Technical Note

A Global Green New Deal for Climate, Energy, and Development

A big push strategy to

Drive down the cost of renewable energy
Ramp up deployment in developing countries
End energy poverty
Contribute to economic recovery and growth
Generate employment in all countries
and
Help avoid dangerous climate change

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Key Messages

Energy is the key to economic development, and renewable energy is the key to a future without dangerous climate change.

But renewable energy is too expensive today, especially for the world's poor, many of whom have no access to modern energy at all.

Although the price of renewable energy is falling, it will not fall fast enough anywhere, on its own, to help the world win the race against time with dangerous climate change.

Public policies can help produce the necessary decline in the global price of renewable energy and make it universally affordable in one to two decades.

The key mechanism is a rapid increase in installed capacity. A "big push" in both public and private investment to scale up renewable energy will lead to rapid cost reduction, technology improvement, and learning by doing.

Investment and cost reduction will generate a "virtuous cycle" of additional investment, economic growth, employment generation, energy security, geopolitical stability, international cooperation and emission reductions.

This "big push" cannot be implemented by any country alone. In the first decade-and-a-half, it will require globally funded guarantees, or price supports (e.g., through a global "feed-in tariffs" program), to subsidize investment.

After that, the "virtuous cycle" will take over and make further price supports or international transfers unnecessary, as renewable energy becomes the default option for new energy investment worldwide.

Price supports will be complemented by a global renewable energy extension program: research, technical, and policy support designed to accelerate the process.

This strategy is called *the Global Green New Deal*, and the time to adopt it is now.

Introduction: Push Down to Lift Up

The world *can* avoid dangerous climate change – by pushing down the price of renewable energy, as quickly as possible.

The aim of climate negotiations is to reduce greenhouse gas emissions and enable adaptation to climate change without endangering momentum on development. This paper proposes an approach that can help achieve all these objectives in a practical and timely manner: a focus on accelerated investment in a renewable energy future.

There is now broad agreement on the need to *dramatically reduce* global emissions of carbon dioxide in the coming decades. At the same, there is also agreement on the need to *dramatically increase* the economic prospects of the world's poorest people, and in particular to provide them with modern energy services. These goals are often seen as being in conflict with one another, and continuing to view them as conflicting slows progress towards either. Only by considering them together as a single, *integrated* challenge does a way beyond the impasse become visible.

But first, we must change our strategic perspective on the problem of climate change. Currently, all eyes are locked on the accumulation of greenhouse gases in the atmosphere, and therefore on emissions reduction, or "mitigation," as the strategic response to this problem. But we must remember that emissions reduction is a *goal*; it is not a *strategy*. In fact, the almost exclusive focus on emissions targets offers few attractive choices to negotiators (Birdsall and Subramanian, 2009). It locks the world into a perceived "win-lose" or even "no-win" scenario, as an ever-shrinking emissions pie must be divided up among (1) those who have already eaten more than a lion's share, and (2) those whose growing and justifiable hunger exceeds the size of the remaining pieces on offer.

As a *goal*, the need for emissions reduction is unimpeachable. As a *strategic focus*, however, it is leading us down a dead-end path.

The only viable strategy is to create a bigger pie – and this requires us to shift our focus from the rapid reduction of greenhouse emissions to *the rapid expansion of renewable energy.*

Energy is the key to economic development and social wellbeing, and renewable energy is the key to a future without dangerous climate change. While forest conservation, land-use changes, and efficiency measures are essential contributors to any positive climate scenario, there can be no future climate stability without a rapid conversion from fossil fuels to sun, wind, and water-based energy technologies.

Fortunately, there are encouraging signs that such a transformation in the energy sector is already under way. The global market for renewable energy has been estimated at $1.6 trillion as of 2007-08. Annual growth rates have been reported as 25% for wind energy, and 80-100% for solar photo-voltaics. With these dramatic increases in capacity have come equally dramatic declines in cost. For example, the cost of solar panels has

fallen from $5 per watt in 2005 to just over one dollar per watt in 2009; and in just three to five years, Japanese planners are expecting to cut the cost of a solar electricity generation system in half (European Commission, 2009).

Despite these rapid advances, renewable energy remains expensive, especially for the two billion people who have no access to modern energy services. Prices are falling, driven by increasing market demand, scale economies, and technological diffusion as well as technology improvement. But prices have not fallen fast enough to make such technologies affordable at large scale in developing and emerging industrial economies. They have not fallen fast enough to outcompete coal, oil, and natural gas as the default choices for energy. They have not fallen fast enough to offer a realistic alternative to millions of women huddled over wood fires, or to others who continue to suffer from the health- and planet-damaging soot of burning biomass.

In sum, the price of renewable energy has not fallen fast enough to save the world from experiencing dangerous climate change. Nor will it fall rapidly enough, on its own, to do so.

But this problem is actually an enormous opportunity in disguise – for it is a problem the world can do something about. By working together to *push down* the price of renewable energy, as rapidly as possible, we can *lift up* the prospects of people everywhere, both environmentally and economically.

Creating positive tipping points and virtuous cycles

Recent research by the United Nations and others (see, e.g., United Nations 2009, Birdsall and Subramanian 2009, Jacobsen and Delucchi 2009) has focused on ways to drive down the price of renewable energy in the near term, accelerate its spread globally, improve the economies of both the developed and developing world, and end energy poverty. This genuine "win-win" strategy carries with it another extremely important benefit: it makes possible the attainment of critical emission reduction targets, and thus reduces the risk of dangerous climate change.

The "Global Green New Deal" (GGND) brings the different components of the strategy together into an integrated program: international goal-setting, limited-time subsidies, targeted investments, coordinated national development policies, and comprehensive extension systems. Together these can accelerate the global economy's arrival at a "positive tipping point" in the spread of renewable energy. Pushing down the price of renewables and removing the barriers to their adoption will accelerate the process of industrial scaling-up in that sector – a process which is already under way. Expanded markets for renewable energy, and faster growth rates in production, will lead to faster technology improvement, which will further lower costs and thus prices. The result will be a “virtuous cycle” of expansion, learning, and cost reduction. Within a relatively short period of time – between 10 and 20 years, depending on how quickly the world ramps up – prices will have fallen to the point where subsidies for renewable energy are no longer necessary. (See box, "The Global Green New Deal - By the Numbers.")

The Global Green New Deal - By the Numbers

The mechanics of the GGND strategy are straightforward. Step 1: define the "global affordability target", assumed here to be $0.03 to 0.05 per kilowatt-hour, corresponding roughly to $1.00-$1.50 per Watt investment cost. Step 2: Collect information on current investment costs as well as current and expected future (in this case, 2025) levels of installed renewable energy capacity, assuming no global renewables investment program. Step 3: use learning curves to estimate the installed capacity corresponding to the global affordability target. Step 4: Estimate the additional investment needed to expand installed capacity to the level estimated in the previous step. Step 5: Estimate the share of the incremental investment that needs to be supported through international price guarantees.

The main variation in the result stems from different estimates of technology learning curves. However, even the conservative estimates of learning curves show that the global affordability target can be reached with additional investment of up to $100 billion (in 2005 dollars) per year over fifteen years. This would bring down the costs of two leading renewable technologies (solar PV and wind) to a level that is universally affordable. Significantly greater investment is necessary for Solar PV than for Wind, but even wind requires subsidized investment to achieve the target price within the target timescale.

Step		Wind	Solar PV
1.	Global Affordability Target (Investment cost $/W)	1.00	1.00
2a.	Current investment costs ($/W)	1.50	2.90 - 3.40
2b.	Current installed capacity (GW)	120	13
2c.	Installed capacity expected in 2025 under BAU (GW)	570	160
3.	Installed capacity corresponding to GAT cost (GW)	700	1390
4a.	Additional capacity needed to achieve GAT (GW)	130	1230
4b.	Additional investment cost (billion 2005 USD)	$33	$1,476
5.	**TOTAL ADDITIONAL INVESTMENT COST**	**$1000-1500 billion**	

Source: Preliminary analysis by UN/DESA-DSD, using expected installed capacity data provided by IEA (2009), and learning curve estimates (investment costs per watt of installed capacity) provided by IIASA (2009).

This is the upper end of such estimates. The actual figure would very likely be lower. Step 5 (i.e., international transfers) is not estimated explicitly, but it can be expected that at least two-thirds of the additional capacity would be deployed in developing countries. In higher income countries, the additional costs of renewable energy are generally passed on to consumers in their electricity bills.

The strategic objective of the GGND is to make proven renewable technologies universally affordable, so that renewable energy becomes the default choice for the world as a whole. Making renewable energy affordable directly addresses the needs of developing countries and emerging economies, where the demand for new energy services is most acute, and where the vast majority of new energy development is expected to occur in the coming decades.

But pushing down the price of renewable energy also ensures that, as aging infrastructure comes up for replacement in the industrialized countries, those replacements will also result in a shift from fossil to renewable power sources. In both cases, pushing down the price helps prevent the lock-in of investment capital in fossil-fuel-based technologies, which would expose the poor to decades of pollution, and doom humanity to suffer the consequences of additional global warming.

The GGND involves the mobilization of large-scale public and private financing for *investments*, whose returns at the global scale include:

- *Employment*: Millions of new "green jobs" in a rapidly expanding renewable energy sector in both developed and developing countries. (Investments in renewable energy have been shown to create two to three times as many jobs as investments in conventional energy development.) (Pollin and Garrett-Peltier, 2007)

- *Energy Security*: Increased geo-political stability, improving the conditions for trade and exchange of all kinds. (As nations become less dependent on the production and importation of fossil fuels, they will have less reason for conflict over the sources of both energy and emissions.)

- *Reduced Climate Risks*: A significant reduction in costs associated with the expected damages from accelerated global warming. (As the Stern Review and others have noted, inaction on global warming could result in costs as high as 20% of world output in the coming century.) (Stern, 2006)

- *International Cooperation*: A clear pathway for multiple actors to channel international finance for mitigation, as well as a mechanism for phasing out such financing within one to two decades. (In recent work, Stern et al. note that a well-structured finance scheme will create aligned incentives, encourage governments and private sector actors to work together, and create the virtuous cycle of investment and development that is the essence of this strategy.) (Stern, 2009)

- *Greenhouse Gas Mitigation*: The contribution of this investment to greenhouse gas mitigation consists of two components: direct and indirect. The *direct* component is the avoided emissions due to the substitution of a new renewable energy plant for a conventional energy alternative, most likely coal. In this case, this works out to the avoidance of between 2.5 and 3.5 billion tons of carbon dioxide per year by 2025 and every year thereafter. Assuming an investment life of 40 years, the cumulative emission reduction would be between 100 and 140 billion tons of carbon dioxide at an incremental cost of up to $1,500 billion, in other words, between $15 and $11 per ton of carbon dioxide. However, this is only a part of the story. Once the cost of the renewable energy becomes competitive and affordable, it will become the default option for future power sector investments. This means that. between 2025 and 2050, the initial investment of $1,500 billion will continue to produce additional offsetting of

carbon dioxide. If power sector capacity continues to grow at historic rates and in accordance with rising demand from developing countries, this will result in the avoidance of an additional 8 billion tons of emissions per year at no additional cost.

From forward-looking firms in the energy sector, to individual householders in the world's poorest countries, to skilled workers and experts in all countries, a Global Green New Deal creates many winners in the global economy. Implementing the GGND will lay the foundation for a new, self-sustaining cycle of green growth globally, while steering the world on a course to end the scourge of energy poverty and avoid the threat of dangerous climate instability (Figure 1).

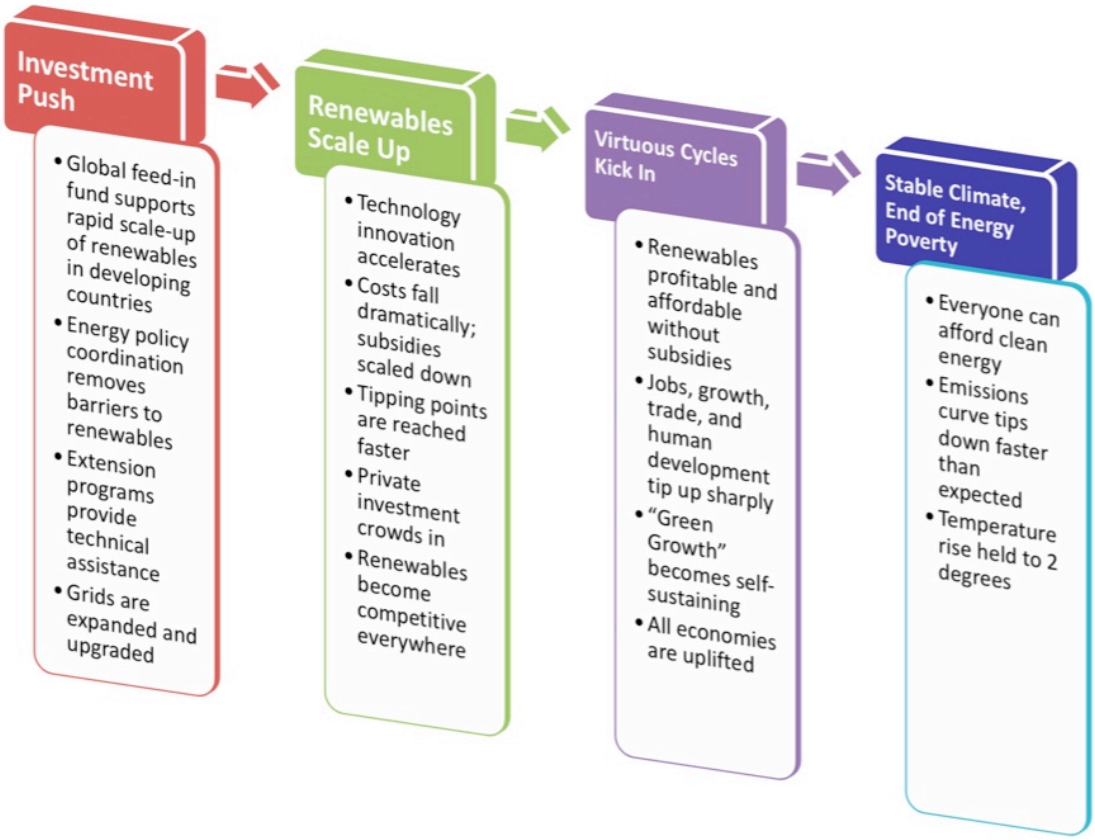

Figure 1. A schematic of how the Global Green New Deal will work to accomplish its objectives

The Elements of a Global Green New Deal

The GGND involves the rapid deployment of nine integrated mechanisms that will work together as a renewable energy accelerator:

The GGND Road Map

1 **Set Targets:** Set clear targets for both *renewable energy costs* (i.e., the cost needs to become affordable as well as competitive with conventional technologies, currently between $0.03 and $0.05/kWh), and for *the year by which the target cost is to be reached* (e.g., a global target year of 2025). Given known rates of cost reduction, this will imply a corollary target for renewable energy installed capacity.

2. **Set Price Guarantees:** Determine a schedule of guaranteed prices ("tariffs") to be offered to suppliers of renewable energy, based on estimates of current and future costs. The tariffs offered to new entrants in the market would decline by a predetermined amount every year, converging on the target price by the target year. This tariff schedule would provide a strong incentive for accelerated investment and development of installed capacity in the near term.

3. **Determine Host Country Contributions:** Create a formula for estimating the share of the feed-in-tariff to be paid by the host country. This formula would be related to per capita income in each country, the cost of specific renewable and conventional alternatives, domestic investment capacity, and other relevant factors.

4. **Establish a Global Investment Fund for Renewables:** A global investment fund for renewable energy is essential for underwriting the gap between the feed-in-tariffs that need to be offered to suppliers to make renewables competitive, and the share of the subsidy that can be contributed by host countries. The investment fund will guarantee – *for a fixed period of time* – a subsidized price for the delivery of new renewable energy in developing countries.

5. **Provide Additional Support to the Least Developed Countries:** Support could include low interest loans, e.g., for grid expansion, financial assistance for capacity building and institutional development, technical assistance, or subsidized access to technological information.

6. **Create Mechanisms to Serve Off-Grid Communities:** Offer special provisions within the global financing scheme to support renewable energy development for off-grid communities, e.g., supplementary subsidies or assistance for building local grids.

7. **Create a Network of Innovation Centers:** Building on the analogy of the Green Revolution, establish a network of research and extension centers that will adapt technical knowledge to local conditions, and make that knowledge available to policy makers, investors, and communities.

8. **Create a Global Climate Conservation Corps:** Learning from the lessons of several successful large-scale initiatives – including the Peace Corps, the Civilian Conservation Corps, and Médecins Sans Frontiéres – establish and recruit a global body of skilled practitioners who can support national institutions and serve as their link to international experts and knowledge bases.

9. **Develop the Appropriate Institutional Architecture:** Careful attention must be paid to creating appropriate institutional vehicles – both new and in relationship to existing bodies – to channel the resources from the global feed-in fund, through national energy administrations, to renewable energy suppliers.

Agreement and action on these elements as rapidly as possible, at a global scale, will speed renewable energy toward its own "global tipping point" – a point of self-sustaining take-off powered by accelerated learning and expanding markets.

While the GGND is a new, comprehensive strategic approach, it brings together the converging conclusions of several recent global analyses, all of which point to a central role for increased public investment in renewable energy, particularly in the developing world (e.g., Stern, 2009; Birdsall and Subramanian, 2009; UNEP-SEFI, 2009). The strategy also builds on what is already happening: successful models for each of these mechanisms exist, in both the developing and developed world. A number of developing countries (notably China, India, and Brazil) have already established key elements of such policy, finance, and technical support mechanisms. However, the scale expansion needed to bring about the necessary cost reduction is larger than what can be achieved by these countries acting alone. The GGND will supplement national actions with international support, and simply enable developing countries to do more – and more quickly.

The GGND also encourages an even faster diffusion of working models in the industrialized world, where countries like Denmark, Germany, and Spain have led the way on developing the necessary technologies, policies and programs. These early investments in renewable energy are already being rewarded with both near-term financial returns and longer-term competitiveness; the Global Green New Deal will work to amplify these effects, reward innovative enterprises, expand employment opportunities in technologically advanced countries, and spread the benefits more rapidly to other countries.

The GGND ensures long-run predictability and market stability for renewable energy producers as well as equipment suppliers, and thus creates the basis for effective public-private partnership, mobilization of large-scale private sector resources for investment and innovation, capacity expansion, and cost reduction.

The GGND also ensures that international resources are linked to tangible outputs (delivery of final renewable energy services) rather than inputs.

Finally, adopting the GGND will bring many benefits of the kind that economists call "intangibles," but that are widely recognized as both real and necessary for success in any venture of magnitude. These include:

- a feeling of *hope and optimism* – specifically, that large-scale problems like global warming and energy poverty can be solved;

- an encouragement to *entrepreneurship* – there are genuine business opportunities to pursue; and

- a sense of common strategic *focus* – on the goal of reducing the price of renewable energy, and accelerating a global transition to a clean energy future.

The GGND represents a global opportunity for cooperation, for only by pushing together, and pushing hard, can we lower the price of renewable energy enough to lift many millions out of energy poverty and provide clean, affordable energy to the world.

The Case for a Global Green New Deal: Changing the Game on Climate, Development, and Energy

The GGND represents a new approach to addressing, simultaneously, the problem of global warming and the imperative of bringing energy and economic development to the world's poorest peoples. But while the overall concept is new, the elements of the GGND are based on existing models and supported by extensive current research. The following sections summarize the case for the GGND, explain the underlying assumptions, and describe how the strategy would work in more detail.

A. Climate, development, and energy are interconnected issues.

The rationale for the GGND begins with a fundamental insight: climate change is not a problem that is somehow set apart from other problems. In particular, it is intimately connected to both the type of development and the energy path chosen to power that development.

Behind the GGND is the following postulate: A massive deployment of nonrenewable, fossil-based energy technologies in the *developed* world is what enabled those countries to attain unprecedented levels of prosperity within a short span of time; but it also led to the current climate dilemma. A rapid and equally massive deployment of clean, renewable energy technologies in the countries of the *developing* world can enable them to attain similar levels of prosperity and, when joined to a large-scale energy switch in developed countries, can lead the world out of that dilemma.

The energy needs of the world's poor have long been overlooked in the global discussion on climate change, in terms of both current needs and future planning. (Figure 2) And yet, the poor also represent the world's largest undeveloped energy market. Today, about 1.6 billion people lack access to electricity; and 2.4 billion still cook with firewood. By 2050, there will be 3 billion additional people living on planet Earth, and the vast majority of them will be relatively poor urban dwellers in developing countries. If the energy systems developed to provide light, heat, mobility, and other services to all of these people are based on fossil fuels, there will be no possibility of attaining the emission reductions necessary to maintain climate stability.

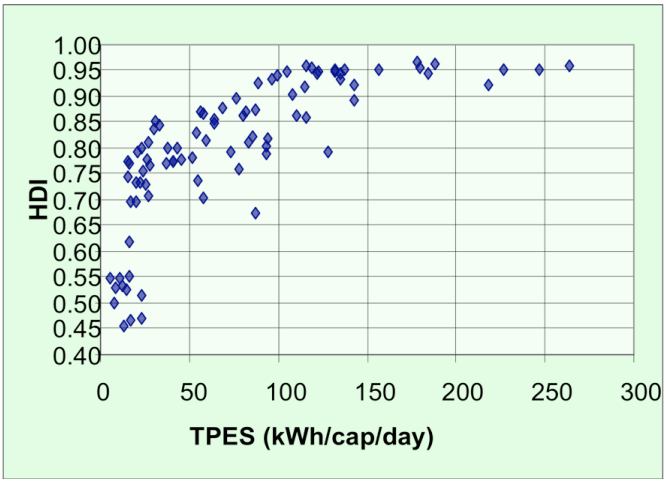

Figure 2. Distribution of countries showing the correlation between Total Primary Energy Supply (TPES) and score on the Human Development Index (HDI). Source: United Nations, based on UNDP and IEA data.

Providing energy to the world's poor should not merely be seen as a "long-term vision"; it is an urgent global imperative. Energy services are key inputs to development generally, and to human development in particular. Improvements in health, education, and standards of living are closely correlated with access to energy. Inadequate and unreliable energy services are

centrally implicated in the inability to provide clean drinking water or sanitation facilities.

On the other hand, most low-cost energy sources available today to meet the needs of the poor are neither clean nor renewable. They contribute to greenhouse gas emissions and often carry with them significant health risks, such as respiratory illness from exposure to soot particles.

When the low-cost energy needs of the poor are seen as being in opposition to emission reduction goals, agreement on a way forward becomes exceedingly difficult. But by looking at climate change and development as *united* by a common issue – energy – rather than divided by it, true win-win solutions become possible.

The GGND offers such a win-win solution in the form of a strategy that meets the needs of developing nations for energy development, while accelerating progress toward the goal of a low-emissions economy for the world as a whole. It functions as a bridge between perspectives and priorities, providing everyone at the climate negotiating table with a common goal: the provision of clean, affordable, renewable energy to all.

B. The world has a common interest in reducing the price of renewable energy, worldwide, as rapidly as possible.

The next 10-20 years are a critical window for the implementation of the GGND, because so much new energy development will be planned and implemented during this period. If renewable energy is to contribute a significant portion of new energy development, especially in the developing world, reducing its price is essential.

As of August 2005, about 1.4 billion people in the developing world were living on less than $1.25 per day (the World Bank's poverty line). However, even people living on ten dollars per day cannot afford to buy adequate amounts of renewable electricity at the current price per kilowatt-hour, which ranges from about 36 cents from solar photovoltaic panels to as low as 10 cents from a wind turbine. For low-income people around the world, energy that costs more than 3-5 cents per kilowatt-hour is simply not affordable; and so in the absence of subsidies renewable energy will not be their choice.

From a developing country perspective, a strategy of simply *increasing* the price of conventional energy to make renewable energy more competitive makes no sense. Nor can the governments of developing and emerging-market countries afford to subsidize renewable energy on a large scale, given current costs and per capita incomes. Meanwhile, in the developed world, the strategy of simply waiting for the market to produce competitive renewable energy, and greenhouse gas emission reductions, has also been "failing to deliver" (*The Economist*, 15 October 2009, citing Committee on Climate Change, 2009).

To make progress at a pace that can win the race against time with global warming, we need a global strategy for reducing the price of renewable energy, everywhere. This requires accelerating the process by which the price of these new technologies is already falling: that is, by scaling up.

For example, in Europe today, every time the amount of wind generation capacity doubles, the price of electricity produced by wind turbines falls by 9 to 17% (Krohn, European Wind Energy Association, 2009). With each new wind turbine, the industry

learns how to make these machines more efficiently and more effectively, thus driving down the costs per kilowatt-hour. Economists call this effect a "learning curve": the more renewable energy generating capacity gets installed, the more we learn about how to produce renewable energy, and the less expensive it becomes.

Such steep and beneficial learning curves are associated with several so-called "emerging technologies", including wind energy, solar photovoltaic and concentrated solar energy (Figure 3). In contrast, "mature technologies", such as Hydro PPL (Figure 3), have stable cost curves with relatively small opportunities for further cost reductions. Current evidence suggests a very large potential for cost reductions in wind and solar energy. There is even evidence to suggest that their learning curves are changing in favorable ways, creating the prospect that a virtuous cycle of investment scale-up and cost reduction will happen even faster than current analyses might predict. For example, a consortium of solar cell companies in China has twice revised estimates on the speed of cost reduction just since 2007. They have moved up the planned target year to achieve a government target price ($0.146 per kWh) from 2020 to 2012, because of unexpectedly fast technological advances and lower polysilicon prices (Saber, 2009).

Relatedly, studies on the costs of compliance with government environmental policies and regulations support the conclusion that *ex ante* costs are often overestimated because of a failure to take into account scale economies and technological advances (EC 2005).

Although learning rates have occasionally been described in terms of the cost decline per year, their primary driver is the *installed capacity*. (Figure 3) That is, prices fall with growing installed capacity because of such factors as a larger market, greater market stability and predictability, standardization of equipment and component production, competition amongst suppliers, improved designs, and learning by doing.

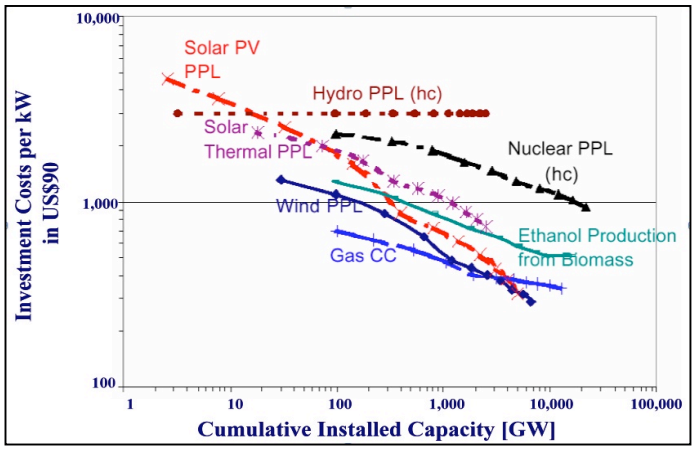

Figure 3. The greater the installed capacity of an energy technology, the lower price for every new unit installed. (Source: Nakicenovic, IIASA, 2009)

In sum, one can accelerate progress down a learning curve by *speeding up the increase in installed capacity*. The GGND proposes to do just that, by reducing the primary barrier standing between developing countries and current renewable energy technologies: their relatively high price. Using public investments and subsidies to reduce the price to rough parity with fossil fuels, combined with a stable policy environment and technical support, will remove the major constraint to accelerating installed capacity. It will also unlock waves of demand and drive the rapid deployment of these technologies. As the technologies spread, industries scale up, and capacity doubling times decrease, then prices will fall, following the well-known pattern of the learning curve.

Having described the driver of the GGND – the technology learning curve – we now turn to the accelerator: price supports.

C. *A globally coordinated program of price support guarantees for renewable energy will unleash a transformation in the global energy sector.*

Countries have used a variety of mechanisms to promote renewable energy, including direct public investment, investment incentives (e.g., low interest rates, tax write-offs, accelerated depreciation), portfolio obligations, and feed-in-tariffs. While all policy mechanisms have had their share of success, the most dramatic expansion in renewable energy capacity was witnessed under the feed-in-tariff programs enacted in Germany and Spain. "Feed-in tariffs" obligate electricity grids to purchase renewable energy as it becomes available (to "feed it in"), and they offer to potential providers of renewable energy a guaranteed price (the "tariff," or rate paid for the electricity). The tariffs are generally fixed for a given period, between 10 and 20 years, at levels that ensure the profitability of the investment. The existence of a guarantee that successful development of a solar or wind energy installation will be rewarded with a customer as well as a subsidized price essentially levels the playing field, removing the cost barrier to renewable energy development in comparison to fossil-fuel-based technologies.

The effectiveness of the feed-in tariff policy is by now well-established. A study comparing the effect of these policies to other policy mechanisms designed to support the spread of wind energy found that they resulted in *7-8 times* as much installed wind capacity. (European Commission, as reported by Thomas B. Johansson, Chair, Global Energy Assessment) (Figure 4) The overall success of the German, Spanish, Danish and other national-level feed-in programs has inspired similar initiatives in China and, more recently, South Africa and India, as well as by regional and state governments in the UK, US, and Australia. Today well over 50 countries now have feed-in tariff laws on the books, and smaller-scale experiments are now a global phenomenon.

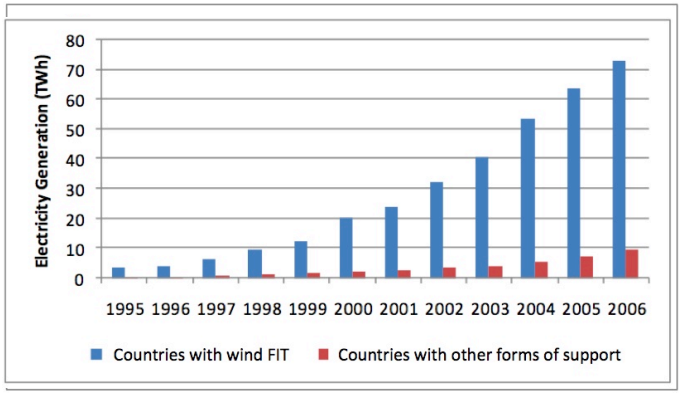

Figure 4. Countries using feed-in tariffs compared to countries using other forms of policy support for wind energy. (Source: European Commission, 2008, cited by Johansson, 2009)

Of the different options to support renewable energy, the feed-in tariff is increasingly seen as the "policy of choice" that provides the most benefit at least cost (DB Climate Change Advisors, 2009). It can be applied consistently and transparently, while being readily adapted to different specific conditions in different countries.

Where feed-in tariffs have been employed in developing countries, they often have to be accompanied by government budgetary allocations to cover the differential between the guaranteed price that the utility pays to the renewable energy suppliers, and the average rate that it is allowed to charge consumers for each kilowatt-hour of electricity. This dependence on national budgets to cover the difference places a cap on the total expansion of renewable energy that can take place in a developing country, and thus creates a disincentive for expanded renewable energy investment. International

financing to support the tariff, or price guarantee, will remove this constraint and create highly favorable conditions for accelerating renewable energy investment and development.

As the phrase itself indicates, feed-in-tariff policies have been employed exclusively in regard to grid connections. Given the current level of grid development in most developing countries, the policy framework would need to be amended to be able to include off-grid areas as well.

In practical terms, the GGND involves linking the demonstrated favorability and effectiveness of feed-in-tariff policies with the rapidly growing energy needs of developing countries, offering suitable mechanisms for finance, policy, and technical support for rapid scale-up. It delivers the right mix of policy and market stability that, according to recent research summarized by Stern et al., can create the highest possible leverage for public financing, mobilizing up to 15 times the original investment in additional, follow-on funding (Stern, 2009, and UNEP SEFI, 2009).

The GGND Road Map (page 6) brings together elements of successful programs, including feed-in-tariffs as well as other complementary actions, in such a way as to accelerate the process of policy design and technology diffusion and adoption that is already occurring, remove major barriers and obstacles, and adapt the program both to international requirements and local conditions.

As mentioned in the GGND Road Map (Paragraph 4), a new global investment fund needs to be established to contribute the global share of the subsidy for renewable energy services and supplement the national guarantees offered by each country. As such, the Fund will reduce uncertainty and ensure predictability in the renewable energy industry. Once it is in place and adequately resourced, it would help stimulate a rapid and massive expansion in the market for solar, wind and other renewable technologies – and speed them toward an economic tipping point, after which they would be on track to become the dominant energy option on the planet.

The price support mechanisms need to be structured in such a way as to reward the most efficient renewable energy suppliers and to give them an incentive to reduce costs as rapidly as possible. The concept of a declining tariff schedule mentioned in the GGND Road Map (Paragraph 2) seeks to ensure this by stipulating that price supports decline and disappear within a defined period of time (10-20 years). Producers would race to enter the market ahead of the declining subsidy and establish their competitive position in the marketplace. Where appropriate, countries could choose additional policies (such as renewable portfolio standards and innovative financing of upfront costs) that would encourage utilities and local governments to be more proactive in cooperating with renewable energy suppliers.

If the GGND were launched immediately, the economics and the technologies of the world energy sector could be transformed by 2025. With renewable energy costs becoming competitive with fossil fuels, subsidies could soon be discontinued. The majority of the world's poor would have access to energy from affordable, renewable sources – the new default option.

D. A large-scale global investment in renewable energy will bring multiple economic, social, and environmental benefits – especially to the developing world.

The GGND would transform the global economy, to the great benefit of people everywhere. For example, renewable energy is a much more effective engine for employment creation than fossil-fuel based energy production: research suggests that it produces *two to three times as many jobs*, in comparison with conventional fossil-based energy development. (Pollin and Garrett-Peltier, 2008)

Wind and solar energy systems do have the problem of intermittency – that is, they are less available when the wind is not blowing or when the sun is obscured – and this will need to be addressed in the coming decade as the scaling-up process gains speed. But technology is also advancing in the area of energy storage. Initially, the expansion of intermittent renewable technologies might need to be accompanied by additional consumer guidance on tailoring demand to availability, as is often provided in many developing countries whose energy systems are subject to frequent service interruptions. More generally, renewable energy is also viewed as a more resilient, reliable, and safe technology: wind and solar-based systems break down far less often than fossil-fuel combustion-based systems, they are simpler, less dangerous to operate, and far less polluting.

For energy importers (a term that includes all but a handful of countries), economic stability will also benefit from creating a global energy sector that is far less reliant on imports. Poor countries especially will be shielded from the impacts on their balance of payments and growth prospects from global price swings and peaks.

The reduction in fossil-fuel emissions will also bring significant health benefits by reducing exposure to pollutants like soot and ground-level ozone. And while renewable energy installations take up space on the land or in the water, this can be managed in ways that are minimally disruptive to natural ecosystems.

Private companies producing and installing renewable energy technologies, and the private banks and international financial institutions that finance them, are already significant beneficiaries of the world's transition toward renewable energy. The GGND would certainly accelerate that trend as well. But also benefitting would be companies that provide material inputs for production of renewable energy, as well as companies providing such associated services as smart grid development, smart metering, energy storage and batteries. These technologies would get a significant boost as a by-product of the GGND, from private investors as well as from international financing institutions such as the World Bank and regional development banks (who would play a crucial role in financing the development of smart grids, for example). All of this additional economic activity would further accelerate the "virtuous cycle" of investment and technology improvement.

A GGND could be an engine of true "green growth," improving per-capita incomes and employment in countries around the world. The greater levels of job generation, energy reliability, technology advance, and economic stability, together with reduced vulnerability to fossil-fuel price fluctuations, can be expected to support the world's long-term recovery from the recent financial crisis.

Overall, the GGND is expected to put the future world economy on a more solid foundation for long-term sustainable development. This expectation is supported by

United Nations economic models looking at the impact of high levels of public investment in low-emissions energy (World Economic and Social Survey 2009) as well as relevant case studies. In Germany, for example, approximately 280,000 jobs have been created in renewable energy – two-thirds of them as a direct result of the country's renewable energy laws. And the rate of job growth is still increasing. (German Ministry of Environment, 2009)

E. Direct public investment and investment support are essential; offsets and other market mechanisms focused on the price of carbon are not sufficient to achieve the goal.

The logic of the GGND is straightforward. To address climate change, renewable energy must be made both competitive and affordable. To do this, the installed capacity of renewable energy must be expanded. To expand capacity, there will be a need for some form of subsidy in the near term, either from governments or from consumers. Subsidies for renewable energy are happening today, but in an uncoordinated manner. New energy infrastructure is being built rapidly in developing countries, but the share of renewable energy is limited by the lack of financial and technological resources. Effective global cooperation in the form of additional financial resources and technology transfer will be needed to scale up the national efforts to the required level.

The GGND supports simultaneous investment in two global goods, namely, social and economic development based on renewable energy, and climate stabilization. It involves public investment in energy infrastructure as well as investment support to renewable energy suppliers, to ensure adequate private rewards for supplying these social benefits. It offers a straightforward business proposition: do well by doing good. For national economies, this large-scale investment in bringing renewable energy to the developing world and making it universally affordable will bring benefits, in terms of employment, growth, greater macroeconomic stability and energy security.

Specific options for mobilizing international finance for green energy investments in developing countries have already begun to be explored and described in several recent institutional and independent studies (Stern, 2009; Avato, 2008; Mendonça, 2007; UNEP SEFI, 2009). Some of the mechanisms to raise the funds might include: traditional government treasury bonds, "green" bonds linked to renewable energy investments, auctioning of national or international CO_2 emission allowances, carbon taxes, levies on international passenger and freight transport, a tax on financial transactions, an allocation of developed country SDRs, to name a few. Careful review of these and other options would be among the first orders of business in planning the implementation of a Global Renewable Energy Fund, with the likely conclusion involving a mix of options. Complementary investments in grid development (e.g., transmission lines from solar or wind installations to cities) in the developing countries would likely be financed through existing mechanisms and agencies such as the World Bank and regional development banks.

Of course, the need for policy direction and enhanced public support to investment in renewable energy is not limited to the developing world. As noted above, the most striking successes in switching to renewable energy have taken place in countries that adopted feed-in tariff programs. Similarly, as cited earlier, recent analyses in the UK suggest that efforts to reduce carbon emissions by relying primarily on the market deliver only a fraction of the desired result (Committee on Climate Change, 1999). While cap-and-trade programs, carbon offset purchases, carbon taxes, and other economic

instruments will continue to be helpful additions to the policy mix, they appear unable on their own to stimulate the development of the market for carbon-free energy solutions at anything like the required pace to address climate change by making renewable energy affordable to the poor.

Estimates on the scale of investment required to bring about a true transformation in the global energy sector vary, but a preliminary review of current learning curve analyses suggests that investments at the level of approximately $100 billion per year, deployed over a fifteen-year period, would be sufficient to increase the installed capacity of renewable energy to the point where costs were drawn down to the level of affordability in developing countries. That is, in the next fifteen to twenty years (depending on how quickly investments were ramped up), clean and renewable energy could come down to the 3-5 cents-per-kilowatt-hour level that would put it in reach of nearly everyone on the planet (See box, page 3).

Adoption and implementation of the Global Green New Deal is not dependent on raising that level of investment immediately. The mechanisms described here can be put in place at lower levels of investment, and then ramped up over a 3-5 year period (for example), as additional information becomes available on how these mechanisms are working and as confidence grows in their effectiveness. Still, there are payoffs to early and rapid scale-up (that is, to front-loading investments), both in progressing towards the Millennium Development Goals (MDGs) and in avoiding dangerous climate change. Each year's delay in reducing emissions adds significantly to the costs – and reduces the chances – of avoiding dangerous climate change (AVOID, Met Office Hadley Center, 2009). But inability to mobilize funds for $100 billion-per-year investments at the outset is not a reason to forego this significant opportunity to cooperate in creating a sustainable energy future.

A "global feed-in tariff" program of price support for renewable-generated electricity is a payment-on-delivery mechanism; funds flow only when the electricity comes on line, that is, when real and tangible benefits are being provided. Experience suggests that the existence of an internationally guaranteed price support for renewable energy will address the traditional issues of investor confidence associated with renewable energy, opening the door to private bank lending and other debt financiers of new capacity. (Experience in Spain suggests that banks and other financers see investments in renewable energy, backed up by a feed-in tariff, as very safe; and Deutsche Bank notes that "within a consistent and durable integrated policy framework incentives such as feed-in tariffs are a key driver of investability" (DB Climate Change Advisors, 2009).)

F. A complementary global program of coordinated policy guidance and large-scale extension activities will ensure success.

While price is the principal obstacle to the spread of renewable energy in both the developed and the developing world, it is not the only one. The Global Green New Deal includes a commitment to a large-scale program of policy and extension support. Creating a predictable enabling environment for the rapid spread of these technologies is an essential element for the success of this strategy. These have been addressed in Points 7, 8, and 9 of the Road Map described above.

Models for globally coordinated extension programs do exist. The Green Revolution, notwithstanding its environmental and social drawbacks, does provide an example of a global strategy that delivered new technologies from the hands of a few hundred

scientists to millions of poor farmers (most of whom were illiterate) in poor countries at a breathtaking speed and scale. The innovations included the establishment of research institutes and extension programs to assist farmers and other agricultural sector actors with the adoption of new seeds and growing methods. These programs also helped create integrated systems of policy, technology, and capacity that ensured rapid uptake and resulted, as is widely known, in greatly increased agricultural yields.

Point 7 of the Road Map ("Create a Network of Innovation Centers") envisages the creation of a similar network of institutes and centers to support both the design and harmonization of policy and the adoption and adaptation of suitable renewable energy technologies. While the funding and goal-setting will be global, the implementation of the actual policies and energy systems must happen at the national level, with full respect for national differences and preferences.

To further accelerate the process, Point 8 of the Road Map proposes the establishment of a "Global Climate Conservation Corps," a global corps of experts and extension agents who could back up the national institutions, provide training, technical support, and helping hands. Ideally, experts in universities, technical institutions, industry associations, and volunteer networks could be mobilized through financial support as well as network development to participate in a global enterprise. Participants in this program could be drawn from young entrants to related professions, experienced professionals, and highly-skilled retirees from both the developing and developed world. For some, the motivation to participate would be the ideal of service; for others, especially young people from developing countries, the program would serve as on-the-job training and an employment opportunity. It would also help to accelerate the development of the next generation of technical experts to service a rapidly expanding industry.

Since renewable energy installations can be decentralized and small-scale, mechanisms and policies are needed to accommodate small-scale and off-grid installations, particularly in developing countries (see Point 6 of the Road Map). While large, industrial-scale installations of solar, wind, and other technologies are central to the Global Green New Deal, the extension model is ideally suited to this additional decentralized dimension and medium and small scale installations.

These programs, in addition to materially supporting and accelerating the implementation of a renewable energy revolution, will create a global feeling of hope and inspiration – intangibles that are important to meeting the challenges we face. In a time when the world is locked in a literal race against time, with both the eradication of poverty and the restoration of climate stability as conjoined goals, these programs of on-the-ground cooperation may prove as important to success as financial investments and technical advances.

G. Both renewable energy technologies and complementary technologies will be adapted to national situations.

Although explicit mention has been made above of wind turbines, solar photo-voltaic arrays, solar heat concentrators, wave and tidal energy convertors, and other emerging renewable technologies powered (ultimately) by incoming solar radiation, a number of other technologies would be needed to achieve success. As noted earlier, the GGND would include measures to support the adoption and diffusion of complementary technologies. These include:

"Smart grids" and "smart meters." These are now picking up speed in the developed world and should also be the focus of leapfrog technology efforts in the developing world.

Efficiency technologies. In the building sector, rapid advances are permitting drastic reductions in the energy needs of both new and retrofitted housing. Light, heat, cooling, and other energy-dependent services can now be provided at fractions of previous electricity consumption, depending on the designs and materials used and the methods employed. The GGND should include mechanisms that encourage an equally rapid spread in these technologies as well.

Selected specific and acute priorities. The GGND could potentially include provisions to address a limited number of non-grid but energy-related issues that have been identified as acute, global-scale problems, such as the black soot emitted by cooking fires (which is both a serious health hazard and a dangerous addition to global warming). The extension program of the GGND could, for example, be used in concert with policy and finance mechanisms to plan and accelerate a conversion to cleaner and more sustainable cooking technologies. Indeed, the green revolution extension model appears well-suited to fostering adoption of new cooking technology by hundreds of millions of dispersed rural households.

Finally, the proposed network of research and policy institutions would keep a close and continuous eye on innovations and developments emerging around the globe. It would provide analyses on new opportunities to further improve the implementation of the program with better technologies and additional policy support.

Seizing the Opportunity for an Energy Transformation

At this historical juncture, the international community of nations faces unprecedented challenges. It must find a way to address the following simultaneously: to stimulate and sustain global economic recovery, to end poverty, and to avert dangerous climate change. The GGND is a strategy designed to contribute substantially to all three objectives. While there are details remaining to be developed, the broad outlines are clear. Addressing the closely linked challenges of climate change, sustainable economic development, and global energy poverty will require greatly enhanced levels of cooperation among nations – a requirement that in itself could generate very positive impacts in terms of global understanding, trust, and collaboration.

The transformation of the world's energy sector is an opportunity not to be missed. The word "transformation" can often be misused but, in this case, the term is both appropriate and timely. A transformation in the global energy sector is not optional if we are to confront the challenges we face, especially that of averting dangerous climate change. The rapid growth in energy demand in developing countries and an inevitable decline in the availability of cheap and abundant oil make an early start on a renewable energy transformation all the more imperative.

A global-scale combination of targeted price supports, policy coordination, and extension programs to ramp up renewables over the next 10-20 years has the potential to make the transformation happen. By pushing down the price of renewable energy, we can raise living standards of poor people, boost our economies and significantly increase our chances of living in a world of relative climate stability.

It is realistic to imagine that implementation of this strategy could begin within two years of the conclusion of the Copenhagen climate summit (CoP-15). International dialogue necessarily takes time, but two years would be adequate for an accelerated program of fashioning the relevant global policy agreements, thoroughly investigating the financing options, and drawing up the appropriate institutional designs. This two-year period of implementation planning would afford the opportunity for additional research and refinement as well as pilot testing, drawing on examples and models around the world, of those mechanisms and programs envisioned under this strategy. It would give the international community the opportunity to establish, in time for the 20th anniversary of the United Nations Conference on Environment and Development, a fully convincing and confidence-inspiring response to the challenges acknowledged and the promises made in Agenda 21.

Great global transitions do not happen instantaneously. Years of visionary thinking, innovative actions, and many small steps seem to produce only marginal results for a period of time; but once they reach a tipping point, their collective impact generates an accelerating virtuous cycle, and the outcome becomes overwhelmingly greater than the sum of the initial incremental steps.

So it can be with the adoption and implementation of this strategy. The incremental actions of nations, international institutions, and initiatives large and small, in the public, private, and civil society sectors, over many years, have paved the way for this opportunity. The parts are all there. It is time to sum them up – to make a big push that will carry us beyond the tipping point – and to achieve an impact greater than what we currently believe to be possible.

The time has come for a Global Green New Deal.

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