The Untapped Energy Mine

The Revolutionary Scope of Renewable Energy to Fight Climate Change,
Revitalize the Economy, and Gain Energy Independence for Bangladesh

"Our task is to look at the world and see it whole." [1]
E. F. Schumacher

Think Globally, Act Locally

Thomas Alva Edison (1847-1931), "the father of the electrical age," said: "We are like tenant farmers chopping down the fences around our house for fuel when we should be using nature's inexhaustible sources of energy—sun, wind and tide. I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that." [2]

Apparently, we have paid little attention to Edison's advice—rather, warning, and many other warnings over the years. Instead, we continued to rely more and more on the fossil-nuclear energy path of oil, coal, natural gas, and uranium to fuel the economy. But these resources are limited.

All the reserves of oil, natural gas and uranium are estimated to be exhausted by 2050, and coal by 2250.[3] These resources took millions of years to accumulate. Of course, we can go on arguing about the exact number of years before the world runs out of oil, continue to dig for additional reserves with more efficient and innovative extracting tools, and entrench ourselves in the nonrenewable path even more by substituting one nonrenewable fuel for another.

But, at best, all this amounts to is choosing one disaster over another and keeping the wolf away from the door for a bit longer. And the wolf is, all-in-one-body: sky-rocketing fuel prices, threatened national security, terrorism, pollution, climate change, acid rain, nuclear contamination and energy wars.

The solution requires us to be awakened to the simple truth—and the holistic, perennial wisdom—that the essential condition of sustainability lies in our ability to live harmoniously within the limits and renewability of our natural resources. The age of unlimited, exploitative, and imbalanced industrial growth at any cost is over. And the truth should invoke within us an urgent need for a transition—from an obsolete, destructive, and unsustainable non-renewable energy path to a sustainable path of innovation, renewable energy and peace.

Is such a transition possible? The answer is yes, but only under certain conditions. Such a transition is possible only through *a worldwide moratorium on further entrenchment into the fossil-nuclear path while, through conservation and efficiency, utilizing these resources only as transitional fuels toward a sustainable renewable energy path.*

Undoubtedly, the transition will face short-term challenges and risks, but these pale in comparison to a suicidal entrenchment into the dead-end non-renewable energy path—and that path is inevitable if the risk is not taken. We must set a clear goal and an uncompromising and sustained action-oriented policy for transition. Fortunately, the enormous potential of renewable energy technologies still offers us that choice, but only if we act—now!

The Renewable Choices

"Nuclear power and fossil fuels are the choices of the past. Renewable energy is the choice of the future that is here today." **Hermann Scheer,** Chairman of EUROSOLAR, General Chairman of the World Council of Renewable Energy (WCRE), President of the International Parliamentary Forum on Renewable Energies, Member of the German Bundestag, and author of *A Solar Manifesto* and *Energy Autonomy: The Economic, Social and Technological Case for Renewable Energy*.[4]

The sun sends an immense amount of energy to Earth—freely—and it will continue to do so for its entire life, estimated to be between five and ten billion years. The energy from the sun, or solar energy, is received through the renewable subsystems of light, heat, wind, water movement and photosynthesis. Sunlight that falls on Earth only in around one hour contains the amount of energy we use globally in an entire year.[5]

In addition to direct or natural uses, we need to technologically convert only a fraction of the solar energy to meet the global energy need. The extraordinary variety of renewable energy technologies such as photovoltaics, wind turbines, hydro-electric generators, solar water heaters, solar greenhouses, bio-gas plants and solar cookers—ranging from microwatt to megawatt scales—are being applied for a wide range of domestic, industrial and consumer products and purposes.

Large scale utilization of other options—solar hydrogen, bio-fuels, geo-thermal—are on the horizon as these mature through criteria such as cost advantages and equitable and ecological considerations. The promise of renewable energy lies in its diversity, in the amazingly diverse natural and technological means through which the energy sources can be utilized.

The transition to a renewable energy path will not be easy, especially because of the extent to which we have become entrenched in the non-renewable path and the powerful vested interests that guard and reinforce this entrenchment. Investment in renewable energy technologies at various public and private levels is growing around the world, but it doesn't come close to allowing us to avoid a catastrophe.

The Energy Information Administration (EIA) of the US government projects world energy consumption to nearly double between 2004 and 2030. In the face of a growing energy shortage from non-renewables and escalating energy need, barely seven percent of the world's energy is generated from renewable energy technologies.

On the hopeful side, people around the world are becoming increasingly conscious of the problems—environmental, health, economic, social, philosophical, political, legal, moral, even spiritual—arising from dependence on nonrenewables. Al Gore and the UN's Intergovernmental Panel on Climate Change (IPCC) being awarded the 2008 Nobel Prize for Peace is a recognition of the consensus of the global scientific community *and* the global public concern over the climate change crisis—and an urgent call for action. There’s been a dramatic rise in global public response to call for awareness and action by organizations, such as 350.org, led by the

environmentalist writer Bill McKibben. Public support for renewable energy has risen dramatically. In the U.S., despite a barrage of negative campaign ads targeting clean energy, a recent national survey reveals that more that 92 percent of voters "believe it is 'important' for the U.S. to develop and use more solar energy."[6] At the same time, the costs of an increasing variety of renewable energy technologies are decreasing. A growing number of incentives such as subsidies, tax benefits and financing options are being offered. Some of these are Feed-in-Tariff (FIT), direct purchase with subsidies, leasing, Power Purchase Agreement (PPA) with its most attractive features: zero upfront cost to install solar systems, locked-in electricity rate for many years that's even slightly lower than what the customers currently pay, and the whole process of site evaluation, system design, hardware acquisition, installation, management and monitoring handled by the PPA provider. The PPA provider can be the local utility provider or an independent vendor in contract with the local utility. Individuals and communities around the world—from rural to urban settings, from a village home in Bangladesh to a skyscraper in New York City—are tapping into these opportunities and acting on solutions. Even countries as a whole, like Germany, Denmark, Iceland and Cuba, combining national policies and practical actions, are setting into motion an up to one hundred percent transition to the renewable energy path within the foreseeable future.

What's also most hopeful is what scientists are saying about the revolutionary potential of the renewable energy technologies we have *now.* Reasserting numerous other similar findings on the scope of renewable energy, *The Energy Report: 100% Renewable Energy by 2050,* released in 2011 by the World Wildlife Fund, puts it this way: "By 2050, we could get all the energy we need from renewable sources. This report shows that such a transition is not only possible but also cost-effective, providing energy that is affordable for all and producing it in ways that can be sustained by the global economy and the planet."

The Bangladesh Energy Scenario

"We have for over a century been dragged by the preposterous West behind its chariot, choked by dust, deafened by noise, humbled by our own helplessness, and overwhelmed by the speed. If we ever ventured to ask 'progress towards what, and progress for whom', it was considered oriental to entertain such doubts about the absoluteness of progress."[7] **Rabindranath Tagore (**1941)

Tagore speaks to us today with only more relevance and urgency than in 1941. No statement speaks as pointedly about the dragging which still continues—only with worsening consequences—even though the West's chariot of progress itself is caught in a dead-end street of dust and noise, propelled by its own speed, and its power humbled by a rapidly depleting non-renewable fuel tank.

As with the world as a whole, the energy crisis has reached a critical point in Bangladesh. Energy being the lifeline of an economy, the crisis epitomizes the "development" and "progress" Bangladesh has been dragged into by relying on the non-renewable energy path. The fuel import bill is over 70 percent of the country's total export earnings. The only sizable fossil fuel reserve is natural gas. Estimates vary and there is no consensus. After closely examining various estimates, in the report, "Energy Strategy for Bangladesh: A Brief Survey with Recommendations," the Energy Panel of Bangladesh Environmental Network (BEN) determines 10.6 trillion cubic feet (TCF) to be the most reliable estimate of proven reserves.[8]

How long the reserves will last is another matter of speculation. It could be anywhere between 7 to 20 years, depending on the accuracy of an estimate and rate of consumption. A speculated additional reserve may stretch the gas supply for a few more years.

Whatever amount of gas is found, the economic feasibility and net economic benefit remain serious questions. The cost of exploration and extraction increases as reserves get more difficult to reach. Explorations by multi-nationals have already caused critical environmental and economic damages. Promises of adequate compensation have been grossly violated.

With the worldwide growing energy demand, the pressure to export gas has been mounting. There's been a growing opposition to export, but the power and pressure of dollars and "development" aid mean little of that gas may be available for the country's own consumption.

Currently only a small percent of the population has access to natural gas for cooking; and even that supply has become increasingly unreliable. But the answer to the crisis is not more natural gas. The use of natural gas will also contribute to climate change. Bangladesh is among the regions which are most vulnerable to this unnatural disaster. Cyclones Sidr, Nargis, Bizli and Aila—so consistent with the IPCC projections—at a massive human, environmental and economic cost—are yet only samplings of what is to come—unless there is an urgent reversal of the energy path we are on.

If economic development is the rationale for exploiting natural gas, enough is known about the potential catastrophic economic consequences of climate change, which far outweigh any economic benefit derived from natural gas. By entrenching itself more into natural gas, should Bangladesh pave the path of its own disaster? Or should it set an example by taking a stand to reverse the direction and demand from the world community that following that path of disaster is no longer acceptable—for itself or for any other country?

As of now, Bangladesh is one of the least contributors to climate change, while being one of its most vulnerable victims. The major emitters of greenhouse gases contributing to climate change are the industrially developed countries. The US, with six percent of world's population consuming thirty-three percent of all the energy produced in the world, is the world's leading contributor of greenhouse gases, as well. China and India are on a rapid rise as they aggressively follow the western conventional, suicidal and unsustainable path of unbridled industrial development, relying mainly on the nonrenewable energy path. Both the countries have launched impressive renewable energy programs, but they amount to a mere pittance compared to the countries' aggressive pursuit of non-renewable options.

The rising sea level is drowning Bangladesh. The question is how much and how soon? If the signs and predictions of climate change with rising sea levels are correct, between one-third to the entire Bangladesh, largely situated on river deltas and coastal lowlands, will disappear under water by the end of this century. Of course, so will a significant portion of the US Gulf Coast, New York, Boston Harbor, London, and Amsterdam, as well as significant portions of countries including Nepal, Bhutan and Malaysia. Many island nations around the world will nearly, if not completely, perish. Scientists are still working on determining exactly how much the Earth is warming due to human activity and how high the sea will rise, but there's no valid argument against that these are happening. The catastrophic consequences are widely acknowledged.[9] According to the United Nations: "Over the next decades, it is predicted that billions of people, particularly those in developing countries, face shortages of water and food and greater risks to health and life as a result of climate change."[10]

But it's not just about the future. Climate change is happening right *now*, victimizing millions of people and other species around the world and causing irreversible damages to the environment. For example, more frequent cyclones and sustained droughts are present realities that are consistent with what scientists have been predicting and equating with climate change.

When a cyclone hits Bangladesh or a drought in an African country is reported on television, we see the actual images of a suffering humanity and a devastated Earth. Even though those images last only for a few fleeting moments, the suffering and devastation continue.

This means, every greenhouse gas emitting power plant that goes up—anywhere in the world—far more than the supposed benefit it promises for a few, carries with it the decree of death and destruction for many who are disenfranchised, who'll not benefit from it, but become its innocent victims.

The sufferers can no longer be categorized merely as "victims of nature"— to be treated with condescension and charity. Instead, the awareness is stemming from legal and human rights perspectives demanding—and to deliver through action, not just promises—compensation; support for mitigation, adaptation and renewable energy technologies; migration rights; and equitable justice. And it's demanding the developed countries to curb their own consumption patterns responsible for climate change. This is inevitable and morally justifiable.

In Bangladesh, one of the world's most densely populated countries—an estimated 160 million people (2012) with a 3 percent growth rate—living on a 144,000 sq km area (smaller than Iowa), the land areas not submerged will face an unthinkable explosion of environmental refugee crisis, civil unrest, diseases, and salinity and other contamination of water and cropland. Hydro-electricity contributes 3 percent of the total energy supply in Bangladesh. However, mainly due to inappropriate topology and plant size, the only major hydro-electric power generating facility, the Kaptai project on Karnaphuli River in the Chittagong Hill Tracts (CHT) area, has turned into an ecologically damaging and unreliable power source.

Consequently, once touted as an energy and economic solution, it's turning into a long-term economic liability, as well—outstripping its benefits. Its imposition and negative impact on indigenous communities, particularly on the Chakmas—which amounts to nothing less than a cultural genocide, long rationalized as an inevitable price of "progress" and "development," raises the question of the moral legitimacy of such projects.

Constructed (1957-1963) under the Pakistani government, funded by USAID, the project uprooted some 100,000 tribal people, including 18,000 families—of which 70 percent were Chakma. Over 400 square miles of land was submerged under water, including 40 percent of all the fertile agricultural land in the CHT area. The tragic and unjust legacies of the project, including its failed rehabilitation and compensation promises, continue to linger in the political and social tension which so characterize the area even to this day.

The Kaptai hydro-electric project is also a warning that even a renewable energy project will have to be planned and implemented holistically through proper human, ecological, social and moral considerations.

Such warnings come from other large hydro-electric dams around the world, as well. It's against such destructive consequences that opposition to the Hydro-Quebec in Canada, the Kinzua Dam on the upper Allegheny River in Pennsylvania, the Mahaveli Dam in Sri Lanka, the Narmada Dam project of a series of large hydro-electric dams on the Narmada River in India, the Kaptai Dam project on Karnaphuli River in the Chittagong Hill Tracts area in Bangladesh, the

proposed Tipaimukh Dam project in Manipur State of India, and other large scale hydro-electric dams has surfaced.

Large hydro-electric dams used to be considered one of the cheapest ways to generate power. Assessing them holistically and counting the externalities, they have now been proven to be disastrous—environmentally, culturally, economically and, not the least, morally.[11]

A concern is also growing over possible connections between large hydro-electric dams and earthquakes. On the one hand, earthquakes can break a dam, and on the other, by exerting enormous pressure on the earth's surface, large dams can also cause earthquakes, both with catastrophic consequences. Scientists of varied disciplines are beginning to investigate these connections. With aging large dams, more dams in the pipeline, and a growing number of earthquakes around the world, their findings must be taken seriously.[12]

The battle against large scale hydro-electric dams is still a battle against the tide. Fortunately, however, the opposition is growing and there's also been a growing trend towards smaller, ecologically balanced, hydro-electric systems. Genuine progress and development do not have to be at the expense of equity and social justice. What cannot be undone can certainly serve as a guideline for future projects.

The negative impacts of large hydro-electric dams are so reminiscent of the impacts of other large energy projects—coal, natural gas, uranium—have had around the world. In Bangladesh, once again, such a scenario is unfolding at Phulbari in Dinajpur district, with multi-national corporate, donor-driven proposals for coal mining in the region. It's happening in spite of growing opposition from environmentalists, geologists, activists, and local people—including indigenous communities which have thrived there for ages and who have vowed to "die in order to protect our homeland."

The profit-driven, export-oriented, open-pit coal mining project with a 30-year life, will displace an estimated 130,000 people, disrupt 500,000 people, and destroy 650 square kilometers of highly fertile multi-crop land. It will deplete groundwater—expediting desertification, pollute soil, water and air, and ruin the rich bio-diversity evolved over centuries. The coal export facilities to be constructed will also cause extensive damage to the Sundarbans, the largest cluster of mangrove forests in the world, a UNESCO World Heritage Site, and a natural barrier against cyclones.

Prof. Anu Muhammad, economist and general secretary of the National Committee to Protect Oil, Gas, Mineral Resources and Ports—leading the national opposition has said: "The proposed ‘development' project is merely a scheme to loot natural resources from a poor country for the rich. We will not allow GCM Resources (the recent new name of Asia Energy) to turn a land of food for the people into a black hole for corporate profit."

There have already been extensive propaganda, intimidation, attacks, and casualties.[13] In August 2006 security forces opened fire and killed three people and injured many more who were returning home from participating in a peaceful protest march against Asia Energy, a London-based multinational corporation, there to do the mining. The donor behind the project is Asian Development Bank (ADB).

However, in the face of growing protests against the project, reportedly ADB did not consider the Phulbari project at its June 2008 board meeting, saying that it will not be funding it in the short term. This is indeed a great victory for the protesters. But we must be vigilant—what

does "not in the short term" mean? What will ADB decide in the long term? Will other donors be sought or step in?

In the face of continuing protest, the Bangladesh government, too, has backed away from its aggressive move to permit coal mining. In November 2009, Prime Minister Sheikh Hasina asked the energy division to further review the draft coal policy, especially for the possible impact of open-pit mining on the people and environment. “Nothing is to be done in a hurry,” the Prime Minister declared as her decision at a meeting with the energy officials who were recommending open-pit coal mining of the north side of the Barapukuria underground coal field in Dinajpur.[14] The decision applies to the Phulbari open-pit mining proposal, as well. Indeed, it was a commendable decision by the Prime Minister and a victory for the protest movement. Both deserve congratulations! But, vigilance is still called for. “Although it is not yet complete, it is people’s verdict that won, it is people’s victory. Nevertheless for obvious reasons, we should remain vigilant and active,” Anu Muhammad wrote in a personal message to me.[15] The National Committee is continuing to mobilize the protest movement.

More recently another major support to the protest movement has come from the UN. On 28 February 2012, a team of seven UN special rapporteurs issued a press release calling for an immediate halt to the plan for the Phulbari coal mine. Reviewing the plan’s potential impacts, the experts declared, “The Government of Bangladesh must ensure that any policy concerning open-pit coal mining includes robust safeguards to protect human rights. In the interim, the Phulbari coal mine should not be allowed to proceed because of the massive disruptions it is expected to cause.”[16, 17]

The list of predictable and multi-faceted negative impacts from the proposed Phulbari coal mining project grows longer, far outweighing its pittance of a dubious and short-term benefit promised to Bangladesh. A more decisive good sense and credibility of just governance from the national administration are urgently being called upon.

For eventual success, some of the challenging questions which a protest movement faces are: what to offer in place of what is being protested, what solution to work toward while protesting what is considered a problem, what renewable energy alternatives are there while protesting coal mining or other nonrenewables? After hearing about the shooting in Phulbari, I thought it would be important to start charting a path there so that people don’t have to turn to coal for energy. The Phulbari issue has grown into a multifaceted complex problem, but energy is at the heart of it.

I contacted Anu Muhammad. I am grateful to him for the opportunity to travel to Phulbari with him on July 6, 2009, to see the region first-hand and feel only more convinced of the critical necessity of protecting it against the proposed destructive coal mining there. I am also grateful to Phulbari’s Regional Committee members of the National Committee to Protect Oil, Gas, Mineral Resources and Ports for the opportunity to meet with them and for locating an installation site for a solar electric system I wanted to donate.

Arriving after an eight-hour bus trip, during the same day we installed a 40-watt, stand-alone PV system at the home of Bablu Roy and his family. Bablu—a 38-year old former van driver—was permanently paralyzed from the waist down by a bullet wound when the BDR open fired on the local people barricading The Asia Energy office in protest of coal mining in August 2006. Three were killed instantly and many more were wounded. I thank Bablu and his family

for accepting this gift, both for its daily utility and for its symbolic significance of the practically untapped revolutionary potential of renewable energy solutions in Bangladesh. I thank Solar Engineer Sudip Saha, of BRAC Solar, and his regional colleagues, Md. Ashraf Ali, Md. Kabir Iqbal, and Shankar Kumar Das, for installing the system with the utmost efficiency in about three hours. The curiosity, enthusiasm and collaboration of the community people—from the youngest to the oldest—during the installation, and the smiles on everyone's faces when the lights came on when the system was jointly inaugurated in the evening by the local chairman, Aminul Islam Bablu, and Bablu's (the paralyzed Bablu) two and a half year old son, Dipankar, will forever remain with me a memorable and inspiring experience! After a delicious dinner hosted by a local supporter of the movement, followed by a stop at the editorial office of *Desh MA*, a local activist paper, to give an interview, we took the midnight train, returning to Dhaka early in the morning.

Still, it's only one solar system. So I continue to wonder: what would it take to multiply the number and turn Phulbari into a model solar community—with the revolutionary implications it would have toward empowering the protest movement—and enabling the people of Phulbari to inspire all who rise up to defend human rights, the environment, sustainability, equity and justice—anywhere in the world? The Phulbari solar project proved what can be achieved through listening to people's voices and needs, reaching out to each other, and taking action collaboratively—in just one day! Envision building upon that Phulbari solar project into a "Solar Phulbari"! It can start with the next step: 50 solar systems distributed throughout Phulbari—practical, quickly implementable, and with support from multiple sources—affordable! I propose to the people of Phulbari, the National Committee to Protect Oil, Gas, Mineral Resources and Ports, any of us individuals or families, and organizations—within and outside Bangladesh—to unite and contribute in ways that each of us can to turn that vision of "Solar Phulbari" into a reality!

Lately, there's also a renewed push for the construction of a nuclear power plant. It is promoted as the solution to climate change and scarcity of other non-renewable resources. But the promoters carefully avoid mentioning the devastating economic, environmental and political consequences associated with it, such as the intensive use of fossil fuels for the nuclear power generation process (which belies that nuclear energy does not contribute to climate change), uranium depletion, radioactive contamination during uranium mining, tilling, processing, and power production, high water consumption, waste storage, disposal, decommissioning, risks of accidents, terrorist attacks on nuclear power plants, nuclear weapons proliferation, and out-of-control costs.[18] Add to that Bangladesh's topography and dense population, increasing the risk many more times.

The Fukushima Daiichi nuclear disaster on 11 March 2011, the largest nuclear disaster since the Chernobyl Disaster in the Ukraine in1986, at an incalculable human and environmental cost and irreparable damages, sent a chilling warning around the world. Though highly dependent on nuclear power, amidst continuing public protests against nuclear power, Japan itself has decided to permanently shut down all its nuclear power plants by 2030.[19] Japan, thereby, joins a growing list of countries—Austria, Belgium, Germany, Italy, the Netherlands, the Philippines, Sweden—who have decided to abandon nuclear power. Germany has decided to do so within the next decade and transition to a 100 percent renewable energy path by 2050.

Anti-nuclear protests are not new in Japan. There's a courageous history of protests from its scientific, academic and civil communities. But in a climate dominated by highly aggressive governmental-industrial policies and power, such voices remained dormant—even suppressed. The Fukushima explosion also fueled the movement to spread across the nation—uniting people from all walks of life—and explode. In the book, *Farewell to Nuclear, Welcome to Renewable Energy*, an inspiring collection of poems by 218 poets, Ryuichi Sakamoto, musician, composer, record producer, writer, singer, pianist and actor, writes in the preface what I consider a warning—a wakeup call—a call to action—not only for Japan, but also for the world:

> "Japan has been irradiated 3 times: Hiroshima, Nagasaki then Fukushima.
>
> Engraved on the memorial cenotaph in Hiroshima is an epitaph: 'Rest in Peace, for we shall not repeat the error.'
>
> However, our country has committed the same error, guised by the hallucinatory proclamation to use nuclear energy peacefully.
> No excuse can be made for those tens of thousands of people who were lost to the atomic bombing and the subsequent radiation poisoning.
>
> Now that the worst accident in history has awaken us from our deluded slumber to 'use nuclear energy peacefully,'
> the next step is prove to the world that people and nukes cannot coexist,
> whether it be for weapons or electricity."[20]

However, rejected by a growing number of countries around the world as a dead-end technology, and a false propaganda as an environmentally preferable technology, the nuclear industry is turning to unsuspecting or energy starved and desperate developing countries. It's aggressively imposing itself on the developing countries who are hostages both to the ideology and political-economic control of the developed countries and are well-equipped with corruptible channels, but are poorly equipped with the interdisciplinary education, scientific knowledge, technological resources, legal institutions, environmental regulatory frameworks, and skills to critically evaluate the imposition of the technology. It's a modern version of "techno-colonialism." Bangladesh does not need to fall victim to that.

In short, while the demand for energy is multiplying in Bangladesh, a growing scarcity of firewood and cooking gas, rising costs, an inadequate and unreliable electric supply, environmental destruction and pollution have reached a crisis which is impossible to solve by relying on non-renewables or manipulating the power supply. Fortunately, Bangladesh has an alternative—practically untapped!

The Untapped Energy Mine: Renewable Energy Prospect for Bangladesh

"The Sun, it shines everywhere."[21] **Shakespeare**

Bangladesh is richly endowed with renewable energy sources. Sunlight is abundant year-round in this semi-tropical region. Even during the monsoon season the solar radiation is as good as the annual average.[22] In addition to ample light and heat, the hundred-plus-mile long coastal

areas, hilly sections, and islands provide plenty of wind for wind turbines; waterways of varied forms and speed provide sufficient wave and gravity driven water flow for ecologically balanced hydro-electric generators; and the lush vegetation provides rich photosynthesis and biomass for fuel for a variety of purposes. Compared to Germany—an inspiring example of a country set on a full transition to the renewable energy path—Bangladesh receives twice the amount of solar radiation than Germany. Bangladesh is truly an exceptional, naturally endowed and integrated, renewable "energy mine."

Judiciously planned and harnessed, this energy mine has an inexhaustible capacity far beyond meeting the country's annual 4,000 megawatts of electricity need, while also generating other forms of usable energy such as heat and bio-gas.

However large the capital cost appears up front, that cost will be minor compared to the alternative. That alternative is the vast amount of money which will need to be invested towards the, at best, short term solutions—but in the long run, dead-end *non-solutions*—from non-renewables, leaving the country only more economically impoverished and indebted, environmentally ruined, and politically vulnerable.

None of these is inevitable if the current energy crisis is viewed as a warning, a critical turning point, a crossroads, and, indeed, both an unprecedented and one-time opportunity to act urgently on a revolutionary transition to the renewable energy path. It is in their support for the transition that the other countries and their donor agencies can play a vital role, if they're truly interested in helping Bangladesh solve its energy crisis. Currently some support is being given to renewable energy projects, but nowhere close to the rate needed to make a transition. A much bigger push is needed for non-renewables. So, the motive and extent of collaboration will need to be examined. Genuine collaboration for a transition is necessary and welcome. It's good for Bangladesh and it's good for the world.

Bangladesh's renewable energy mine offers such a promise. Contrary to the publicized notion that it will take a miracle to solve Bangladesh's energy crisis, it is indeed a "development" blunder of a miraculous proportion that such a crisis could be contrived in Bangladesh.

Since the late 1980s, various renewable energy technology projects have been implemented at the NGO, private, commercial, academic, and governmental levels. The actors played varied roles as users, educators, and sellers. Through innovation and turnkey transfer, some components, such as charge controllers, deep cycle batteries, and 12V DC lights and fixtures, began to get manufactured locally. Some have attained qualities that are among the best, at the same time the cheapest, in the world. Forums, workshops, seminars and conferences began to take place at various levels. The number of active players continued to grow.

Especially since the late 1990s a much bigger combined thrust has come from more NGOs, governmental and semi-governmental agencies, universities and businesses to research, educate and disseminate PV systems around the country. Among these are Grameen Shakti, BRAC, Rahimafrooz Solar, Bangladesh Power Development Board (BPDB), Rural Electrification Board (REB), Local Government Engineering Department (LGED), Thengamara Mohila Shabuj Shangha (TMSS), Anando, Bangladesh Centre for Advanced Studies (BCAS), COAST Trust, Integrated Development Foundation, Centre for Mass Education in Science (CMES), Srijony Bangladesh, Shubashati, Bangladesh Rural Integrated Development for Grub-Street Economy (BRIDGE), Padakhep Manbik Unnayan Kendra, Development Organization of the Rural Poor, Palli Daridra Bimochan Foundation, Hilful Fuzul Samaj Kalyan Sangstha, Mukti

Cox's Bazar, Rural Services Foundation, Associate Resource Management Company (ARMCO), Micro Electronics, BAPA (Bangladesh Poribesh Andolan), Pathshala—The South Asia Institute of Photography in Dhaka, Muktijuddha Jadughar/Liberation War Museum, Singer Bangladesh Limited, Upokulio Bidyuatayon O Mohila Unnayan Shamity of Char Montaz, Bangladesh Institute of Fuel Research and Development of BCSIR, Department of Applied Physics and Electronics at Dhaka University, Center for Energy Studies at the Bangladesh University Engineering and Technology (BUET), Sun's NRG Bangladesh, and Shidhulai Swarnivar Sangstha. Infrastructure Development Company Limited (IDCOL), under the Rural Electrification and Renewable Energy Development Project (REREDP), with funding from the Global Environmental Facility (GEF), IDA of the World Bank, KfW and GTZ, promotes Solar Home Systems (SHSs) through partner organizations (POs), which are included in the above list.[23]

The economic, technological and environmental advantages of photovoltaics, bio-gas and solar cookers have been well proven in Bangladesh. To date, there are more than l,100,000 installed stand-alone PV systems, termed "Solar Home Systems" (SHSs). These, combined with a fewer number of larger systems for residential, commercial and industrial purposes, sold through over 30 vendors, generate over 55 megawatts of power. Grameen Shakti has installed over 1,000,000 of these systems and BRAC over 80,000. The number grows at the rate of several thousand systems a month! Systems range in capacities from 20 watts to 20 kilowatts. A typical 40-watt solar home system comes with three 8-watt fluorescent lights, a deep cycle battery, and a charge controller. The cost, around Taka 22,500 (about $320), includes installation and warranty. The solar module comes with a warranty of 20 years, and the battery, 5 years (with an expected life of 8-10 years and recycling options). The system also comes with the options of powering a small black and white TV and cell phone batteries. Such a system can save around Taka 400 per month spent on kerosene.

Still, the upfront payment can be high for many, so micro-credit financing helps in making the systems affordable. There are also around 25,000 mostly home-scale, biogas plants in Bangladesh, installed by the Fuel Research Institute of BCSIR, BRAC, Grameen Shakti, and some other NGOs and private entrepreneurs. Although there are only a few installations, pilot projects with wind turbines, micro hydros, and grid-connected PV systems show great promise.

Bangladesh is getting global recognition for its role in advancing the use of renewable energy technologies. It's a matter of immense pride that Grameen Shakti, Rahimafrooz Battery and Shidhulai Swarnivar Sangstha have been awarded the prestigious Ashden Awards for Sustainable Energy. Grameen Shakti and Rahimafrooz Battery received the award in 2006 for "the central roles which they have played in delivering the world's most successful solar power programme bringing light and power to rural people." Grameen Shakti also received the "Eurosolar Prize" in 2003 and the "Right Livelihood Award" (Alternative Nobel Prize) in 2007. Shidhulai received the Ashden Award in 2007 for its innovative solar powered school-library boats in the remote Chalanbeel region in Rajshahi.

We should also take pride that two of the lead authors of the report by the Nobel Prize winning IPCC, which has done a historic service to thrust the climate change crisis to the world's attention, are from Bangladesh: Dr. Atiq Rahman, executive director of Bangladesh Centre for Advanced Studies, and Dr. Saleemul Haque, head of Climate Change Group, International Institute of Environment and Development, London.

A renewable energy infrastructure is evolving. It's time to build upon it on a massive scale. We have the knowledge and experience of the crisis, and we have the knowledge and experience of the solution. Stand-alone PV systems are already proven to be the most cost effective way to generate electricity in areas outside the grid.

70 percent of the land area in Bangladesh lies outside the grid. Even in some areas with grid, the actual electricity supply is unreliable and negligible, if not nil. PV systems can be installed with a variety of designs and scales. Such expansion must also include recycling options of the system components.

Batteries, for example, contain toxic elements, and improper disposal of used batteries is harmful to health and the environment. It is highly commendable that Rahimafrooz, the largest seller of batteries for cars and solar systems in Bangladesh, was one of the first businesses in the world to institute a recycling program for used batteries. The program even includes free pick up and using a part of the proceeds from the recycling for environmental welfare.

One of the main barriers to widespread utilization of solar systems has been the high upfront cost. Undoubtedly, micro-credit loans have helped in overcoming the barrier for many. At the same time, pointing to the usual range of interest rates, 18 percent to 70 percent, critics have raised the concern that such interest rates are too high. The lenders usually justify it on the grounds of compensation for default risk and the high cost of administering small loans and providing social-financial support services which often accompany microcredit programs. The issue, however, is still hotly debated, calling for a fair hearing of both sides and examining those concerns.

There's also room for innovation in program development, efficiency in operation, and equitable sharing of benefits. Therefore, to build an infrastructure for expanding renewable energy technologies, as an integral dimension of a sustainable and just economy, policy makers must address these micro-credit lending issues by instituting proper controls, support mechanisms, and guidelines so that the professed values of microcredit lending are realized. It is encouraging that these concerns are beginning to be raised within the MFI (Micro Finance Institution) industry itself. They should be brought to the forefront for greater public awareness and scrutiny and acted upon with the utmost urgency.[24]

There are many other options in addition to stand-alone systems: Hybrid systems combining PV and wind turbines or ecologically balanced hydro-electric systems; distributed generation through grid-connected PV systems for urban and other gridded areas, installed on roofs and walls, which feed the grid with solar-generated electricity, "turn the meter backwards" and reduce stress on the power line; solar powered IPS systems; solar thermal systems for heating and cooling; solar greenhouses; various types of solar cookers; wind turbines ranging in size from 250 watts to over 5 megawatts each—with cut-in wind speed as low as 7 miles/hour and cut-out speed as high as 120 miles/hour; utility-scale, megawatts-size wind farms and PV fields (in April 2012, India inaugurated the world’s largest PV field in Gujarat—a 600 MW plant, completed in 14 months, costing $2-3 billion), some combining electricity generation, grazing and agricultural production; offshore wind farms; industrial and community scale bio-gas plants generating gas and electricity, with superb quality organic fertilizer and fish feed as the byproduct; large dish-type concentrators which both cook and produce steam to power electricity generators; PV, wind turbine and other renewable energy technology hardware manufacturing plants through turnkey transfer.

All these options have successful examples around the world, for Bangladesh to judiciously emulate and innovate. These also come with a revolutionary potential for "green jobs" creation and employment, fueling an energy-independent and sustainable economy.

Some of these options have been tested as pilot projects in Bangladesh. In 1999, BRAC Solar Energy Program installed a PV-wind hybrid system at the BRAC Area Office in Cox's Bazar. The program also installed two grid-connected systems, one at BRAC's Training and Resource Centre in Mymensingh (1,200 watt), and another at its Area Office at Madhabdi. These pilot systems have contributed much valuable data on their feasibility and constraints.[21] Building on this pilot experiences BRAC Solar has gone on to install several other grid-connected systems around the country. Some of the other vendors, too, have started installing such systems.

Also, a 1.1 kilowatt grid-connected rooftop PV system has been installed in 2007 at the Renewable Energy Research Centre, Dhaka University, by a team of faculty members and research associates of the university's Department of Applied Physics, Electronics and Communications Engineering.[25] These systems take only a few days to install. They are simple, reliable, and durable. With political will, policy, planning, investment, programs and action, hundreds of thousands of building roofs across the country could be urgently transformed into grid-connected electricity generating power plants, launching an instant pay-back period and a downward cost curve—transforming into a revenue curve. As a step toward that goal, the government has mandated inclusion of solar in permitting new electric connections. Depending on the category—residential, commercial and industrial—and size of the connections in each category, the solar requirements range from 3 to 10 percent of the building's total electricity consumption. The mandate is part of the governmental policy to meet 5 percent of the country's total electricity demand by 2015 and 10 percent by 2020 from renewables. The government has also exempted VAT and eliminated import duty for solar panels. Mandating the use of renewables in building codes not only facilitate the transition, it also adds a whole new revolutionary and sustainability dimension to the architectural, engineering, and building-construction education and professions.

To further demonstrate the government's commitment to encourage the use of renewable energy, a 21.6 kilowatts peak capacity PV system was installed at the Prime Minister's Office (PMO) in November, 2009. It is the country's single largest solar system so far. According to Power Development Board (PDB) officials, this initiative is "only the beginning for a quick expansion of renewable energy technology to other government and semi-government offices."[26]

The government has also distributed energy-efficient light bulbs on a massive scale. While this will help to reduce energy consumption, it must also be noted that these bulbs contain mercury. Therefore, safe bulb retrieval and recycling requirements must be integrated in the distribution program to avoid a potential disaster. But that's not happening in Bangladesh, and despite some warnings, sales and distribution of such bulbs are growing rapidly at private levels and through other programs. Used-up and damaged bulbs are already being dumped as regular garbage. This must be stopped. However well-intended, the lopsided and non-holistic planning and digging of millions of deep tube wells during the 1960s and 70s throughout Bangladesh and West Bengal, India, to provide enough clean water for drinking and agriculture, funded by UNICEF, UNDP and the World Bank, resulted in arsenic poisoning of millions of people and contaminated wells—labeled one of the worst mass poisoning in history. The crisis lingers to this day, fueling the enormous human, environmental and economic cost of this "development"

blunder. The parallel between the arsenic poisoning and mushrooming mercury poisoning must not be ignored.

On the brighter side, safe retrieval and recycling requirements also offer much needed "green jobs." The Light Emitting Diode (LED) lights for widespread and cost-effective distribution are already available. Investing in it—even at its initial higher costs—would prove to be a more judicious decision than furthering the massive distribution of energy-efficient bulbs.

Facilitating urban utilization of renewable energy, several Solar-Hybrid IPS systems have been installed in Dhaka. Some of the pioneering installations of this system by ShineHardy Solar and Power Tech are located at the BCSIR Chairman Dr Imamul Haque's office, The BUET professor of petroleum department and former energy advisor during the caretaker government M Tamin's residence, the coordinator of the Renewable Energy Research Centre of Dhaka University and secretary of the Bangladesh Solar Energy Society Dr Saiful Haque's residence, and at 'Sanjher Maya,' the family residence of poet Sufia Kamal. BRAC Solar, too, now includes Solar-Hybrid IPS as one of its offerings and has installed around 1700 such systems. It is a significant initiative to cut down on conventional fuel consumption and reduce greenhouse gas production and pollution due to a rapid growth in the use of IPS systems and generators using conventional fuels. Also, about one hundred electric three-wheelers have been fitted with solar panels for charging batteries during daytime—with similar environmental and economic benefits.

Bangladesh Bank has installed a 20-kilowatt stand-alone solar system on the roof of its main building in Motijheel, Dhaka. It lights an entire floor of the multistory building. A plan is under way to replace the fluorescent lights currently powered by the system with LED lights, thereby significantly increasing the powering capacity of the system, as well as utilizing an environmentally preferable option. Under the direction of its progressive Governor, Dr. Atiur Rahman—whose own office room is lighted by solar—the Bank has also established a Taka 200 crores Renewable Energy Refinancing Fund. The fund lends money to commercial banks at the low annual interest rate of 5%. In turn, the banks give out loans dedicated to financing renewable energy systems to individuals, NGOs, companies and other delivery agents at an interest rate of around 8%. The fund is enabling NGOs and other organizations nationwide to launch their own renewable energy programs with financing options for the borrowers, helping overcome two of the major barriers to a widespread dissemination of renewable systems: high upfront cost of purchasing a solar system and higher interest rates of loans from other sources, including most "microcredit" lenders. Also commendable is the installation of a huge sign on the roof-level frontal wall of the building, highly visible from the heavily traveled street underneath, boldly proclaiming: "SOLAR POWER SOLUTION."

Taking another major step, on April 30, 2010, the country's first solar panel assembling plant was inaugurated in Savar. Set up by local company Electro Solar Power Ltd (ESPL), the plant with a production capacity of 10-megawatt electricity a year, will also assemble charge controller, battery and other components for solar home systems.[27] Rahimafrooz Renewable Energy Ltd, too, has announced setting up solar panel assembling plant in Bangladesh within the next few years. Telephone Shilpo Sangstha and Cable Shilpo Sangstha, both under Bangladesh Telecommunications Regulatory Commission have announced taking up some mega projects which include production of solar panels.

The need for hot water is a major universal need. Even in a tropical country like Bangladesh, hot water is a daily need for clinics, hospitals, restaurants, hotels, bathing or showering in winter, and a host of other residential, commercial and industrial purposes. Conventional methods of heating water with firewood and gas stoves are rampant. Residential units in urban buildings are major users of conventional electricity-powered water heaters for showers. A simple, cost-effective, environmentally advantageous and sustainable solution of solar hot water systems is practically absent, even though the technology is used for a range of purposes in neighboring countries like India and Nepal. However, inspiring examples are entering the scenario.

One such example is Shuktara, a nature-retreat atop paired hills surrounded by other lush green hills, in Sylhet. Opened in August 2012 and located only twenty minutes away by road from the noise and chaos of the city, the eco-friendly retreat catapults a visitor to serenity and a breathtaking view, overlooking miles and miles of hilly landscape, all the way to the Indian border of Tamabil-Dawki into Meghalaya, the foothills of the Himalayas. With superbly managed accommodation for families, couples, groups and single travelers, Shuktara Nature Retreat is an environmentally responsible organization that proudly projects a face of Bangladesh that's as real as any other face of the country to discover. An architectural masterpiece, all the structures have been crafted by hand using natural and local materials, and much of it is recycled materials. All the construction work has been done by local people, thus providing employment and contributing towards community development. Much of its furniture are examples of the superb design and skill of Bangladeshi craftsmen utilizing local and fast-growing resources such as bamboo and cane. The indoor display of artworks by Bangladeshi artists and crafters complements the surrounding forest-like natural landscape visible through oversize glass windows and walls, allowing ample utilization of daylight. Its own landscape is an exquisite display of the natural biodiversity of plants and flowers, both planned and wild, inhabited or visited by many different species of birds and some animals. The food menu lists an impressive variety of authentic Bangladeshi dishes, using many locally grown items and ingredients, and prepared by a chef with experience and skill to satisfy the most demanding connoisseur of taste and flavor! Solar thermal systems provide hot water, and rainwater harvesting and biogas systems are in the works. Its ecological and educational implications spread far beyond its limitation as a facility for a few, one of which is for being a pioneer in the use of solar thermal systems in Bangladesh. Eco-tourism is a global phenomenon, and Shuktara is a bright spot on the map to stop by for a day, two days, or more![28]

The Energy Park of the Renewable Energy Research Centre demonstrates various types of renewable energy technologies—PV, solar cookers, solar thermal systems—dispersed throughout its grassy compound. The solar thermal systems of several designs and capacities are designed and manufactured at the Centre. The goal is to develop some prototypes that can promote local manufacturing and cost-effective commercialization of this technology.

Indeed, these are highly commendable steps. And a long journey stars with the first step. However, to make a transition to a renewable energy path, which implies a fundamental reversal of the trend towards the non-renewable energy path, requires more. Based on the common-sense understanding and the perennial wisdom that long-term sustainability lies fundamentally in our ability to live harmoniously within the limits and renewability of our natural resources, a

comprehensive national policy—with a *Policy-Programs-Practice* continuum (PPP)—must be conceived and implemented. Applicable to every country in the world, including Bangladesh, and conjoining "top down" and "bottom up" approaches, it will require the following:

One, maximizing conservation and efficiency in the use of non-renewables, while utilizing them only as transitional resources; **two**, transparent, equitable, and socially and environmentally responsible public-private partnerships to maximize efficiency and expediency; **three**, a moratorium on further entrenchment into the non-renewable path, combined with disincentives such as a reduction of subsidies for nonrenewables and a progressive carbon tax and cap on carbon production; **four**, proactive and massive utilization, investment and development of appropriate renewable options; **five**, a combined offering of public education, technical support, a legal framework and financial incentives to renewable energy users and producers; and **six**, collaboration between experts and stakeholders in both nonrenewable *and* renewable energy fields to devise an integrated and comprehensive public policy—holistically assessing both the nonrenewable and renewable options, from both global and local perspectives—to lead the transition through action (programs into practice).

The multi-faceted energy crisis will have to be understood and addressed from multiple perspectives and skills. Bridges have to be built between policy makers and practitioners, economists and environmentalists, academics and field workers, specialists and generalists, educators and activists, idealists and realists, industrialists and ecologists, program planners and implementers, problem researchers and problem solvers. Some bridges exist, but more as exceptions. We must engage in dialogue and collaborate—within the country and with the world—in a shared vision and action. It's good for Bangladesh, and it's good for the world.

Transition to a renewable energy path may seem like a daunting—even revolutionary—task. But insisting on the nonrenewable energy path that has led Bangladesh—and the world--to the crisis we are in is not a solution; it is suicidal. On the other hand, the revolutionary scope of renewable energy offers us another choice, a hope, a one-time opportunity to pave a path towards a solution. Bangladesh is capable of achieving the "impossible." Against all odds and formidable opposition, the Liberation War proved it. An essential meaning and realisation of that blood-drenched liberation is now to be found in Bangladesh's claim, commitment and achievement of her energy independence and sustainability. The task amounts to nothing less than a national task with the utmost urgency—and a call to action—now!

Begum Rokeya—A Global Visionary of Renewable Energy

> The kitchen was situated in a beautiful vegetable garden. Every creeper, every tomato plant was itself an ornament. I found no smoke, nor any chimney either, in the kitchen—it was clean and bright; the windows were decorated with flower garlands. There was no sign of coal or fire.
>
> "How do you cook?" I asked.
>
> "With solar heat," she said, at the same time showing me the pipe, through which passed the concentrated sunlight and heat. And she cooked something then and there to show me the process.[29]

This quotation is from "Sultana's Dream," a short story by Begum Rokeya (1880-1932), a pioneer of women's education and gender equality, writer and social reformer, who was born in Pairabond in Rangpur (now in Bangladesh) and died in Calcutta (now Kolkata).

The story, originally published in *The Indian Ladies Magazine*, Madras, India, 1905, in English, is one of the earliest, if not *the* earliest, documented expressions of the scientific imagination behind solar cookers. The same story, a pungent satire on male dominated society, which antedated by a decade the much better-known feminist utopian novel, *Herland*, by Charlotte Perkins Gilman, is also a masterpiece of ecological and renewable energy literature which envisioned natural conservation, environmental protection and—even more astonishing—scientific advancements which included the use of solar electricity, solar heat collectors, rainwater harvesting and hydrogen-powered vehicles!

Rokeya Sadan, a shelter for girls and women operated by Bangladesh Mahila Parishad, is named after Begum Rokeya. It occupies an entire upper floor in a multi-story building in Mahila Parishad's headquarters in Dhaka. The building, Sufia Kamal Bhaban, is named after Poet Sufia Kamal (1911-1999), the founder-president of Mahila Parishad. Fortunately, she was also my mother and the one who introduced me to Begum Rokeya's writings on renewable energy.

It was a great honour and pleasure for me, with the support of my family and friends, to be able to contribute a stand-alone photovoltaic system which reliably provides lighting for Rokeya Sadan, even when it is dark in the rest of the building due to the frequent load shedding and the unreliability of the grid. The system was installed in 2004—one hundred years after Begum Rokeya wrote "Sultana's Dream."

Together let us act to more fully to realize Begum Rokeya's dream—and vision—and Bangladesh's aspiration for an energy self-sufficient, prosperous, sustainable and peaceable future. Such a future is eminently possible by relying on a path lighted by its very own renewable energy mine, and at the same time, by becoming a part of the global solution and setting an inspiring example for the rest of the world—which too is our shared home, under the same sun!

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Acknowledgments: Earlier versions of this article was published in the Journal of Bangladesh Studies (Volume 10 Number 1, 2008, USA), *the May 2010 issue of FORUM—the monthly magazine of The Daily Star, and in the book, The Untapped Energy Mine: The Revolutionary Scope of Renewable Energy to Fight Climate Change, Revitalize the Economy and Gain Energy Independence for Bangladesh (Scholars Publishers, Bangladesh 2010).*