 trillion to the global economy (Ekins et al. 2017). Second, as Figure 3 on the following page attests, energy efficiency has already been the mainstay in supporting new demands for energy services. Over the period 1980 to 2015 the global economy more than tripled in size. Energy efficiency has met 58 percent of the new demand for goods and services in that period while conventional energy resource provided only 42 percent of the new demand. Table 1 provides a more detailed resolution of the data. The scale of energy efficiency hovers around 80 percent for the United States and other OECD nations. Although a lesser range, even the Non-OECD countries benefited from energy efficiency resources that provided 51 percent of new services demands (IEA 2017).

Figure 3. Global Demand for New Energy Services



Source: Calculations based on data from the International Energy Agency (November 2017).

Table 1. Key Energy Service Demand Metrics (1980 and 2015)

	Gross Domestic Product (2010 USD PPP)		Total Primary Energy Use (Exajoules)		New Energy Service Demands Since 1980	
Region	**1980**	**2015**	**1980**	**2015**	**Supply**	**Efficiency**
World	33,625	105,035	301.7	571.4	42%	58%
United States	6,529	16,597	75.6	91.6	14%	86%
OECD Nations	20,656	47,731	170.3	220.2	22%	78%
Non-OECD Nations	12,969	57,304	131.4	351.2	49%	51%

Source: International Energy Agency data (November 2017).

With that unexpected contribution to the expansion of the global economy, many might assume that we likely used up the cost-effective energy efficiency opportunities. A closer examination reveals, however, that huge opportunities remain to accelerate even greater gains in energy efficiency. Appropriately designed and supported policies and programs are key to future successes. The section that follows explores a number of recent assessments to highlight that opportunity.

III. The Opportunity and Scale of Needed Investments

In February of 2017, the Metropolitan Region of Rotterdam and Den Haag (MRDH) released a major assessment and strategic plan that it calls, *Roadmap Next Economy*. The region is now home to 2.3 million people. Despite an expected 49 percent growth in per capita GDP by 2050, community and business leaders laid out a policy framework and investment plan that would reduce total energy use by more than 40 percent compared to current levels of consumption. Together with the deployment of renewable energy resources, the roadmap was intended to also reduce energy-related carbon-dioxide emissions to near zero, also by 2050. Beyond the clean energy transition within MRDH, it was further determined that the more productive use of energy and other resources would expanded the regional economy by about five percent over the reference case. Two things are especially notable in that roadmap.

First, an initial modeling exercise indicated a cumulative investment of €63 billion was necessary to drive that level of performance improvement. That magnitude of outlay, over the 34-year period 2017 through 2050, would be the rough equivalent of 64 percent of one-year's current GDP within the MRDH region. The money would be spent to upgrade buildings and structures, technologies and equipment, and public infrastructure. The latter also included a buildout of the digital substructure to enable a more optimal use of resources. But second, the region also recognized that technology investment alone was insufficient to warrant an optimal outcome. An active policy and program staff, together with contractor support, travel and other overhead expenses, were also vital to ensure the most advantageous result.

Following many interactive discussions, but also a review of several studies which laid out differences between program and policy costs rather than pure technology investments, the assumption was that a successful roadmap would also require spending within the public, private, and non-profit sectors to educate the public about this initiative. Additional monies would be needed to train workers in the use and deployment of the new technologies. Funds would also be required to market, promote and evaluate the relevant programs and policies so that new learning might emerge with an eye toward continual improvement. In the aggregate, the various policy and program initiatives within MRDH might require the spending of €100 million per year in addition to the technology and infrastructure investments. In other words, the policy and program spending is a necessary complement to technology investments—if the roadmap will truly elevate the larger performance of the MRDH economy.

Despite those combined costs, including debt service payments to cover investor or borrowing costs, the region concurred with the overall financial aspects. The reason? The roadmap was still expected to save a net of €700 million per year—even as it pushed energy-related carbon emissions down to near-zero by 2050. The modeling exercise additionally indicated, that as the roadmap pushed the innovation frontier further out (see Figure 2), the MRDH region would become a more robust and resilient economy, one that further supported a net average gain of about 60,000 jobs within Netherlands. And while not a major focus of that particular study, the analysis also pointed out that full array of spending and investments would also drive additional productivity benefits as well as avoiding sizeable health, climate, and other environmental externality costs (MRDH 2017).

The conclusion? Yes, it still takes money to make money. To be sure, success entails a sizeable level of spending to support the emergence of a more productive economy at sufficient scale to drive the kind of changes MRDH believes are necessary to guarantee a smart outcome. But equally critical, technology investments may fall short of their intended impact without a robust policy and program effort which also requires financial support. We explore this aspect next.

Working Estimates of Future Energy Efficiency Investment Magnitudes

At this point we want to generate two separate, although admittedly rough, estimates which might inform OECD and non-OECD economies about the scale of efforts to support a transition to a 40-percent improvement in energy efficiency, together with a greater economic productivity and performance. The first, drawn from an array of studies summarized in Table 2 that follows on the following page, is a working assessment of the investment necessary to drive a large efficiency improvement at the global level by 2050. The second is a working approximation of the essential policy and program costs that are likely needed to ensure the most advantageous outcomes from the anticipated technology investments.

We approach the two estimates more as thought experiments or Fermi problems than a precise estimate of costs (Von Baeyer 1993). The reason for this approach is the lack of consistent data to allow a full and precise set of cost estimates. A Fermi calculation, involving the multiplication of several estimated factors, is likely to be more reasonably accurate than first supposed. This is because there are probable factors that are estimated too high, while other factors that are estimated too low. Assuming there is no consistent bias in the estimated factors, such errors will partially, if not more completely, cancel each other out. Hence, we are essentially modeling “for insights, not numbers” (Huntington et al. 1982).

As a starting point, we have reviewed more than 150 publications for their immediate insights in this regard. As Table 2 highlights on the previous page, we compare investment magnitudes from 12 different studies as the primary basis of the working estimate generated for the International Partnership for Energy Efficiency Cooperation (IPEEC) as it is reviewed in this manuscript. The conclusion of the IPEEC exercise is summarized as the 13th and last study cited in the table (IPEEC 2018).

An opening review indicates a scale of clean energy or energy efficiency investment that ranges from a global $27 trillion over thirty years, about 24 percent of one year’s GDP (also globally) to eliminate almost all equivalent carbon emissions (Drawdown 2017), to a European Union estimate for buildings only energy savings of 34 to 71 percent at a cost of €343 billion to only €584 billion. These last figures are about 3 to 5 percent of one-year’s GDP in the EU (BPIE 2011). The International Energy Agency references a global efficiency scenario that lowers total energy use by about 24 percent from 2040 projections for an investment that is about 9 percent of GDP in 2015 (WEO 2017). On the other hand, engineers and economists at Stanford University have created a 100 percent renewable energy scenario that primarily reduces all energy-related carbon emissions by 2050 with an investment that is about 118 percent of the 2013 GDP for the global economy (WWS 2017). The weighted average for the dozen studies in Table 2 suggests an investment of 35 to 40 percent of a single-year’s GDP. We can imagine a larger scale of necessary investment depending on whether we also include an upgrade to the larger infrastructure, the deployment of renewable energy technologies and systems as well as improved communication technologies to make more efficient use of resources.

To provide a reasonable average annual set of investments, program expenditures, and energy bill savings (highlighted in Figure 4 below) we made a number of critical but reasonable assumptions as described in Laitner (2017). We began with the estimated €6.4 trillion of world energy expenditues in 2017. Drawing from the array of studies previously cited, we set a 2050 goal of a 40 percent savings of a forecasted growth in energy demand. Moreover, we followed the magnitudes of technology investments in the Table 2 assessments, but also tapped into other available studies. Again, drawing from a variety of published energy efficiency scenarios, we assumed an average payback of 7 years (which might range from less than one, to more than 13 years, but which averaged 7 years).

Table 2. Estimates of Investments in Large-Scale, Productive Energy Transitions

Study (Year)	Regional Impact	Cumulative Investment
Drawdown 2017	**Global:** Begininng in 2020, 1,051 $GTCO_2e$ removed by 2050, with the possibility of much greater EE with 100% renewables also by 2050.	**Global:** $27 trillion over thirty years. With a net operating savings of $74 trillion (2014$). Total investment is about 24% of one year's GDP in 2014.
WWS 2017	**Global:** 100% Clean and Renewable Wind, Water, and Sunlight All-Sector Energy Roadmaps for 139 countries by 2050.	**Global:** ~$124.7 trillion (2013 USD). About 118% of one-year's GDP in 2013.
Negawatt 2017	**France:** Substantial sustainability and efficiency outcomes over period 2017 to by 2050. With 100% renewables also by 2050.	**France:** Cumulative investment of €39 billion (in 2017 values), about 2% of one-year's GDP, with an overall savings of €78 billion over the period 2017-2050.
MRDH 2017	**Metropolitan Region Rotterdam/Den Haag:** Greatly improved energy efficiency, with buildout of digital infrastructure and a 100% renewable energy by 2050.	**Metropolitan Region Rotterdam/Den Haag:** €63 billion (in 2013 values). About 64% of one-year's GDP to upgrade the combination of existing energy technologies and local infrastructure between 2017 and 2050.
Climate Economy 2016	**Global:** Scaling up clean energy financing to at least US$1 trillion a year could reduce annual GHG emissions ~20% from 2015 levels by 2030.	**Global:** At US$1 trillion (in 2015 values). About 1% of GDP for clean energy improvements and greater levels of energy efficiency.
WEO 2017	**Global:** Energy use 27% below 2040 forecasted levels while CO2 emissions are 57% below 2040 levels (43% below 2015 levels).	**Global:** $11.3 trillion (2016 USD) which is about 10% of GDP in 2015.
Energy Revolution 2015	**Global:** 80% GHG reduction by 2050 compared to 1990 levels.	**Global:** In the decarbonized pathways, the capital goes up from about $28.7 trillion to about $81.5 trillion (in 2014 USD) a year over the period 2012 to 2050. The net increase of $52.9 is 48% of one-year's GDP.
Roadmap 2015	**USA:** An investment strategy to increase the nation's energy productivity and reduces energy use 25% from current levels by 2030.	**USA:** With an investment of ~$100 billion per year (2010 values). That is about 0.6% of GDP annually to ensure greater productivity.
Stern 2015	**Global:** Looking at a 15-year window (by 2030) to shift investment momentum that reduces greenhouse gas emissions by ~60% from today.	**Global:** Increasing infrastructure investments about $2.5 trillion ablove current levels over the period 2015 through 2030.
BPIE 2011	**European Union:** Building stock assessment only with different scenarios of efficiency improvements, ranging from 34 to 71% savings in 2050 compared to current consumption.	**European Union:** With two of the 5 non-baseline scenarios reported here, total investments are estimated to be €343 to €584 billion through 2050. As this includes buildings only assessments, the size compared to GDP is on the order of 3% to 5%.
ECF 2010	**European Union:** 80% GHG reduction by 2050 compared to 1990 levels	**European Union:** In the decarbonized pathways, the capital goes up from about €30 billion to about €65 billion a year over the period 2010 to 2050. When delayed by ten years, the required annual capital spent in 2035 goes up to over €90 billion per year. That net increase will be 11% to 19% of one year's GDP.
ACEEE 2012	**USA:** Exploring a 42% to 59% reduction from projected 2050 values, or a 30% to 50% reduction from total primary energy use from 2010 levels.	**USA:** $2.4 to $5.3 trillion (in 2009 values) over the period 2012 to 2050. About 17% to 37% of one year's GDP.
IPEEC 2018 (this study)	**Global:** A 40% reduction of projected total primary energy use by 2050 which is about 19% below 2017 levels.	**Global:** Including both program costs of €3.3 trillion, and investment costs of €24.9 trillion, the combined €28.1 trillion (in 2017 values) over the period 2018-2050. About 29% of one year's GDP.

Source: All citations shown in Table 2 are listed among the references of this document.

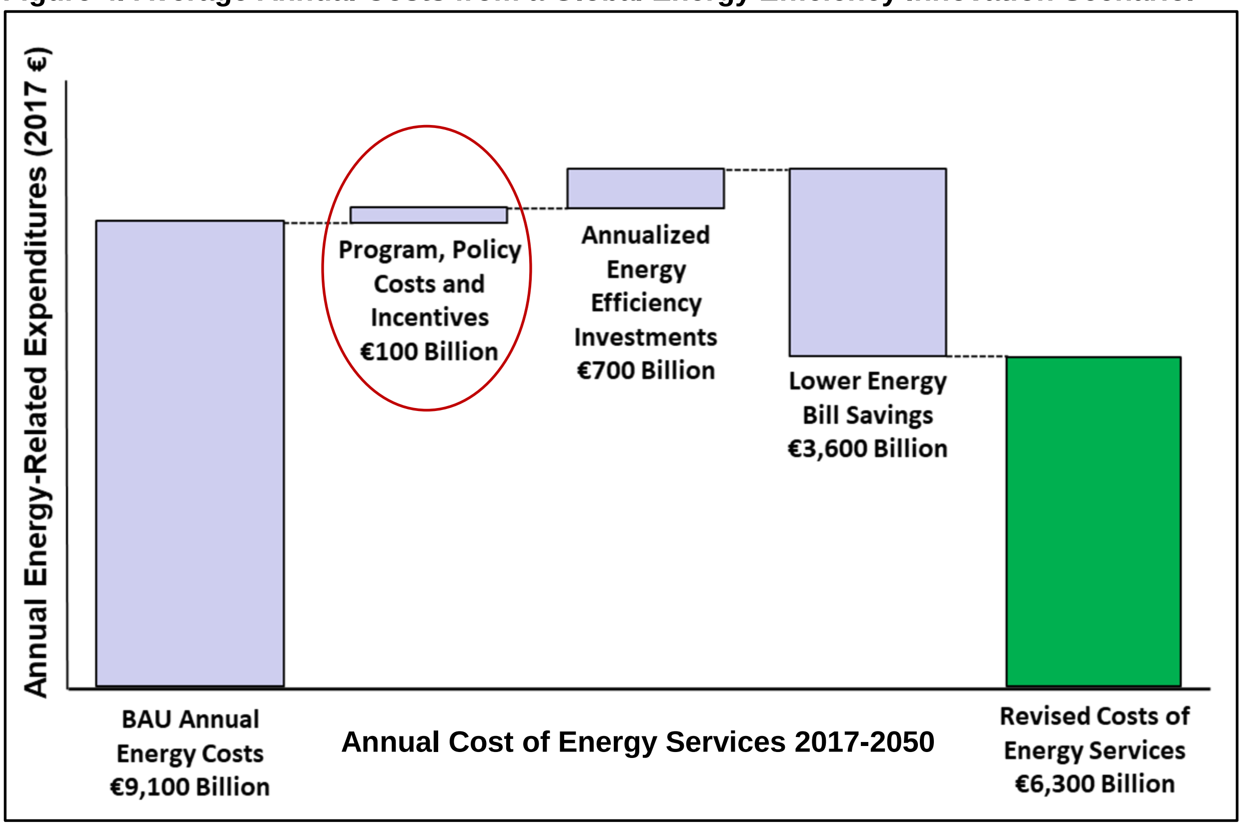
These assumptions all together suggest an aggregate cumulative cost on the order of €28 trillion shown in Table 2 (IPEEC 2018), or about are on the order of 29 percent of one year's GDP. But the aggregate costs also include expenditures for policies and programs which more likely *enable the right scale and the right mix of investments*, which in turn, are more likely to achieve a 40 percent energy efficiency gain by 2050. We next describe the assumptions that underpin our estimates of these latter costs.

Estimates of Policy and Program Costs to Drive Energy Efficiency-Led Investments

Again consistent with the many studies we reviewed, the working hypothesis holds that the mix of policy and program costs might be 20 percent of investments in the early years, but decline to about 8 percent by 2050. The slow reduction in program costs over time, presumes a form of "learning" as well as "economies of scale" and "economies of scope." That is, both experience and expansion of the market decreases this form of fixed costs over time. It also reflects working estimates that include public and private costs. A final assumption is that policy and program costs, as well as technology and infrastructure investments, would be covered by market investors, or by borrowing necessary funds at 5 percent interest over a 20-year period.[2]

A more detailed background on such costs and how they might be financed follow in the next two sections of this report. Here we integrate the immediate findings into Figures 4 and 5 as part of a "Global Energy Efficiency Innovation Scenario." The intent is to provide policymakers and business leaders with a meaningful context on the scale and capacity of such programs to deliver energy efficiency improvements, together with net energy bill savings. At this point, all expenditures and savings (in real or constant 2017 values) were averaged at the global scale over the individual years 2017 through 2050. Figure 4 below shows the resulting values as annual averages over the full time-horizon. Figure 5, on the other hand, displays them as a year-by-year assessment of costs and energy bill savings.

Figure 4. Average Annual Costs from a Global Energy Efficiency Innovation Scenario.

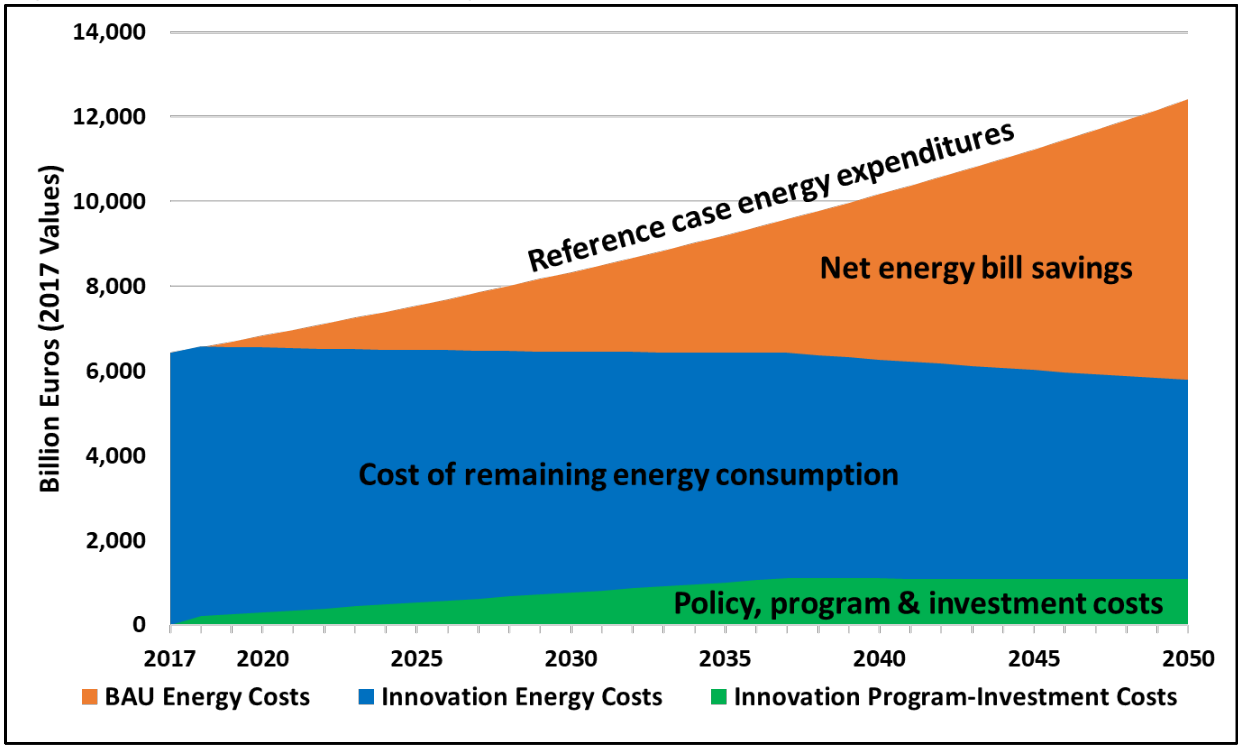


Source: John A. "Skip" Laitner (December 2017).

[2] More of the analytical details can be found in Laitner (2017).

Figure 4 begins with a business-as-usual (BAU) average annual energy cost of €9,100 billion, again over the period 2017 through 2050. Since a major focus of this report is on the critical role of policies, programs and practices to drive down the overall cost of energy services (discussed more fully in the section that follows), we immediately note an implied increased annual spending of €100 billion to ensure a likely positive outcome.[3] As a result, we then have the mix of the €100 billion of program expenditures, coupled with the annualized (amortized) €700 billion of efficiency investments which, in turn, generates the lower energy bill savings (~€3,600 billion). This results in a lower average cost of energy services (~€6,300 billion). The net gain is an average €2,800 billion per year. And as suggested previously, a greater energy productivity would likely increase the robustness of the global economy—for both the OECD and non-OECD nations. That, in turn, would amplify the benefits of these policy and program investments. Figure 5 highlights these global energy expenditures as they might appear annually over the same period 2017 through 2050. The key insight? Without the foundation of smart policy and program investments, the net energy bill savings is likely to be much less than shown here.

Figure 5. Impact of a Global Energy Efficiency Innovation Scenario



Source: John A. "Skip" Laitner (December 2017).

IV. Building Momentum with Smart Policies and Programs

If we are to solve the challenges posed by energy and resource inefficiencies, preemptive actions will require what we call "purposeful effort" and "directed actions" that, in turn, will require large sums of productivity-led investments. Yet, as already put forward, large expenditures on infrastructure and technology by themselves will be insufficient to achieve any new outcome. Current investments and program deployment are moving too slowly and the longer we wait to commit to changing the way we live to higher the price will become. Indeed,

[3] As discussed in the subsequent section of this report, but the policy and program spending, as well as the energy efficiency investments themselves, can be paid through a variety of financial mechanisms are offset by the energy bill savings.

Lord Nicholas Stern (2015) has already asked the question on climate change, "why are we waiting?"[4] Inaction has consequences, not just monetarily, but economically and socially as well. Yes, the costs of committed, focused investments are high; but as discussed here, the cost of inaction is higher still. With the right policies and programs in place, however, large-scale investments become both attainable and significantly profitable.

Still, there are extensive barriers for those who want to innovate or adapt, whether businesses or households (Levine et al. 1995). The slow pace of program and efficiency data has many policymakers waiting for years to see if a certain technology or program is yielding the benefits expected, and in the current system many feel forced to wait for those results to take action. There is also a lack of available program analysis for review. While most programs provide the overall budget numbers and the calculated energy savings this is insufficient when trying to implement new cost-effective programs as the variety of ways in which money was spent within the program are usually not recorded, or not released for public review.

Moreover, there is lack of clear consumer and workforce education, communication, marketing programs, and evaluation tools which can improve the design and diffusion of effective financial strategies and program delivery mechanisms. At the same time, there is a good deal of confusion on all elements of an optimal transition to a clean and productive resource economy. This often leads business and policy leaders who might overlook key programs that would help the movement toward a clean energy economy, and then also show both the energy and non-energy benefits almost instantly.

Given this backdrop, one of the key working assumptions in this assessment is that policies, programs, and best practices are needed to drive the requisite investments in the different innovation scenarios. As one recent analysis argued, if we are to achieve deep reductions in greenhouse gas emissions, promote a greater level of energy efficiency, and support innovations that invigorate a more robust economy as well as the many co-benefits (such as clean air and a better quality of life), it is 'absolutely critical' to get the policy right (Busch and Harvey 2016). At the same time, however, if we are to achieve policy success, a dedicated workforce—in both the public and private sectors—is needed to plan, promote, and carry out programs to ensure the desired technology deployment. Staff are also needed to ensure the training of people who will install and maintain the new technology systems as well as evaluate the actual success of the next policies and programs. To generate an estimate of what these incremental program costs might look like, the authors borrow from a variety of studies including Wolfe and Brown (2000), Laitner and McDonnell (2012), and Hoffman, Rybka et al. (2014), among many others. In this analysis the authors assume that program and policy expenditures might require about 20 percent of the scale of technology investment beginning today, but declining to just 8 percent by 2050.

At the same time, we also build on previous work published by the International Partnership for Energy Efficiency Cooperation, or IPEEC (see, for example, IPEEC 2017a). In addition, we tap into many other assessments to show the costs of inaction and why large scale, meaningful, informed, investments are not only an economic imperative, but how they will make sense economically only if the scale of smart programs are in place to support the larger network of the investment opportunity. Following the insights offered by Lord Nicholas Stern (2015) once again, but many others as well, we begin with the assumption that the environment and the

[4] As a further insight, European Climate Foundation (ECF 2010) found that investment spending for decarbonized pathways would move from about € 30 billion in 2010 to about € 65 billion a year in 2025. But when delayed by ten years, the required annual capital spent goes up to over € 90 billion per year in 2035.

economy can no longer afford to wait for greater energy and resource productivity (Ekins et al. 2017). At the same time, we consider how programs can be better funded to foster the acceleration of clean energy and energy efficiency innovation—even as they help protect against losses and speed up the learning process so that better information and insights can quickly reach those on the front lines of program implementation. This is very much in the tradition of knowledge management techniques—see, for example, the seminal book, *If Only We Knew What We Know* (O'Dell and Grayson 1998)—which would also increase the cost-effectiveness of programs overtime, leading to more investment as the payback periods shorten and the risk is subsequently lowered.

The U.S. Energy Star Program as One Immediate Example of Effective Program Spending

Since its inception in 1992, and through the year 2014, the U.S. Environmental Protection Agency's Energy Star program has saved consumers and business a cumulative $362 billion in avoided energy costs. The net savings appear to be on the order of $31.5 billion in 2014 alone (CPPD 2016). Those benefits have been the result of 16,000 partnerships and collaborations, relying primarily on a smart labeling program (Farrell 2017). The program over the last 5 years—together with its many partnerships, marketing and online activities—appears to have driven an estimated annual investment of $20 billion per year in the purchase of much more energy-efficient products (CPPD 2016).

Energy Star is perhaps to most recognizable energy efficiency program in the United States with the Energy Star labels being recognized by 85 percent of Americans (Ryan 2017). Yet the investment would likely not have occurred without the $50 million annual program effort over the recent years (Farrell 2017). There were no other formal energy star performance standards, nor any other policy effort, to drive this scale of energy bill savings. In other words, the very large benefit of a $362 billion savings would not have materialized but for the programmatic effort of the Energy Star team. Hence, the need to focus attention on the opportunity, provide critical information, and enable a dynamic market response that encourages businesses and consumers to buy Energy Star products. In short, it takes money to make money. The discussion that follows here both characterizes and highlights the critical role that smart energy efficiency policies and programs necessarily play in driving more productive effort, and encourage critical investments in the more productive use of energy.

Energy Star emphasizes best practices in both the program design phase as well as the program implementation phase. For very basic program design the best practices include: conducting extensive market research, assessing the local home energy rating systems (HERS) infrastructure, assessing credentialed heating, ventilation and air-conditioning (HVAC) contractors in the market, benchmarking construction practices, and identifying potential barriers to full program participation. In the program implementation phase the organizers should: Invest in marketing, set up strategic incentive structures, budget for staff training, conduct a cohesive communication strategy between stakeholders, and ensure sufficient investment in strong measurement and evaluation (CPPD 2016). Needless to say, all of this takes adequate funding to ensure success.

The best practices suggested by the Energy Star program align and support the thesis outlined in this paper. They show the vast experience and success of the Energy Star program can provide very real benefits to both consumers directly, and to many collaborations and strong partnership programs that seek to improve as new insights and data emerge, and as evolving markets and new technologies continue to unfold. When such programs adhere to best practices shown by the many successful partnerships, the benefits can be brought forward and implemented quickly—with a minimized risk. Equally important, as the programs move forward with continual improvement, based on actual findings and past successes, they amplify the opportunities for future benefits and returns.

Other Equally Effective Policies and Programs

Any number of studies and scenarios point to large opportunities and net benefits associated with a variety of energy efficiency improvements. But most omit those key policy and program expenditures as part of their analytics or scenario evaluations. As but one example, the European Climate Foundation (ECF 2010) provides a solid Roadmap 2050 showing that Europe could achieve an economywide reduction of GHG emissions of at least 80% compared to 1990 levels. But omitted in the analysis are the costs of policies and programs necessary to safeguard that positive outcome. Similarly, the well-known McKinsey study (Granade et al. 2009) found that, if executed at scale, a holistic energy efficiency investment in the U.S. economy would yield gross savings worth more than $1.2 trillion. This was anticipated to achieve a roughly 23 percent reduction in projected energy demand, “well above the $520 billion needed through 2020 for upfront investment in efficiency measures,” but again not including program costs. The assumptions appear to be that the program costs are relatively small, and that they’ll likely pay for themselves with lower energy costs, especially when externalities and the benefits from a more robust economy are included. But that “assumption” doesn’t help policymakers from OECD and non-OECD nations understand the scale of what must be implemented to catalyze a positive outcome. Hence, the review provided here.

Looking at how energy efficiency programs have fared with past large investments provides a starting point to review the practices that have worked when large investments are moved into the clean energy industry. Having the benefit of time to look back and review many programs associated with the 2009 economic stimulus package implemented within the United States, most now believe that the clean energy programs provided many advantages in both energy savings and other non-energy benefits.

A journal article by Mundaca and Richter (2015) provided an assessment of the 2009 stimulus package to review the full range of benefits associated with Green Energy Economy areas of the American Recovery and Reinvestment Act. While the report concluded that, overall, many benefits in energy savings, emissions, and non-energy benefits were clearly documented, there were missteps when it came to program effectiveness. This was the result of a few key issues including: a lack of impact and evaluation reporting, common data points, as well as an incomplete measurement of social impacts, together with limited program level data.

They also found that there were missed opportunities because of the lack of employee training in the use of newly-funded technology; and there was a lack of communication and cooperation between organizations that would have made the programs much more cost-effective in the long term (Mundaca and Richter 2015). This supports the argument that stronger evaluation and measurement is needed in all programs and brings to light the importance of organizations working together more closely so that their funding and available resources are more effectively deployed and put to work. Other reviews also support such a perspective. Schauer (2015) notes, for example, that valuing non-energy benefits, such as health and safety gains and improved sustainability, is no simple task. This does not mean, however, that the benefits do not exist and cannot be measured with some degree of confidence. Improved program design with real-time learning can also extend the array and scale of such benefits in the future. But again, this takes funding.

With the success of the Energy Star program, and with the review of the many difficulties arising from the investment of the 2009 stimulus package, there are many areas of improvement now recognized as needed in program organization. If adequately implemented that would better support large and fast-moving investment that decreases risks and maximizes both near-term and long-term successes. Yet again, this will require adequate and on-going financial support as well as an active collaboration among many different parties. We next explore the range of policy and program costs.

Estimating Administrative and Overhead Program Costs

More broadly, government assets provide a critical slice of infrastructure necessary to support economic activity within the United States—or within any region. According to the U.S. Bureau of Economic analysis (BEA 2017), for every five dollars of investments and assets provided by the private sector, at least one dollar of state, local or national government investments must be provided to enable the economy to meet the full array of social and economic demands within the U.S. Roads and bridges are perhaps the most familiar form of investment, but they include other assets such as structures, equipment, and intellectual property of various kinds.

There are also many benefits that spring from associated programmatic activities of governments as well. For example, the U.S. General Accounting Office (GAO 2017) cites measurable financial benefits of $63.4 billion from its investigative work—a return of about $112 on every dollar of GAO spending. At a more local level, Colorado Governor John Hickenlooper (2017) noted that Colorado is home to nearly 30 federal labs and research institutions which attract some of the most innovative research conducted globally, contributing an estimated $2.6 billion to Colorado's economy annually and returning $5 for every $1 invested. To date, third-party evaluations for the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy (EERE 2017) have found that a taxpayer investment of $12 billion has yielded a net economic benefit of more than $230 billion over time. The annual return on such investments is placed at more than 20 percent. It should be very clear from these several examples that—when properly funded and allocated—government programs can provide a significant benefit for any regional or national economy.

Yet, the array of examples listed above reflect various kinds of non-specific government operations. To better understand typical overhead costs associated with establishing and operating energy efficiency programs, we begin with a study that evaluated the prospects for an Energy Efficiency Resource Standard which could become a highly useful energy productivity tool for United States as whole. Laitner, Furrey and Nadel (2009) reviewed a modest 10 percent energy savings for natural gas and 15 percent for electric utilities by 2020 (within implied benefits extending out to 2032). Their analysis suggested a benefit-cost ratio of greater than 3.0 with a net gain of 247,000 jobs by 2020. Program costs were estimated to be 36 percent of the cumulative investment. As might be expected, the programs costs included both administrative expenses and other overhead costs, but they also included incentives that might be given to utility customers as rebates to encourage their adoption of more energy-efficient technologies and best practices.

We can compare the estimated 36 percent scale of program costs with a review conducted by the Electric Power Research Institute (EPRI 2014). The intent was to assess the energy efficiency potential for electric utilities in the United States through the year 2035. In that particular study, the analysis indicated, that even with a number of efficiency initiatives already underway (beyond business-as-usual), a further reduction of 11 percent might be anticipated in 2035. To capture the achievable potential assessed in that study over the forecast period would require a cumulative $401 billion in additional capital costs. The program administration costs were assumed to be 20 percent of the incremental costs of the technologies, or about $80 billion for utility-administered programs.

We can step back a bit, both in history and scale, to compare other estimates of administrative program costs. Wolfe and Brown (2000), as one example, examined an array of program planning costs, design, analysis and evaluation expenditures, as well as activities devised to reach customers, bring them into the program, and deliver services such as marketing, audits, and application processing. In addition, tasks such as ongoing bid reviews, inspections and quality control assessments, but also staff recruitment, placement, compensation, development, training, and transportation, data collection were included. Moreover, reporting, record-keeping, and accounting, and finally overhead costs such as office space and equipment, vehicles, and legal fees were reviewed as part of a series of 12 policies and programs. In the aggregate, these various costs were estimated to run about $0.50 per gigajoule of primary energy saved.

Berry (1991 and 1989) reviewed the expenses incurred by utilities to administer demand-side management programs in the 1980s. Her work appears to provide the only published overview of administrative costs relevant to energy efficiency programs at that time. She estimated those costs approached 20 percent of the incremental technological costs per unit of primary energy saved. This was perhaps not so surprising since both Berry as well as Wolfe and Brown were all working with the Oak Ridge National Laboratory at the time, and they frequently collaborated and shared relevant information in a timely way.[5]

A review of other program administrative costs averaged 26 percent of total utility costs (excluding customer cost contribution) which is consistent with earlier findings by Berry (1991). When customer costs are included, program administrative costs fell to about 13 percent of the total cost of the programs (Eto 1996).

While the specific overhead costs of many energy efficiency program cannot yet be determined, we can infer a set of administrative expenditures that might range between 10 and 30 percent of total incentive payments provided to program participants. Thus, the average share of 20 percent of total incentive payments is specified as overhead costs in this study (Suerkemper et al. 2012). To extend the analysis of what these incremental program costs might look like, the authors (of this current manuscript) borrow from a variety of studies including the already-cited Wolfe and Brown (2000), the previously-referenced Laitner and McDonnell (2012), Laitner et al. (2012), and Hoffman, Rybka et al. (2014). Following those insights, and as already discussed, the authors assume that program and policy expenditures for this analysis might require about 20 percent of the scale of technology investment beginning today, but declining to just 8 percent by 2050.

Evaluation, Monitoring and Verification (EM&V) Budget

Another key budget item to look at is the cost of Evaluation, Monitoring and Verification (EM&V) evaluations. This goes back to the need for cost-effective evaluations of program outcomes to both validate expected outcomes, but also to ensure an ongoing review of program design to ensure an even more positive result in the future. In order to conduct these reviews, however, a portion of the program budget needs to be set aside for this kind of verification. This presents the same issue as the overhead budget as many programs do not report or even budget for program evaluations. Sometimes it may be included in the larger cost estimates while other

[5] In the interest of full disclosure, one of us (Laitner) was a senior economist for EPA's Office of Atmospheric Programs in 1996 through 2006 and funded the Wolfe and Brown (2000) study.

times it may be treated as a discrete expenditure. Yet, a robust EM&V is an essential component of any successful energy efficiency program. It should be typically kept in between 3 to 5 percent of program budget (Schwimmer and Fournier. 2014). For a number of programs that have been identified, the separate monitoring and evaluation costs appear to average less than 3 percent of total utility costs—that is, before including customer costs or contributions to the efficiency improvements (Eto 1996).

These differences in 'needs' for less or more rigorous EM&V also translates into significantly varying levels of investment in EM&V. Anecdotally, it appears that many public utility and local and state government efficiency programs, as well as private sector projects, have very little, if some level of inspections to verify installations. A somewhat recent study by Lawrence Berkeley National Laboratory (LBNL) indicated that EM&V activities in energy efficiency program funded by utility customers ranged from less than one percent to over five percent of program budgets (Messenger, et. al. 2010).

In most cases, and compared to an aggregate of total administrative costs, EM&V budgets were reported to vary between 1 and 5 percent of the program budget with most recommendations between 3 and 5 percent of the total budget. In a review of 15 states where EM&V budgets were reported for energy efficiency programs the average had 3 percent of the total budget set aside of EM&V activities (SLEEAN 2012).

EM&V provides valuable data that can help close the gap in needed information to quickly and effectively deploy energy efficiency programs at a high level and because of this EM&V should always be included in program budgets and be conducted throughout as well as after the program has ended. The data from these evaluations can help future programs build off of past successes and learn from past failures, both being imperative to a solid understanding when deploying programs quickly and effectively.

V. Financial Mechanisms to Enable Positive Outcomes

The purpose of finance is to underwrite both policy and program costs as well investments that enable communities, households, businesses, and governments to upgrade practices, equipment, and infrastructure to greater levels of energy efficiency. The key idea presented here is to convert energy bill expenditures into assets that generate a return through much lower costs of energy (and often with other savings such as reduced water consumption, lowered operation and maintenance expenses, and even a smaller regulatory burden). Perhaps equally important, and a key idea, is that anticipated energy savings can also fund staff support and activities which enable assessments to be done, and new initiatives to be carried out, as well as enabling the monitoring and evaluation of efforts that can lead to new initiatives. In this section we examine two key elements of finance. First, we lay out the idea of a business plan that can generate an initial quote to move the project(s) or program(s) to the next phase. Second, we provide a brief overview of a mechanisms that might be useful in underwriting the desired energy efficiency upgrades – especially as they might be put to work in developing nations where access to capital may be more limited.

Requisite Authority and Modes of Governance

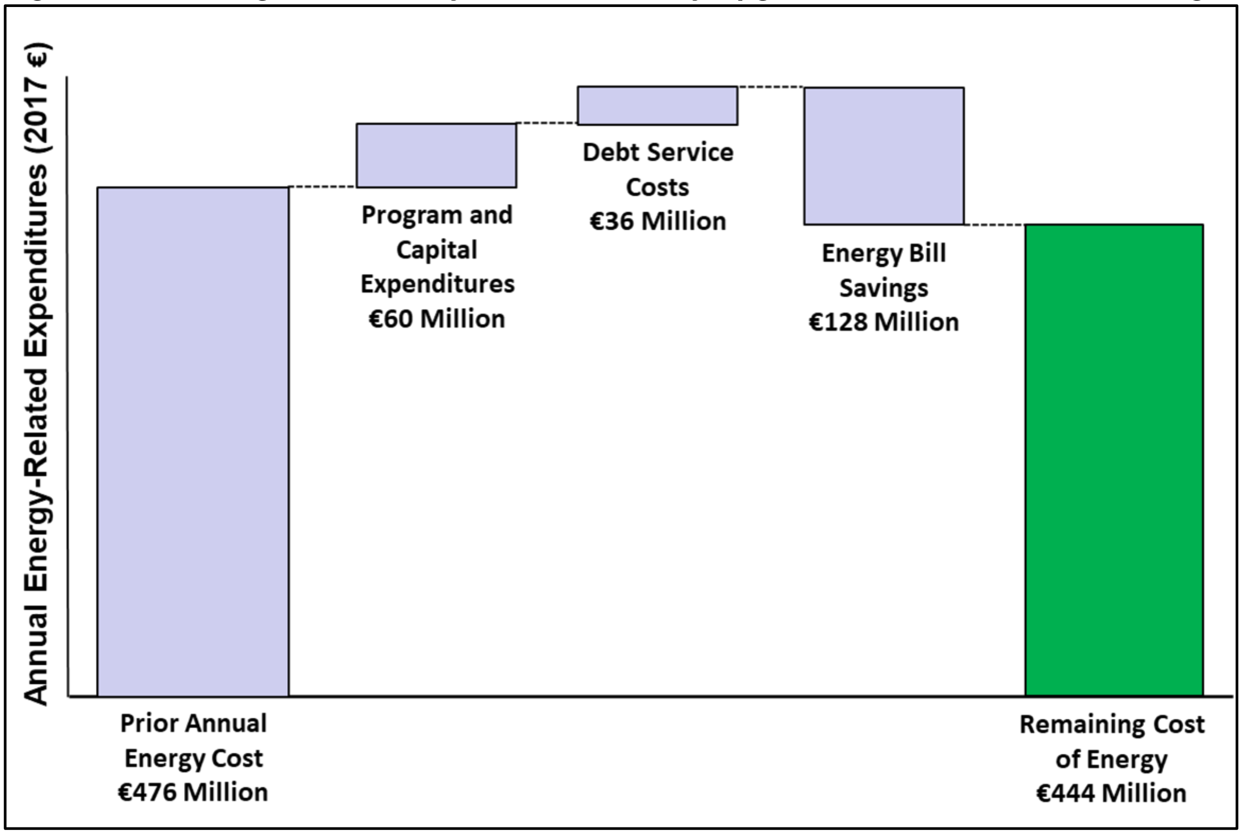
It is generally well-understood that nation states possess the necessary authority and means to implement programs, policies, and financial mechanisms that enable investment in the energy efficiency measures necessary to enable positive, community-wide outcomes. Yet, it seems less clear for many subnational governments or municipalities that they, too, possess substantial legal means to effectuate the same positive energy efficiency outcomes. Indeed, the development in many countries suggests that municipalities may not fully use their authoritative powers; and they are reluctant to apply authoritative modes of governing through regulatory measures and strategic planning.

Some have described urban authority as being comprised of four modes or categories. These modes are distinct in terms of their governing capacities and range from soft forms of governing to traditional forms of state intervention. First, *self-governing*, can be defined as the capacity of local government to govern its own activities, for example, by improving energy efficiency in government offices and other municipality-owned buildings. Self-governing relies on reorganization, institutional innovation, and strategic investments. This is especially important when the facts on the ground positively support such investments—and hence, the value of a concrete estimate which we will draw attention to shortly. Second, *governing through enabling* refers to the role of local government in coordinating and facilitating partnerships with private entities and encouraging community engagement. Tools such as persuasion and (positive) incentives are most important for this mode of governing. Again, such engagement can be better supported by a solid business plan. Third, *governing by provision* implies shaping practice through the delivery of particular services and resources. This is accomplished through infrastructure and financial policy. Fourth, *governing by regulation* can be characterized as the use of traditional forms of authority, such as control and the use of sanctions. Although these modes of governing may overlap, and individual measures are often based on a combination of several modes, these distinctions provide a framework for helping to illuminate the full range of latent municipal authority (Kern and Alber 2009).

Key elements of a business plan

Perhaps the best way to explain the central idea is to use an illustrative example. Let us suppose—by way of a working example only—that there might be a subnational region or city somewhere within Europe that has a population of 190,000 people within its borders. After some initial review we might find that, on average, its inhabitants currently have a per capita energy expenditure of €2,470 annually. Total energy costs economy-wide might, therefore, run about €476 million for all current uses of energy. And let us further imagine that key business and community leaders—for whatever reason—want to reduce energy use by, say, 30 percent (if not more). But, not surprisingly, there may be no immediate funding for such an effort within the community; nor is there a sufficient available staff support to enable such a project (or set of projects) to move ahead. Let us also imagine that a working assessment suggests that the idea is feasible, and that the simple payback of a portfolio of energy efficiency upgrades (as we previously noted) might pay for themselves, on average, within seven years. Except that, as we also noted, there is no immediate staff available to manage these details and to carry out any level of project activity. Given that situation, we must finance not only the intended mix of energy efficiency upgrades, but also the necessary staff activities as well, to see that the job gets done.

Figure 6. Financing a Community-based Efficiency Upgrade for a Possible 30% Savings



Source: From the example described in the narrative.

After further investigation, we might learn that the region can secure financing over a 20-year period at five percent interest if there is credibility and support that underpins the plan itself. And while the scale of effort might be possible, we might also find the need to staff support to ensure an effective implementation and a positive end-result. Based on the prior discussion we might anticipate that staff support will average 20 percent of the required investment. It might necessary for a higher level of staff effort in earlier years to negotiate the financial outcomes and to get the activities underway. And need for staff support might be less in the future as the market adjusts and as consumers become more familiar with the program effort. Finally, we might assume that although the financing might have a 20-year time horizon, the program implementation generally will take place over the first five years of effort. We might then find, that for this phase of effort, slightly more than half of staff support will be required in the first five years with the last 15 years of effort costing the remaining half of staff time.

As Figure 6 above suggests, beginning with an annual flow of €476 million in energy expenditures, the program and capital costs might average €60 million per year over the 20-year period. That covers perhaps €10 million for staff support and other program costs, with the actual cost of the efficiency improvements averaging €50 million. In addition, we might anticipate debt service (interest payments) to average €36 million. If the various and assessments prove to be valid, then energy bill savings might approach €128 million per year. Combining both the extra costs to make the efficiency upgrades possible, the net savings (not show) might be only €32 million which reduces the remaining cost of energy to just €444 million. So, with a credible business plan, proper financing, and appropriate staff support also covered, total energy costs are now slowly reduced by 30 percent by the smart redeployment of financial resources to accommodate both staff activities and the resulting investments.[6]

Overview of potential investment models

So where do we get the capital? The Energy Efficiency & Finance Task Group under the G20 & IPEEC has already published some very useful tools to guide businesses and policy leaders in the development of monetary tools which can channel large investment flows toward desired outcomes (e.g., IPEEC 2017b and 2017c). These range from on-bill financing with fixed payments to utilities and other energy suppliers, and energy performance models patterned on the energy service company or ESCO model. The MRDH community is currently investigating that approach together with support from the European Bank and the cooperative banking community. Almost immediately, the owner-financed model has emerged out of the natural, underlying tendency for the rational-economic building or asset owner to value the cost savings apparent in energy efficiency retrofits and a reduction in energy bills. Building owners have the ability to independently contract and finance the energy investments through savings or a loan often secured by the building itself. The owner-financed model has significant barriers to overcome to reach an optimal, often large-scale investment. This is particularly evident where the building owner is not the same party responsible for the energy bills. The owner-financed model, on its own, may well be insufficient to leverage the levels of capital necessary to ensure a robust economy going forward. Such a model might be easily complemented by some form of economic performance financing (EPF) through what are called Economic Performance Bonds (EPB). Again, the previous IPEEC work on the variety of financial toolkits (e.g., IPEEC 2017b and IPEEC 2017c) provide a useful bridge between the opportunity and the reality. Regardless of the source of financial support, the critical element is to lay out a solid business plan, underpinned by the (admittedly simplified) analytics that is characterized in Figure 6, but that also inspires confidence among both investors and the community more generally.

VI. Conclusion and Opportunity—If the Choice is Made

The evidence is compelling—immediate solutions are warranted to address climate change on the one hand, but also to ensure a robust and sustainable economy through the greater use of energy and resource productivity (OECD 2017). To address these needs at scale will also require large-scale funding and investments. Equally compelling, however, is the need to a policy-driven response that is supported by adequately-funded program and administrative support. In short, funding for technology solutions alone may not achieve an optimal outcome—either at sufficient scale or with the right combination of programs, incentives and efforts. Hence, the need for financing mechanisms that benefit from large scale energy bill savings, but that also provide funding support for smart policies and programs that are more likely to guarantee the kind of returns that will enable smart climate as well social and economic solutions to emerge. The need is there, the opportunity is there, and the returns can be generated at scale—but only if the appropriate choices are made.

[6] Some readers may note that a savings of €128 million is only 27 percent of €476 million. The reason is because of a smaller initial savings in the current couple of years as the program builds to scale. The 30 percent savings is reached by the last year of the program, but it averages only 27 percent over the full several years.

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