PART III: PROSPECTS FOR SUSTAINABLE DEVELOPMENT

6. Alternative Strategies

A Need for Change

130. The preceding discussion described a seemingly precarious balance between the rate at which the world's energy resources can be effectively utilized for satisfying rapidly escalating growth in demand on the one hand, and a global order and national frameworks that are only partially able to meet people's needs with existing supplies on the other. Such an arrangement leaves those at the fringes of the modern energy network—constituting a large majority of the world's poor—grossly or completely denied access to efficient forms of energy. It also posits serious sustainability issues, both environmental and economic, because of a continued reliance on depleting fossil fuel reserves and large amounts of ecologically valuable biomass resources.

131. This situation, if left to persist, will not only continue to perpetuate existing economic and social inequities (urban–rural, rich-poor, developing-developed country, etc.), but may in fact further exacerbate such disparities on account of reinforcing demographic trends and environmental impacts which may well swell the ranks of the energy-deprived poor further. The questions raised by such an imperfect system are not only of a moral and ethical nature—compelling as such arguments are on their own, considering the plight of a quarter[30] of humanity who, in the 21st century, are still condemned to live a wretched, destitute existence not much removed from that prevailing in primitive times and with little or no means of overcoming such conditions. They also pose a much broader one of equally global consequences: political turmoil over scarce energy resources, price volatility and the financial stress of maintaining unpredictable supplies, social upheaval caused by growing levels of depravation, and the damaging effects on the regional and global environment of current patterns of energy use with their attendant economic, social and political fallout.

132. It is therefore prudent to take stock of the consequences of present trends in energy supply and use, and to rethink strategies for addressing the implicit drawbacks and adverse repercussions of the baseline scenario.

Baseline Facts

133. As detailed in **Part I** of this paper, international projections predict significant increase in world energy consumption over the next quarter of a century averaging up to 2% per annum, buoyed by continued economic growth of over 3% of world gross domestic product (GDP) per year. Most of this additional energy demand will emanate from the developing world, whose needs are expected to grow almost threefold by 2030, with developing Asian countries leading the growth. Outlays to the tune of tens of trillions of dollars will be required to finance such supplies and the associated production, processing, handling, transportation, and distribution infrastructure. This will place enormous pressure on global financial resources—particularly of developing countries, where half of these investments would need to be made. Fossil fuels, led by oil but with growing shares of natural gas and coal, will continue to meet an increasing and dominating proportion of energy supplies (up from 80% at present to 82% in 2030)—implying little change in the underlying economic and physical foundations in terms of supply sources, methods of use, derivative industries, infrastructure characteristics, commerce and trade, transportation and distribution networks, pricing and access issues, and resultant environmental

[30] Poverty assessments vary according to source and methodology of estimates. According to one recent estimate (Chen, S., and M. Ravallion. 2004. How Have the World's Poorest Fared Since the Early 1980s? Policy Research Working Paper 3341, p. 30), 21.1% of the world's population had an average daily income of less than $1.08 while 52.9% survived on less than $2.15 per day (in 1993 PPP terms).

and social development consequences. In fact, given that total world primary energy consumption in 2030 will be 72% higher than in 2003, these aspects of the global energy framework are expected to be that much more firmly entrenched and accentuated in the coming decades. Rising fossil fuel prices notwithstanding, there is little to challenge such baseline trends since adequate proven reserves of oil, gas, and coal exist today that can adequately meet the increased demand well into the next century.

134. The impact of rising fossil fuel use on the environment has transcended from being a perceived threat to a cause for mobilizing real action, albeit belatedly, for mitigating greenhouse gas (GHG) emissions. Asia's contribution to the global emission of GHGs is rising, as its large population and economies grow and consume ever increasing amounts of oil and coal. At the same time, the population of developing Asia in particularly at risk from climate change impacts: on agriculture (crop failures, pestilence, land degradation, etc.), water resources (drought, variable precipitation, glacial retreat, etc.), natural calamities (hot and cold spells, tornados and cyclones, flooding, landslides, etc), coastal zones (sea level rise, salt water intrusion, declining fish catches, etc.), and habitat and ecosystems (loss of productive land, displacement of communities, impact on natural resources, etc.). At the local level too, fossil fuel use, especially in developing countries with rapidly growing and increasingly congested large urban centers, is having seriously adverse effects on humans and the environment alike. Asian urban atmospheric pollution levels are among worst in the world, with rapid growth (population, industry, vehicular, etc.) threatening further deterioration. Rising oil prices are sustaining or even increasing reliance on low-grade coal for power generation in the largest economies of Asia (the People's Republic of China [PRC] and India), with others contemplating the same path (e.g., Pakistan and Indonesia). Transboundary pollution, such as acid rain and the Asian Brown Cloud, are aggravated by such unregulated fossil fuel use and lax environmental controls. Though GHG emission levels for developing Asia are presently low in per capita terms compared with those for developed countries, given Asia's large population and fast growth rates, total carbon emissions from the region pose a serious concern at the global level, as does the current high carbon intensity per unit of GDP. The impact of both climate change and local atmospheric pollution is felt most directly and acutely by Asia's poor, whether it be health-related, extreme weather conditions, or in terms of reduced agricultural productivity and threats to natural resources.

135. An important consequence of such baseline projections is that the present status quo with respect to inequitable energy access and use will also likely persist largely unchallenged, although poverty may decline and per capita use of modern energy may rise somewhat in relative terms due to nominal economic growth. Indeed, the developing world's poor relying almost exclusively on traditional biomass for all their energy needs will increase from the present 2.4 billion to 2.6 billion, while those without electricity will fall only marginally from the current 1.6 billion to 1.4 billion in 2030. These projections do not take into account the contribution of other poverty-exacerbating factors, such as fuel price shocks, climate change, conflict, pandemics, etc., which could tarnish the outlook further. Barring radically higher economic growth in the developing countries than that projected over the period, only external interventions can thus be expected to significantly affect the inevitability of such a future:

- a reconsideration of current energy deployment and end-use practices; and/or
- major technological advancement that can dramatically improve the availability, cost, or use of existing or alternative energy resources.

136. It has been established in **Part II** that no country has substantially reduced poverty without massively increasing its use of energy. Electricity, in particular, plays a crucial role in improving levels of human development and quality of modern life. Quantifiable thresholds can

be discerned in terms of per capita electricity (and energy) consumption required to reach acceptable levels of development, as measured by standardized human development indices. For countries low on the HDI scale, the benefits of incremental increases in modern energy used by the population are disproportionately large, but the problem has been in achieving even modest increases in energy supply and consumption across large populations, presumably because of the costs involved for both investors as well as consumers. An important determinant of electricity use per capita—other than supply (or installed generation capacity per capita)—is thus affordability. For example, with power tariffs, largely determined by cost of service provision in most liberalized power markets, being essentially similar, huge disparities in actual consumption exist depending on income levels relative to electricity prices: per capita electricity use is high in the high-income, developed economies of Asia and an order of magnitude less, even at lower tariffs, in the developing nations of South and Southeast Asia with their much lower GDP per capita.

137. An immediate focus on overcoming such barriers to incremental and gradual, yet sustained, increases in energy consumption is therefore required to ensure that increased human prosperity is a corollary of baseline economic growth. Development and energy policies in most countries are dictated in the main by political, economic, and strategic considerations, and more recently, by market reforms. Energy access, affordability, and use has not been a primary concern—an important oversight which lowers the human impact of economic development and slows down the reduction of poverty levels. Pricing of energy for the poor with respect to their incomes remains a crucial determinant of energy accessibility and use. This is a factor that is usually not recognized adequately in national planning, especially in the face of rationalized tariffs in the increasingly liberalized energy markets of the developing world. In simple terms, modern energy supply must not only be made *available* to the world's poor, but also be made affordable for them before any substantial benefits of human growth or poverty reduction can be realized.

138. At a more strategic level, increasing the supply of energy to the levels required, say, for developing Asia to match current Organisation for Economic Co-operation and Development (OECD) countries per capita consumption by 2030 would require far greater resources than those projected under the baseline scenario: given its rapidly rising population and high poverty levels (India alone accounts for a quarter of the world's poor), it would take the entire global production of primary energy supplies and electricity just to meet Asia's enhanced needs. Such an objective would clearly be beyond the capacity of even existing large fossil fuel reserves to cater to, not to mention that of international and regional financing mechanisms to pay for.

Responding to the Challenge

139. A proper understanding of the existing baseline situation can, however, help guide a response strategy that more appropriately addresses the needs of the poor as well as possibly spawn "out-of-the-box" solutions. At the very least, it can help redirect and revitalize efforts at mitigating the effect of energy poverty among deprived populations by helping integrate energy access more fully into ongoing development activities and planning and making more optimal use of the resources available.

140. As summarized above, business-as-usual energy projections forecast an improved energy situation for developing Asia, but only marginally so for the absolute numbers of the poor with little or no access to modern energy services. Significant improvement in human development indicators will require substantial additional energy resources and investments, beyond available global or regional capacity. An achievable strategy would therefore require setting more realistic standards, for instance, for per capita energy consumption and national HDI values for the 2030 time horizon that are lower than the ultimately desirable threshold

values applicable to developed societies, but still substantially higher than those presently obtaining in developing Asia. Such a strategy would exploit the steep end of the HDI-per capita energy curve, reaping rich dividends from relatively moderate investments and making a discernable impact on the economic fortunes and quality of life of the poor. Such achievable targets, specifically quantified and pursued actively through institutionalized national and global commitment—for instance by being explicitly included in appropriately revised Millennium Development Goals (MDGs)—could ensure the gradual attainment of progressively higher subsequent targets, and thereby positively motivate action and investment beyond the baseline scenario.

141. Alternative strategies also need to focus on modalities of energy service delivery. The traditional supply-side emphasis on economic and demographic trends ignores other delivery scenarios possible that can leverage additional benefits with useful, mutually reinforcing synergies—alternative and efficient energy use, cleaner fuel mix with a lower environmental footprint, affordability linkages with aggregate income and economic growth, pricing and fiscal incentives, and prioritization of basic needs for cooking, lighting, heating, and space conditioning in devising effective energy provision for the poor.

142. Only a "virtuous cycle" emanating from such cross-linked strategies that ensure macroeconomic stability and growth, expansion of energy production and delivery systems, system-wide efficiency gains, affordable pricing, and augmentation through viable alternative methods and fuels would help lift the income-earning capability of sizeable numbers of the poor and fortify sustainable growth. A narrow or passive supply-oriented focus, even when coupled with prudent demand-side measures, alone would neither be sufficient nor sustainable in the long run without the concomitant economic payback accruing from investments in social and human capital that is required to integrate the poor into the mainstream economy. It is important for national planners and policy makers to realize that energy supply and consumption are not an end in themselves, but a means for achieving other benefits (e.g., improved quality of life; intellectual and material growth; economic and financial freedom; and a long, healthy, productive, and satisfying life). Awareness of the energy dimension to economic prosperity is key to reducing poverty effectively, because without modern and convenient energy services, none of these benefits are attainable.

143. At the very least, energy strategies should not aggravate social problems further—on the contrary, these should be specifically targeted for reduction through energy-centered policies. Thus, in addition to energy policies and planning, poverty reduction efforts in developing countries also need to focus on universal access to adequate, affordable, reliable, quality, safe, and environmentally benign forms of modern energy which can contribute to the solution of social problems. These include the lack of economic opportunities; facilities for human development and social welfare, including education and training in marketable skills; reduced labor and improved health conditions, specially for women and girl children; and involvement of the socially marginalized (underserved communities, the urban and rural poor, women, etc.) in energy-related decision-making and managerial capacities that helps empower them economically and socially.

144. The response strategy must, of course, focus on a greatly expanded provision of modern energy services, including alternatives and efficient means of use, to the population at large, especially to those at the bottom of the energy ladder. It should also facilitate movement of the poor up the energy ladder in terms of increasing their capacity for the use of modern energy and fuels for purposes of economic and human development beyond meeting very basic needs. Access to reliable "on demand" electricity at affordable rates must be central to the response strategy, in addition to other modern fuels, especially for lighting and fans, cooking, heating,

refrigeration, transportation, motive power, and electronic communications, and be targeted across all income strata in order to maintain upward economic mobility and national growth.

145. Energy access, consumption rates, and intensity targets need to be conflated with overall GDP growth and poverty reduction goals in national planning, so that such indicators can be meaningfully tracked and responded to. The introduction of energy-specific MDGs, as discussed later, would be an important means for achieving such integration of energy access within pro-poor development activities and for triggering appropriate national action and international assistance. At the same time, governments must realize the necessity for overall economic stability, growth, and liberalization as the only sound, long-term means for increasing incomes and investment flows. Enhanced economic capacity would be essential for expanding energy provision as well as make its use affordable for a greater proportion of the population, especially for the bulk of the population hovering around the poverty line (poverty in low-income Asian countries runs deep: for instance, in India, while just under 35% of the population, or 359 million, had daily incomes of less than $1 in 1999–2000, as much as 80%, or 826 million, were only slightly better off at below $2 a day in 2001[31]). Increases in energy access (both its supply and affordability), per capita energy consumption, poverty reduction, human development, national income and GDP growth are inexorably intertwined, and reasonable progress on one front cannot be made at the exclusion of the others. National targets must be set for all of the above and actively pursued simultaneously using multi-pronged intervention strategies, investments, and budgetary allocations. Such a holistic strategy can allow mutually reinforcing synergies to take root and enable increasing numbers of the chronically or marginally indigent to lift themselves permanently out of the clutches of insidious poverty.

146. Global and national inequities in the use and distribution of energy resources undermine the efficiency, optimization, and security of available supplies and their use. Perpetuation of a world economic order based on existing structures of fossil fuel pricing and resource sharing will only intensify such issues further as absolute energy consumption increases in the future—with developed countries tying up disproportionate and excessive resources and developing countries, especially Asia, stymied by high population growth and insufficient financing, struggling to maintain their hard-earned economic gains. A sustainable, long-term response strategy should thus address both sides of the energy equation—improving energy access for all in the developing countries while encouraging national policies that ensure that increases in more widespread energy supply are not offset by rising population pressures, while reducing waste and extravagant energy use by affluent segments of the world's population, particularly in the developed world.

147. Such a strategy would require global buy-in and action, similar to the motivation for "common but differentiated responsibilities" agreed to by the world's nations for addressing climate change at the Rio Earth Summit of 1994. This could be supplemented by concerted regional initiatives within developing countries to improve the provision of modern energy services to their poor and check unsustainable population growth. As an example of the synergies alluded to earlier, modern energy services in poor communities can of themselves help reduce infant mortality and enhance life expectancy, thus reducing some of the factors responsible for high fertility rates in poor developing countries. Modern cooking fuels and devices also reduce the need for child labor for household chores and fuelwood collection, just as modern energy does for commercial labor. With a reduced need to exploit children for income generation purposes, the incentive for having large families as a social "safety net" in

[31] Chen, S., and M. Ravallion. 2004. How Have the World's Poorest Fared Since the Early 1980s? Policy Research Working Paper 3341, pp. 30–31.

poor households is correspondingly diminished, further helping reduce their sizes, and hence the population and its energy needs.

148. Integration of environmental concerns in energy planning through better understanding of the externalities (e.g., environmental and economic costs and benefits) of different energy resources and transformation processes, leveraging of carbon financing for greater deployment of clean and renewable technologies, tighter end-use regulation and compliance, increased efficiency standards, fuel switching, alternative fuels, mandated targets and quotas, market-based pricing, smart subsidies and fiscal incentives, and policy measures aimed at promoting sustainable energy use can help reduce some of the negative consequences of continued fossil fuel use. This is important not only for realizing significant shifts to cleaner energy, but also because current policies typically may encourage suboptimal efficiency and end use, thereby wasting huge amounts of useful energy between its source and ultimate use that could otherwise directly benefit greater numbers of those currently underserved. Multilateral assistance, supplemented with increased official development assistance (ODA), can be of particular relevance here, both in terms of technical and financial assistance as well as in reducing risk perceptions for private fund flows to developing Asia, and can supplement accelerated local sector reforms—unbundling of monopolies, greater privatization, credible regulation, fewer physical controls, cost-reflective pricing, and increasing use of local and global markets for future growth.

149. There must also be an increasing realization of the worldwide impact of persisting energy poverty in large populations of Asia and Africa, both economic and environmental, which may be accentuated further by globalization and climate change. A preemptive redressal of such imbalances is more prudent than reactionary and ad hoc measures later, which invariably would extract a much greater cost and could also be accompanied by in political, economic, or financial upheaval. It is therefore in the interests of both the developed and developing world to chart a clear, achievable, and well-graduated path for rapidly ending wide-scale poverty in developing countries by creating an enabling environment for sharing and developing the world's energy wealth more equitably.

150. In the long term, radical technological advances would be required to meet growing world energy needs sustainably and fully. However sporadic and unpredictable technological innovation is, economic and policy pressures can help significantly catalyze the resources employed in relevant research and development, technology transfer, and its assimilation, both in the developed and developing countries. In the shorter term, technology-driven cost reductions in alternative and renewable energy supplies and efficient end-use can help augment supplies to the poor at lower cost, if employed judiciously.

151. The following sections outline specific aspects that need to be taken into consideration in the design and implementation of an appropriate response strategy for ensuring energy for all of Asia's current and future generations.

Targeting the Poor

152. Two factors are of particular significance at the outset in appropriately understanding and evaluating plans to reduce energy poverty: first, identifying the population that most suffers its consequences so that remedial actions can be properly focused; and second, the need to set quantifiable targets and indicators to measure the results of such actions.

The Demographics of Poverty

153. Most of the developing world's energy poor comprise the bulk of its rural population, although the increasing ranks of the urban poor are also faced with a grim affordability challenge and poor service quality with respect to the relatively better energy choices available

to them. The 2.8 billion rural poor in developing countries depend overwhelmingly on inefficient, polluting, and unsustainable biomass-based traditional fuels for their needs, which greatly degrade their economic and living conditions. The urban poor face severe issues of affordability and intermittent, poor quality energy supplies that consume a major portion of their incomes with suboptimal returns.

154. The rural poor also bear the greatest brunt of the inherent negative consequences of baseline trends: escalating and volatile oil and gas prices, climate change and atmospheric pollution from fossil fuel use, increasing urbanization and industrialization that further marginalizes rural needs, and the environmental degradation of unsustainable biomass harvesting. All of these factors further intensify poverty pressures within developing nations.

155. However, it is also among the rural population of developing Asia that greatest change can be brought about rapidly and with the largest payback, not only because the population of potential beneficiaries is so large but also, crucially, because their basic energy requirements are relatively so modest. These consist of domestic cooking, lighting, fans and space heating, and food storage requirements, in addition to the provision of mechanical power for water delivery, agriculture, and small-scale agribusinesses.

156. If targeted poverty reduction is to be achieved, ways must be found to integrate the poor into mainstream economic growth so that their incomes do not remain stagnant. The recent economic upturn in many Asian countries has been accompanied by a growth in inequality. For instance, the southern Indian states have been growing at 3 percentage points faster than the more populous and poorer northern regions. Per capita consumption of the richest quintile in both Sri Lanka and Pakistan has been increasing at an order of magnitude higher rate than that for the poorest quintile. Such income disparities are likely to persist and keep millions in pockets of abject poverty, besides creating additional social tensions and possible strife, unless ways can be found for a more equitable sharing of economic gains.

157. Good, efficient, and clean governance is key to achieving better results. Many Asian countries, especially in South Asia, have long suffered from confrontational politics, violent civil and military conflicts, enduring corruption, and unresponsive or discretionary administrative, judicial, and policy-making mechanisms, especially at the grassroots level. Such an environment not only disenfranchises the poor from their basic rights and results in very few resources trickling down to benefit them directly, but also creates conditions in which national economic growth and foreign direct investments in the country are constrained. Asia's GDP growth has been achieved despite such mitigating circumstances, and could be accelerated further by several percentage points a year if more transparent and effective governance systems could be deployed.

158. The aim of focusing better on the needs of the poor, providing them with the inputs, resources, conditions, and opportunities to help lift them out of destitution, and include them meaningfully in national economic growth has a singular objective: improving their living conditions and level of human development, as envisaged in the MDGs. The importance of energy services in such an exercise have been discussed at length. The next logical step is to find ways of integrating energy requirements into development goals in a manner that can help guide appropriate policies and actions.

Revisiting the MDGs

159. A quantifiable basis for targeting the energy poor can be provided by revising the MDGs to explicitly:

- take into account the energy requirements necessary for meeting the existing MDG targets, without the provision of which *none* of the stated goals can be achieved; and

- set acceptable levels of modern energy consumption as a target in itself for the intrinsic human satisfaction, freedom, and convenience that it provides, which is a hallmark of life in advanced, developed societies.

160. The existing MDGs have failed to take both of these important factors into account, which not only seriously jeopardizes the attainment of the targets set, but may well result in the population of the energy-deprived in 2015 remaining largely the same as today. Just as the Agenda 21 resolution resulting from the Rio Summit over a decade ago was weak in recognizing the energy-environment nexus until gradually these strong linkages were realized, which now assume center stage in the global environmental debate, the Millennium Declaration reached at the Millennium Summit in September 2000 neglects the deep causal relationship between energy consumption, poverty, and sustainable human development. This deficient perspective begs immediate reexamination and can only be corrected by placing the provision of 'affordable and sustainable energy services to all' at par with the other declared MDGs and integrating relevant targets, along with the cost of energy service delivery needed to support the achievement of the MDGs, comprehensively within the national development strategies of the target countries.

161. At a minimum, the existing MDGs require access to energy by the poor for three main purposes:

- heat for cooking, as well as for space heating in colder regions and climates;
- electric power for lighting, appliances, motors, and devices essential for household, commercial, and community facilities (schools, clinics, cottage and agro industry, etc.); and
- mechanical power for agricultural, irrigation, and other productive uses.

162. **Figure 48** summarizes the fuels required for the basic needs outlined above as well as the MDGs that can be better served through such modern energy resources. According to some estimates, in order to halve, by 2015, the number of people without access to such fuels, almost half a billion people will need to gain access to modern energy services every day for the next 10 years.

163. The amount of heat energy required for cooking purposes varies by the type of food, fuel, and cooking devices used as well as the cooking practices employed. Fuel efficiency and cookstove design are of particular importance in this respect: traditional stoves with open, fuelwood fire waste over 80% of the energy produced, while in standard liquefied petroleum gas (LPG) and kerosene stoves this is reduced to a half.[32] As noted in **Section 4**, about 1 gigajoule (GJ) per capita of useful energy is required on an annual basis for basic cooking purposes, which translates into as much as 10 GJ of biomass energy burned, or roughly half a ton of fuelwood, crop residues, and/or dung per person per year. With modern, efficient stoves and fuels, this requirement is only 40 kilograms (kg) of LPG or 45 kg of kerosene per person per year.

[32] Average fuel efficiency for cooking is estimated at 8% for biomass, 18% for coal, 25% for charcoal, 45% for kerosene, and 50% for gas and LPG (Dzioubinski, O., and R. Chipman. 1999. Trends in Consumption and Production: Household Energy Consumption. DESA Discussion Paper No. 6, page 6).

Figure 48: Energy Resources Required for Meeting the Millennium Development Goals

Energy Need	Fuels Required	Fuels Displaced	MDGs Served							
			1	2	3	4	5	6	7	8
Cooking, food preparation, storage, transportation, etc.	LPG, kerosene, natural gas, biogas, electricity, petrol, diesel, CNG.	Fuelwood, crop residues, dung, charcoal.	●		●	●	●		●	
Lighting, appliances, motive power, machinery, etc.	Electricity.	Kerosene, batteries, manual and animal power.	●	●	●			●		●
Agro/food processing, irrigation, productive enterprises, etc.	Electricity, diesel, mechanical wind and hydro.	Manual and animal power.	●	●	●		●		●	

CNG = compressed natural gas; LPG = liquefied petroleum gas.
Source: United Nations Development Programme (UNDP). 2005. *Achieving the Millennium Development Goals: The Role of Energy Services.* New York: UNDP.

164. In practice, although a combination of different fuels is often used by the poor, including biomass, biomass-derived charcoal or biogas, and fossil fuels, the annual energy requirements for cooking for the approximately 2.5 billion Asian rural population in 2015 would therefore be about 100 million tons of LPG or 126 million tons of kerosene, displacing up to 1.2 billion tons of biomass as combustion fuel each year. This compares with over 210 million tons of LPG (90% used for cooking and heating purposes) and about 80 million tons of kerosene (other than jet fuel) consumed worldwide in 2003. However, health and productivity gains can more than offset the costs involved. For example, according to World Health Organization (WHO) estimates, investing $13 billion per year to halve, by 2015, the number of people worldwide cooking with solid fuels by supplying them with LPG can provide an annual payback of $91 billion. Additional fuel supplies, including natural gas, diesel, and petrol are also required for food preparation, processing, and transportation, while electricity is normally required for preservation and storage (refrigeration, freezing, etc.). Modern fuels are also more convenient and socially desirable for cooking and related activities on account of their instant and high heating and cooling efficiency, an aspect in which renewable energy substitute techniques unfortunately often perform poorly (e.g., solar cookers).

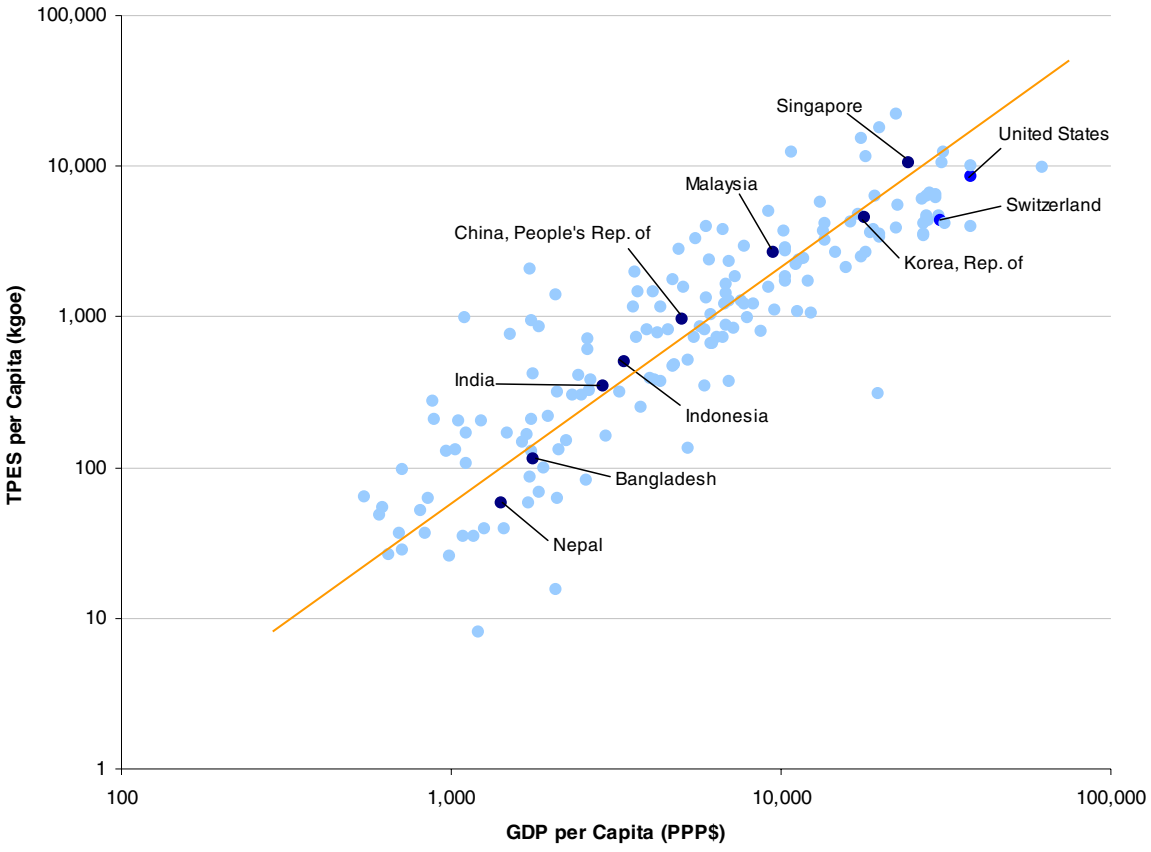
165. Electricity is essential for most other basic needs, such as illumination and space cooling; productive uses, such as machinery, computers, telecommunications; social services, such as medical equipment, ICT, and water supply and sanitation systems; as well as for modern lifestyle needs and conveniences, such as television and other household appliances. As has been described in **Section 3**, roughly 4,000 kilowatt-hours (kWh) per capita per year is required on average in order to ensure that all citizens have access to a decent, modern lifestyle and the facilities necessary for social well being and economic emancipation.

166. Current baseline projections given in **Section 1** estimate 1,252 gigawatts (GW) of installed capacity in developing Asia by 2015, sufficient to raise average consumption to 1,667 kWh per capita and average HDI to 0.78, or above the current (2003) world average of 0.741, but still well below the 0.9 target. With the population of developing Asia expected to exceed 3.78 billion by 2015 (from 3.3 billion in 2002), in order to take the average per capita electricity consumption up from the present 909 kWh to 4,000 kWh (corresponding to the

"developed" HDI threshold of 0.9) within that period, an additional generation capacity of over 12,000 terawatt-hours (TWh) would be required by 2015. This would mean an increment in installed central generation capacity of about 2,600 GW in developing Asia, or over half of the currently projected worldwide installed base of about 5,000 GW in 2015—an investment that will require well over $2 trillion in capital expenditure alone.

167. Mechanical power is also important for meeting MDG targets, and in some cases it can also substitute for electricity, especially in rural applications for transportation, water pumping, farm and irrigation needs, grain crushing and grinding, and numerous other such needs. Mechanical power can be driven by petrol and diesel engines, as well as renewable resources, and cannot only replace human and animal labor and free up time for other needs, but also help increase productivity through efficiency gains and agricultural intensification made possible by the use of tractors, harvesters, threshers, and other such farm mechanization aids. The amount of energy required to provide such mechanical power to the rural poor is difficult to estimate separately as it can vary widely from country to country, but can be assumed in a minimum overall annual primary energy use figure of above 3,000 kilograms of oil equivalent (kgoe) per capita indicated by **Figure 49** for developed countries.

Figure 49: Commercial Energy Consumption and Gross Domestic Product, 2003



GDP = gross domestic product; kgoe = kilogram of oil equivalent; PPP = purchasing power parity; TPES = total primary energy supply.
Source: WB. 2006. *World Development Report 2006: Equity and Development*. Washington, DC: WB.

168. Although the need for explicitly including energy service provision within the MDGs has been widely recognized, both as an enabler for achieving the goals as well as an objective in its own right, agreement at evolving quantitative energy-based targets has been elusive so far

because of the diversity of energy needs, uses, and availability of resources around the world. However, the UN Millennium Project has, in 2004, recommended the following three broad target parameters to be adopted for 2015:[33]

- Enable the use of modern fuels for 50% of those who at present use traditional biomass for cooking. In addition, support (a) efforts to develop and adopt the use of improved cookstoves, (b) measures to reduce the adverse health impacts from cooking with biomass, and (c) measures to increase sustainable biomass production.
- Ensure reliable access to electricity to all in urban and peri-urban areas.
- Provide access to modern energy services (in the form of mechanical power and electricity) at the community level for all rural communities.

169. To these targets, this paper recommends adding a suitable selection of additional targets or actionable objectives as national conditions and capacities allow, such as:

- Set national per capita energy use target for 2015 (e.g., at least 2,000 kWh corresponding to an HDI level of 0.8 on the HDI-u curve in **Figure 32**).
- Establish clear annual targets for rural electrification that can result in providing access to reliable electricity, through the grid or alternative sources, to at least 95% of the national population by 2015.
- Provide remote communities that cannot economically be connected by 2015 to national electricity grids due to long distances and low loads involved with alternative energy supplies, such as off-grid generation capacity and dispersed renewable energy systems, at an expenditure at least equivalent to the capital cost that the corresponding grid extension would have entailed.
- Delicense and deregulate small-scale off-grid generation based on renewable energy and alternative fuels below certain capacity (e.g., 5 MW), and greatly simplify rules for self-generation and community-level distribution networks.
- Devise targets for including renewable energy, particularly off-grid power generation and biogas plants, in national planning, including indicative and mandatory quotas of renewable and alternative energy in the primary energy mix and utilities' electricity purchase portfolios by 2015.
- Establish financing targets, based on per capita energy needs, for providing effective and adequate capital grants designed to partially off-set the high, one-time initial costs of renewable energy systems for low-income consumers in order to enable large numbers of the poor population, who are able to meet much lower associated lifetime system operational costs, to gain access to such energy services, and to allow a domestic market in such technologies (solar PV home systems, biogas digesters, micro wind turbines, micro to small hydro, etc.) to proliferate and provide further economies of scale.
- Mandate standards for renewable, alternative, and efficient energy use in all public-sector investments and uses, such as transportation, buildings, and physical infrastructure, including incorporating such features in urban design, mass transportation, and other planned development.

[33] UNDP. 2005. *Achieving the Millennium Development Goals: The Role of Energy Services*, page 39.

- Target quantifiable improvements in energy service delivery, such as reducing national electricity transmission and distribution losses to no more than 10% of power generated, setting and enforcing more stringent power voltage and frequency limits and liquid and gaseous fuel quality standards at the points of sale, and removing price anomalies that encourage fuel adulteration.
- Revise electricity tariffs, especially lifeline rates, so that they explicitly take national poverty and income statistics into account, in order to improve affordability among lowest tier consumers (i.e., by setting targets for reducing the proportion of per capita disposal income spent per unit of energy consumed, especially for the lower income groups).
- Consider making ethanol-blended gasoline (E10 or higher) mandatory for all petroleum sales by 2015, and introduce incentives for biodiesel use.
- Implement clear fiscal incentives and charges (energy and pollution taxes) to discourage excessive, inefficient, and environmentally harmful energy use and to create supplemental financial resources for expanding energy infrastructure and access for the low-income consumer base.
- Studies have shown that the use of solid fuels and inadequate ventilation in kitchens are responsible for the highest concentrations of particulate matter in indoor air, and that women experience the highest exposure. They have also indicated the advantages of a number of interventions (improved ventilation, behavior change, and fuel switching), and suggest the adoption of a relevant environmental indicator—levels of access to clean fuel and proper ventilation—as a new MDG target.

170. These and other such actionable objectives can be combined with the existing MDGs to devise a "revised" set of country-specific targets that can properly integrate the contribution of energy access for meeting human development needs. Only if such explicit recognition is provided to the role of modern energy services in poverty reduction and human growth can the existing MDGs and their basic objectives be achieved for the greatest number of people.

Enhancing Supplies, Paring Demand

171. Once properly targeted, both in terms of the beneficiaries and achievement goals, the provision of universal access to modern energy services would need to concentrate on ways of increasing supplies, expanding distribution networks, keeping costs within reach, and ensuring that the objectives of energy use—rather than just the quantum of energy consumed—are optimally met. This would require action on several fronts simultaneously, aimed at enhancing supplies while managing needs prudently.

Optimizing Resource Utilization

172. As noted earlier, available world reserves of fossil fuels are presently deemed adequate for meeting baseline demand projections to 2030, but insufficient for elevating average developing country consumption, even for Asia, to current OECD standards. Optimizing the supply of available energy resources in such a scenario will require nations to ensure that positive trends are further accelerated and supplemented—such as by the increasing deployment of renewable energy (e.g., especially for dispersed and off-grid applications); use of alternative liquid fuels and technologies (e.g., for transportation); switching to efficient technology options (e.g., combined-cycle power generation, cogeneration, etc.) and fuels (e.g., natural gas instead of oil for electricity generation); and reducing transformation, transportation, and distribution losses (especially of electricity). Such technology and fuel switching is already gaining momentum in the region: for example, after a period of substantial increase in oil-based

thermal power generation, Pakistan has lately substituted indigenous natural gas in virtually all such plants (which led to a ten-fold decline in the country's annual furnace oil imports from 2000 to 2004), and currently has on its roads the third-largest fleet of CNG-powered vehicles in the world (which has reduced growth in diesel and gasoline imports). At the same time, the unavoidable consequences of increased resource use would also need attention so as to reduce their adverse impacts, such as atmospheric pollution and global warming. Given continued trends, cleaner burning coal technologies in particular will be vital to help offset some of the potentially large emissions of GHGs, particulates, and other pollutants that would be released otherwise.

173. Increased energy trade between regions and countries can also help improve the economics of resource use. Most energy resources, such as gas and oil deposits, and large-scale hydropower, can be most optimally employed when utilized by two or more countries to exploit economies of scale and production techniques. This is particularly true for Asia, where regional disparities in supply-demand shortfalls and surpluses exist in close proximity (for example, the large natural gas reserves in Bangladesh and West Asia, adjacent to a large gas-deficit market in India, or electricity imports into South Asia from gas and hydropower-rich countries in the north). Trade also allows countries to diversify their fuel mix, introducing an increased level of energy security, reducing costs, improving operational flexibility and efficiency, enabling the best energy use technologies to be employed, and improving sustainability of use by opening up cleaner fuel options—although carries with it increased supply and price risks.

174. Political, strategic, and price volatility risks have frequently mitigated against expanded intraregional energy trade within developing Asia (such as in the case of gas imports from Iran and Central Asia into India and Pakistan, or for increased international cooperation in civilian nuclear programs), a situation that needs to be redressed to the extent possible, as shown by several successes within the ASEAN countries (e.g., the partially implemented regional power grid, gas pipeline between Thailand and Malaysia, and more planned links between fields in Indonesia and Singapore, Thailand, and the Philippines). The increasing importance of liquefied natural gas (LNG), allowing additional flexibility in the transportation of natural gas across large distances, although requiring substantial investments in related infrastructure and market development, would help boost the international trade and use of this clean, efficient fuel across the region and beyond.

Expanding Renewable and Alternative Energy Supply

175. Of particular importance in supplementing existing energy resources is the increased use of renewable resources employing solar, hydro, wind, geothermal, and biomass conversion technologies. Although not without their own environmental and economic risks, such technologies carry virtually none of the climate change and local pollution drawbacks associated with fossil fuels, and in addition offer other important advantages: practically inexhaustible resource base; zero fuel costs or recurring import requirements; predictable lifetime production costs; suitability for dispersed deployment near loads served, hence reducing transmission costs and losses; and application sizes ranging from household-level to utility-scale. These latter attributes make renewable energy, especially power and biogas generation, particularly apt for rural or remote locations, where modern energy services are most needed and for which expansion of electricity and gas transmission networks is particularly difficult or load demand uneconomical. Increased renewable energy use, especially for the rural poor, is thus an important potential means for significantly improving energy provision above baseline trends in Asia, given that most countries have adequate suitable resources of one kind or the other.

176. However, renewable energy deployment is often complicated by formidable barriers—high initial capital and transaction costs, inadequate legal and regulatory frameworks, lack of technological familiarity, hidden subsidies for fossil fuels, low awareness of benefits and available resources, etc.—and entrenched political and market biases that must be overcome through policy intervention and state support. A major issue is for governments themselves to be able to strategize renewable energy use properly and cost-effectively, given their often limited experience of the underlying complexities. For instance, while grid-connected hydro, wind, and biomass-based power generation can be economical in many instances, the provision of attractive initial incentives and external financial support necessary to attract private sector investments in such projects can often cloud the economic cost of the energy produced with respect to other available options, including online idle conventional generation capacity (with its low marginal activation costs). Thus, unless carefully considered, such projects can cumulatively lead to raising, instead of lowering, system-wide costs of power generated over their lifetimes, or risk creating uneconomical "stranded" capacity if the external financial support mechanisms are eventually withdrawn. In other words, as some of the leading wind power countries learned from their initial experiences, even success in achieving a sizeable installed renewable energy capacity may yet result in questionable economic gains. Relatively expensive grid-connected power technologies, no matter what their external benefits, can thus not necessarily be considered as a viable means for providing greater amounts of affordable energy to the poor, and thus should be critically evaluated in this respect in the specific national context. On the other hand, smaller dispersed off-grid projects, often considered less glamorous by planners and investors alike, can offer substantially greater economic payback because the cost of alternative supplies is usually much higher and the avoided cost of zero supply even greater. According to the World Bank, investments in off-grid generation projects are the quickest way to get electricity to the 1.6 billion in the world presently without lights.

177. Other peculiarities of renewable energy deployment that are often underestimated and can lead to suboptimal deployment relate to the need for tailoring policy support appropriately, based on a wide variety of instruments and strategies that have been tested in the past with varying levels of success, as discussed briefly separately below. Notwithstanding such barriers and need for policy sophistication, which international and multilateral cooperation can specifically help developing countries adopt for their own respective situations, the accelerated development of renewable energy, particularly for isolated household and community use, would represent an important means of addressing energy poverty in rural Asia.

178. End-use considerations and demand characteristics also have important consequences on resource use, and are discussed separately below. However, it is important to point out that alternative energy and end-use technologies, especially renewables, biofuels, energy efficiency, and demand-side management, can collectively allow for much greater fiscal space for more innovative energy planning and a redirecting of resources from merely sustaining existing energy use patterns to expanding them to serve greater numbers of the poor.

Improving Service Delivery

179. In addition to increased supply coverage, affordable pricing, and more productive uses of energy, improvement in quality and reliability of services can enhance its economic value and benefits at low marginal cost. Service delivery criteria include availability in terms of quantum (unlimited versus rationed) and frequency (continuous, as required or intermittent, as available); quality (voltage, calorific value, octane and cetane values, etc.); and relative pricing (versus alternatives, as well as volatility and inflation).

180. The poor in particular, especially in rural communities, suffer inordinately on account of poor service delivery, even when modern energy is made available to them. Unpredictable

supplies make it difficult to work efficiently, while prolonged outages or shortages can make it virtually impossible. Such insufficient availability of supplies for the poor is very common, as utilities and fuel suppliers generally accord a very low priority to their lowest paying, lifeline consumers and often divert limited supplies away to bigger customers during the frequent disruptions common to developing country production assets and supply networks. Routine maintenance of the supply and access infrastructure (distribution lines, pipelines, roads, etc.) in poor communities is similarly inadequate because of the typically low revenue market and negligible political voice presented by poor citizens. As a result, they endure not only low efficiency of energy use, but incur greater expenses on account of frequent damage to their energy-consuming appliances and machinery caused by voltage fluctuations and power distortions, adulterated fuels, and reduced gas pressures. This raises the ultimate unit cost of the energy consumed by poor households to levels higher than those accruing to their more affluent counterparts, decreasing the economic utility of such services for them greatly. Price escalation and variability introduces economic shocks that many poor are ill-equipped to deal with, and are often a cause for a relapse into poverty for the borderline segments that spend as much as a third or more of their net incomes on acquiring energy.

181. System-wide service delivery issues are also important. In particular, existing electricity transmission and distribution losses, which are as high as 15%–25% in South Asia and Indonesia, need to be plugged through institutional, policy, and technical improvements to more acceptable levels, closer to the 4% in the Republic of Korea and Japan, for instance. In some developing Asian countries, as much as 40% or more of the meager total power generated is lost to transformation, transmission, distribution, and pilferage losses. Such high system leaks are ultimately paid for by the consumer in the form of higher tariffs, which lowers their competitiveness and incomes, reduces access for the nominally poor, and drives down the economic benefit of the energy supply further.

Increasing Efficiency of Use

182. In parallel to increasing energy supply and distribution at prices that make universal access possible, optimal energy use is also important in closing the gap between unsatisfied needs and inadequate available resources. In this respect, energy conservation methods, use of efficient devices, and other demand-side management practices represent a “virtual” energy resource that can readily be tapped into, usually at a fraction of the cost of providing equivalent “real” energy, with little or no loss of productivity, convenience, or other benefits. For the consumer, waste or excessive use of energy really means paying more than is needed, and hence conservation and efficiency translates into financial savings. For the energy supplier, the energy thus saved can be provided to meet additional latent demand, especially during peak periods, and for expanding their customer base, while for the nation this translates into increased productivity and income. Energy efficiency, therefore, in any context represents a “win-win” proposition.

183. However, like renewable energy strategies, energy efficiency and conservation markets are difficult to establish in developing countries because of traditional consumer preferences, vested commercial interests, and general government ennui. Many utilities, incorrectly, initially view it as reducing demand, and hence revenues. Other barriers include inefficient monopolies, uneconomic pricing, lack of awareness and wasteful practices, weak environmental compliance, and technology and financing gaps. Energy price rationalization and subsidy removal often helps instigate efficiency of use. Technology transfer and policy support is also usually required in many cases, and international technical assistance can be of particular value in replicating tested practices, interventions, and products locally.

Redirecting Interventions

184. Policy measures and necessary legal and regulatory frameworks that provide for greater investments and partnerships between governments, private sector, communities, and others in providing modern energy services and infrastructure, especially electricity and cooking fuels and efficiency improvements, to the poor on affordable terms need to be devised, adopted and widely propagated. Without such external interventions and barring technological breakthroughs, market forces by themselves cannot engineer such a shift from the baseline scenario. Policy instruments and regulatory reform are the most potent means by which governments can redirect and improve resource utilization, meet demand equitably, and manage methods of energy use at least cost.

185. Policy tools can be effectively employed to remove the institutional, regulatory, technological, social, and price barriers that impede investments where they may be needed the most, such as in serving rural and poor communities. However, such methods must be judiciously devised and monitored for impact, recognizing that different solutions may be required for meeting the needs of the urban and rural poor, or in implementing and nurturing disparate energy resources, technologies, and markets. Policies must also provide safeguards to protect the poor during reforms and against sudden price shocks, help mainstream energy issues into poverty reductions schemes (e.g., PRSPs) and development plans, and mobilize the necessary financial resources and agencies to support energy-centered development objectives, such as the revised MDGs described in the previous section.

186. The policy environment for renewable energy needs to be evolutionary to be able to respond to maturing technologies and markets specific to each country, with important industry-wide commonalities, lessons, and global and regional replication possibilities. For instance, while commercial-scale wind power may need subsidy support and preferential tariffs up front to help initiate incipient capacity, this must gradually evolve toward a more market-based pricing regime—once barriers have been significantly reduced and mechanisms for taking externalities into account introduced—in order for the wind industry to remain sustainable. Thus, for instance, the policy regime could systematically move from investor-friendly “price-setting” options, such as feed-in laws and investment and production incentives, toward more flexibly priced utility-based “quantity-forcing” measures, such as renewable portfolio standards, green tariffs, and net metering and billing that allow competition within, and then across, different renewable energy technologies, ultimately leading to consumer-oriented “market-priced” tariffs competing against all available generation sources once the renewable power industry is fully established in the country. Along the way, a combination of other policy incentives can be offered to bring about necessary investor and buyer response, such as capital subsidies, grants, and rebates; fiscal and tax credits; sales, import, energy, and excise duty reductions; public investments and loans; concessionary financing; public competitive bidding; and mandated rural electrification schemes. The range of policy options available for even a specific alternative technology can therefore be quite staggering, and selecting an appropriate combination that remains responsive to a particular market developing over time in a given country therefore requires astute management skills—experience that may initially be in short supply in developing nations with no prior relevant experience. International support and capacity building in this respect can therefore play a particularly significant role in devising successful policy interventions and avoiding tactics that have previously failed elsewhere.

187. Environmental policy measures aimed at promoting clean technologies, such as carbon credits, green pricing, and pollution taxes, can help increase alternative energy investments and lower their retail prices. Similarly, in the transportation sector measures to phase out leaded fuels, introduce cleaner fuels (low sulfur diesel and CNG), mandate engine tune-ups and enforce vehicle age restrictions, introduce catalytic converters, implement better inspection and

maintenance regimes, improve mass transit and public transportation, encourage pedestrian and bicycle traffic, and improved city and road planning can help reduce the consumption of fuels and enable redistribution of energy resources to the previously neglected. This is particularly true for developing Asia, where the rapid growth of vehicle fleets in fast growing economies presents a serious looming concern both in terms of their environmental impact as well as escalating oil import costs, given that per capita vehicle ownership among the large populations of the PRC and South Asia is still far below developed country levels.

188. Subsidized rural electrification, a policy goal of many developing Asian countries, requires hard targeting, tighter economic valuation, better defined cutoff criteria, demonstrable budgetary sustainability, explicit tie-in with indicators of quality, reliability and use, and verifiably improved impact on women and high priority social services. Such schemes must always be evaluated against other options, such as dispersed supplies, including off-grid community- and household-scale renewable energy. Areas where grid extension is not economically feasible (even over a limited time horizon), must be demarcated at the outset for the provision of alternative energy, with at least as much budgetary support as would have been involved in connecting them to the grid. The principle here should be two-fold: first, that such areas should not be left in limbo indefinitely, without any modern energy services or targeted dates for grid-supplied electricity; and second, that all citizens have an equal right to modern energy services, regardless of their geographical location and income status, and therefore deserve at least equal investment per capita on energy supply.

189. It is also important that such alternative energy services should be comparable in levels of quality and convenience to conventional supplies. Often, rural renewable energy schemes have failed in developing countries because they tend to cater for the most minimum needs, and that too sometimes only partially, not realizing how even communities previously completely deprived of, say, electricity, can quickly move beyond such basic requirements to larger appliance holdings and consumption patterns as they discover the many benefits of the new resource, and outgrow the initial installed capacity as their economic condition improves.

190. Thus, the relevant policy strategy must provide a flexible approach to providing cost-effective and practical energy solutions, realizing that individual energy needs and consumption patterns of even the poorest do not remain static but grow with time, income, and evolving aspirations, and that every human being feels an innate need to constantly move up the energy ladder in order to achieve a better life for himself and his future generations. Meeting minimal needs may be acceptable at first, but the solution must allow for gradual enhancement subsequently, ultimately integrating such supply into the mainstream energy economy, if continued progress toward attaining higher human development goals is to be achieved. In many hilly regions of the PRC for instance, the establishment of small hydroelectric plants in remote locations spawned dispersed local distribution grids which, with the emergence of additional such small networks, gradually increased in density until finally coalescing into larger regional grids that could ultimately be connected to the national electricity network. The commensurate human development fallout for the local populations, raising them from a situation of isolated poverty to living conditions comparable with the rest of the country, can easily be visualized.

Pricing Energy

191. Energy prices influence consumer choices and usage levels, as well as affecting national economic development and growth. High energy prices can reduce the number of people and purposes that such resources can serve, increase costs of production and fuel import bills, and reduce production, exports, and incomes. However, they can also stimulate

more efficient use, technological innovation, and the quest for more natural energy reserves and alternative energy production techniques.

192. In addition to increased supply and wider distribution, affordability is the other vital ingredient of energy access for the poor. As seen earlier in **Section 4**, even roughly uniform retail power tariffs across Asian countries can result in huge differences in per capita electricity consumption that are apparently directly influenced by per capita GDP, indicating that below a certain income level this form of energy becomes rapidly unaffordable. This can be explained by the predominance of lowest-tier consumers among the customer base of utilities in most developing Asian countries, for whom electricity bills represent a major household expenditure. The situation is similar with petroleum products, especially diesel and kerosene used by the poor for transportation and lighting, and LPG used for cooking. Long-term escalation and abrupt changes in the prices of these supplies particularly impact the poor who can already barely afford minimal necessary purchases and have no additional disposable income or cash reserves to finance higher costs.

193. Although lifeline rates are usually cross-subsidized by governments, these lower rates are seldom adequate for increasing energy access and often instead result in a large portion of the benefits accruing to the affluent as well, reducing their effectiveness and underpricing supply unnecessarily for those who can afford to pay its full cost. Poorly designed subsidies also distort the relative price of fuels, inhibiting fuel switching based on true economic costs; discourage use of alternative resources; send price signals that promote inefficient use; impose undue burden on the supply system, infrastructure, and environment; reduce the ability of the utility to maintain, expand and improve delivery system without state support; decrease public investments and discourage private investments; impose a heavy financial burden on tax revenues and foreign exchange earnings; and impede development of indigenous and renewable resources.

194. From a supply perspective, every such subsidy has an associated energy saving potential that can be realized by reducing it. Therefore, energy pricing, taxes and subsidies in developing countries require a major rethink in order to make modern energy services affordable to the poor, while curtailing unnecessary and wasteful use across the board. This would involve, for example, a reevaluation of both subsidy levels, forms and pricing structures, increasing “smart” subsidies where they can be more effective and have a greater economic payback, lowering connection and other one-time charges for the poor, and introducing microfinancing and community participation to help distribute the cost of service delivery for those who might not be able to afford it up front. Demonstration projects have shown that the poor can obtain the same level of energy services at much reduced costs simply by moving up the energy ladder to modern fuels instead of using inefficient, traditional biomass and kerosene. In such cases, they are often prepared to pay nearly the full cost of, say electricity and LPG, because the alternative of using kerosene or fuelwood may involve higher expenditure or unproductive labor. Subsidy design can be refined to augment and optimize such comparative advantages, reducing total outlays, benefiting greater numbers of the poor, and improving energy use while avoiding introducing wholesale price distortions. Energy taxes, especially on petroleum products, are often an important source of government revenue and help check demand. These also need to be carefully considered in terms of their impact on economic productivity, competitiveness, and affordability. Tax receipts from energy services can be better utilized for increasing energy access, cross-subsidizing use by the poor, and funding cleaner alternatives, instead of being subsumed for general budgetary support purposes.

195. In addition, economic instruments for pollution control, including pollution charges, fiscal incentives and financial facilities for environmental equipment, and pricing policies favoring cleaner fuels, road and car use, etc., can be introduced to reduce the environmental cost of

continued fossil fuel use and help check excessive use. As discussed earlier, the primary beneficiaries of any reduction in the environmental impact of energy use would be the poor.

Reforming and Restructuring Markets

196. Most Asian economies, spurred by globalization and encouraged by multilateral agencies, have embarked upon liberalizing their economies and restructuring their energy markets to bring them in conformance with free market principles that encourage competition and attract private participation. Sector reforms and market-oriented policies are gradually replacing public sector monopolies and central planning, leading to a boom in private investment, with electricity generation receiving the largest investment. Attractive policy incentives have also led to increased exploration for oil and gas in regions that were previously untouched due to lack of resources and multinational corporate interest. Fuel distribution networks have likewise expanded considerably and service quality improved as international marketing companies have taken up local sales and distribution, attracted by the potentially large consumer base in developing Asian countries. Innovative marketing and financing, quality and efficient products, and increased competition among suppliers have translated into welcome gains for large numbers of the Asian population who were previously accustomed to abysmally poor energy service standards.

197. However, such reforms have also presented new challenges, especially for the poor. Investments are increasingly influenced by commercial profitability, rather than social needs or benefits, resulting in those with little or no purchasing power to be further neglected. At the national level as well, private financing chasing the highest returns has sometimes created serious investment imbalances and infrastructure constraints. For instance, while independent power producers (IPPs) have greatly supplemented power generation in several Asian countries, investments in their transmission and distribution networks have lagged behind, creating major bottlenecks in terms of service delivery. Large-scale increase in privately funded consumer credit has prompted a phenomenal rise in vehicle ownership among the large populations of the PRC, South Asia, and Southeast Asia, placing an enormous strain on road infrastructure and air quality, besides driving up oil imports, and accounting for a rising burden on government expenditure that could otherwise be allocated for more direct development spending. At the same time, private investments in dispersed power and other fuels have lagged behind. Most of these effects have left the poor in these countries worse off than before or, at best, further excluded from the commercial economy.

198. Energy price reforms have invariably accompanied market deregulation, leading to rationalization and determination through supply and demand principles. While the level of price distortion has been reduced and charges are gravitating toward a cost-of-service delivery basis, unless the subsidy protection provided to the lowest-income segment of consumers is simultaneously bolstered and made more effective, as discussed above, the affordability crisis for the poor will only worsen. Reduced government sharing of energy revenues (through taxes and business charges), in addition to smarter subsidy mechanisms, is essential to increasing private investments while maintaining reasonable consumer price levels. Policies that encourage decentralized energy supply, thereby eliminating transportation costs and losses, through public and private investments, assume greater significance in markets based on least-cost principles.

Financing Supply and Access

199. Meeting the financial requirements for the increased energy production and transportation systems required to fuel continued worldwide growth is a challenging proposition even under the baseline scenario, as discussed in **Section 1**, that will test the capacity of the financial markets, especially in the developing countries of Asia experiencing the highest

demand growth rates. If such capital investments for physical plant and infrastructure, distribution chains, and management structures are not adequately mobilized, economic development will be impeded the most in these developing countries, and the populations of their poor will be the worst affected being at the end of the beneficiary queue. As noted earlier, because of the early and quantifiable revenue-generation potential of upstream energy production, these activities are increasingly being delegated to the private sector in many Asian countries. However, private foreign direct inflows into developing countries (PRC being a notable exception), especially for downstream energy investments, are often hindered by perceived high political, transparency, or security risks, which can only partially be overcome through external guarantees and multilateral risk sharing mechanisms or through supplemental ODA financing. Each country also needs to develop clear and stable policies and rules for their energy and financial markets, improve the financial health of local energy sector entities, especially utilities and distribution companies through effective revenue collection systems and effective management, and the legal frameworks for protecting contracts, investments, assets, and profits and for resolving disputes.

200. The share of national financing of energy investments must also increase from the historical average of 1.0%–1.5% of the GDP witnessed in the past for most countries if significant energy supply chain improvements are to be achieved. Public investment in support infrastructure, dispersed and rural energy supplies, and low-cost energy delivery to the poor is vital in order to fill the gaps in the energy market left unserved by the private sector. Joint public-private partnerships, along with community, non-governmental organization (NGO), and donor involvement, can provide effective solutions for commercially less attractive applications, markets, locations, and target populations. Microfinancing, especially for renewable energy-based supplies, concessional loans, and grants can be effectively packaged with innovative marketing schemes, e.g., through service concessions or revolving credit lines, to devise self-sustaining, long-term energy supply schemes for poor communities. Enhanced financing of public electricity use, such as for schools, hospitals, telecommunications, etc., needs to be adopted systematically for all rural communities.

201. At the institutional level, domestic banks and financial institutions' risk perceptions and awareness of the low-end consumer market and alternative energy investments needs to be improved, so that project financing can be more easily obtained by investors on terms at least at par with those available to the more established conventional energy industry, in order to remove the investment barriers that often preclude such initiatives from being fully considered or scaled up.

Building Capacities

202. Upscaling of energy-related supply and end-use hardware and infrastructure, as well as policy, financing, pricing and market reforms, would also require a continuous upgrading of the corresponding skills, facilities, and capacities required to plan, design, finance, construct, manage, and operate such systems and frameworks at all levels, from individuals and communities to institutions and national agencies. Such capacity constraints are usually a major constraint slowing down implementation of energy projects in developing countries, and an obvious area where international and multilateral assistance needs to focus.

203. In addition, greater monitoring and evaluation of energy delivery mechanisms is necessary to identify bad investments, prevent misuse, and replicate successes. Lax energy supply metering, flat tariff rates, or even free-of-cost service delivery is often employed in developing countries for meeting temporary political and social exigencies (e.g., domestic gas supply in Bangladesh, and farm electricity supply in some Indian states), but become difficult to rectify later when they become taken for granted, wasteful behavior becomes entrenched, and the costlier alternatives elicit strong consumer resistance. Most developing Asian country

interventions suffer from week feedback, remedial, and follow-up action, which extends the learning cycle for successful interventions and results in misdirection or squandering of limited resources and ineffectual institutional memory.

204. A much stricter and efficient governance regime would be required for any strategy that attempts to deviate significantly from the business-as-usual scenario. Since policy frameworks are a leading determinant of change, initial emphasis must be placed on expediting the development and implementation of appropriate guidelines, incentives, regulations, and fiscal measures that can induce positive change in the local supply and use of modern energy services by all segments of the national population.

7. Sustainable Energy for All

A Global Partnership

205. It follows from the preceding discussion that providing energy access to the world's poor will involve greatly enlarging the commercial energy resource base as well as devising measures to help meet unsatisfied human needs in the developing countries through supply chain and demand side optimization and efficiency improvements. This will require global action in undertaking investments to expand energy production, increasing commerce in energy commodities to improve choices and supplies where they are needed most, and reducing wasteful consumption in developed societies to help spare resources for those elsewhere deprived of their bare minimum requirements. It will also involve local action within developing countries for attracting greater domestic and foreign investments in improving the energy service infrastructure and delivery networks, and adopting development priorities that fully recognize the role of modern energy in poverty reduction and human development. For this too, international cooperation in devising and replicating successful, cost-effective energy solutions, policy and regulatory regimes, market reforms, and bilateral and multilateral financing would be a key enabler. Finally, regional and global environmental consequences of both baseline energy use methods as well as augmented supply scenarios will become all the more acute in the future, requiring renewed commitment to preemptive mitigation efforts, with the developed and developing world working in tandem to evolve least-cost alternative development scenarios that minimize the economic pain on both.

206. Alternative development scenarios to baseline energy use patterns are particularly relevant to developing Asian countries given their large growth prospects, and require much more active national and regional collaboration in designing, testing, and implementing innovative methodologies, sharing available resources, and reducing costs of delivery. Developing Asian countries share many similar social conditions, economic issues, and cultural practices and face common development challenges, especially with regard to widespread poverty, rural energy systems, gender inequality, sectoral reforms, demand-side management, and social mobilization and productive uses. These can benefit from a coordinated and collaborative response strategy and successful regional interventions that can supplement and stimulate local action, help tap potential additional resources, enable technology transfer and capacity building, and reduce implementation costs.

207. It is clear, therefore, that energy access improvements in developing Asia and elsewhere will require a much more active global partnership in the future, with all stakeholders recognizing their respective roles and expected contributions, realizing the enormous mutual benefits of reducing world poverty, hunger, and deprivation.

208. Multilateral support, and the Asian Development Bank's role in particular, in helping developing Asia undertake actions for ensuring universal energy access can be channeled more

effectively through specific short-, medium- and long-term assistance strategies that deliver innovative and effectively monitored policy, technical, and financial interventions based on lessons relevant to these countries.

The Technology Wildcard

209. Technological innovation can greatly alter the dynamics of any economic activity, and energy systems are no exception. It is particularly relevant to note that developing Asia has exhibited declining energy intensities in recent decades, even with present low levels of per capita energy consumption, contrary to the experience of the OECD countries, where intensities initially rose with incomes before falling with further economic growth. This trend is expected to continue, with the United States Department of Energy predicting 1.38% per annum decline in intensity for developing Asia between 1999 and 2020. This suggests a degree of technology leapfrogging effects, with these countries shifting directly to highly efficient equipment, vehicles, and energy use systems and bypassing some of the intermediate technologies adopted by the industrialized countries in the past. Asia is also adapting earlier on its development path to cleaner energy technologies. Indeed, as noted earlier, the environmental footprint of increased per capita energy consumption for developing Asian nations is expected to be smaller than that of many OECD countries at an equivalent stage. This is primarily because of the larger pool of renewable and alternative energy supplies, particularly hydro and increasingly wind and natural gas, present in their national energy mix.

210. Further technological advances, driven by the startling recent fossil fuel price rise and global climate change fears, will only accelerate such trends. Fuel cells, ethanol (ethyl alcohol obtained from crops such as sugarcane, maize, barley, wheat, etc.), and biodiesel (fatty acid alkyl esters obtained from vegetable oils and animal fats), along with hybrid and flexifuel car technology, are becoming increasingly cost-effective alternatives to gasoline and diesel as transportation fuels. Scaling up of cellulose ethanol (obtained from wheat, corn, barely, oats, sorghum, rye, and sugar cane feedstock) pilot production is in progress in several advanced countries. Renewable energy technology, especially wind, hydro and biomass conversion, are close to becoming or are already competitive with mainstream power generation options, while solar photovoltaic costs continue to plummet downwards, and other renewable technologies (wave, tidal stream, etc.) are in advanced technology development and demonstration stages. Cleaner coal technologies, including liquefaction, will make it easier to utilize the vast existing reserves of the fossil fuel for electricity generation. New fuels, such as ethanol-derived gels, DME (dimethyl ether), GTL (gas-to-liquids) and hydrogen, are emerging as likely energy carriers of the future.

211. Energy efficiency standards and performance levels have also improved drastically across the board on account of technological improvements in most applications, devices, and end-uses—industrial processes, vehicles and commercial jets, household appliances, space heating and cooling systems, lighting, etc.—as well as for energy production and handling techniques—thermal and renewable power generation, oil and gas extraction, compression and conversion, etc. Nuclear power is making a comeback, after a prolonged period of neglect on account of safety issues, with improved technology and, theoretically, enormous generation potential. Fusion research has advanced steadily, although still distant from application in commercial electricity generation.

212. Virtually all of these technologies promise substantial additional sustainable energy resources that can help meet future demand and have substantially reduced or near-zero lifecycle carbon dioxide emissions attributes compared with fossil fuels. Thus, although various technical and economic barriers still need to be overcome in the production, storage, distribution, and energy conversion aspects of some of these technologies, while additional

massive infrastructural investments would be required to transform a fossil fuel-based world economy to, say, one using hydrogen as the main energy carrier, a gradual transition is beginning to take shape, driven by cost improvements and periodic technological improvements.

213. Technological breakthroughs that fundamentally alter the prevailing situation can also occur, especially when research and development (R&D) efforts are intensified as a reaction to future supply and price threats. Major deviation from anticipated trends in incremental technology improvement and growth can occur unpredictably, and is therefore more of a reason for added optimism in defining future energy strategies than a quantifiable input to actual planning. However, if and when such a technology wildcard enters the equation, it has the potential to radically and quickly change the prevailing situation and future prospects for the better. As mentioned, increased emphasis on R&D, including financing technological innovation in the developing world that has often been quick to invent, adapt, and improve methods for its own specific needs, is the primary means for raising the prospects for such breakthroughs to occur. An emphasis on technology transfer, assimilation, and local development has to be a corollary to international cooperation in future energy research. Open markets could also spur efficiencies and more rapid technological adaptation and improvements, and should be encouraged in developing countries lagging in such reforms.

Lessons for Developing Asia

214. Current and future prospects for energy supply, existing usage patterns, and the impact of these on the world's poor, of which almost a third live in Asia,[34] are well documented and alarming in their implications. In summary, the following key lessons emerge for the developing countries of Asia from the analysis presented in this paper. Translated into action, they can offer an alternative vision for the sustainable growth of Asian countries in which energy inputs can be utilized not only to power development, but also to rapidly reduce poverty and human deprivation.

- Modern energy supplies are a prerequisite for human growth and decent living conditions.
- The world's poor cannot escape their economic and social predicament without an adequate infusion of such supplies, at rates that are affordable and sustainable.
- Such large increases in energy provision are costly in both financial and environmental terms, requiring alternative and complementary strategies for achieving them.
- Under current business-as-usual scenario, although relative improvement in energy access and human development indices are expected in the coming decades, the absolute number of the energy poor will remain largely unaltered, consisting mainly of the rural population in developing countries.
- Asia must therefore rethink its development strategy, aiming at efficient and optimal resource utilization, demand-side management, and exploitation of renewable and other supplementary energy resources.
- The objective for developing Asia has to be clearly targeted: increasing the access to and affordability of modern energy consumption, especially electricity, by its poor as a means for achieving acceptable national human development levels.

[34] According the *World Development Indicators* published by the World Bank, of the 1.089 billion people in the world surviving below $1 a day in 2002, 702 million lived in the Asia and Pacific region.

- On the one hand, this would involve recognizing and integrating energy needs overtly in development strategies by setting quantitative targets for service provision, such as by augmenting the MDGs and associated strategies accordingly.
- On the other, it would require Asian countries to undertake comprehensive policy, sector, and market reforms in order to make widespread energy service provision at economic costs through optimal mobilization of public and private financing possible.
- This will also require greater equity in the worldwide distribution and consumption of existing energy resources, where reduction in excessive energy use would free up supplies and help lower the environmental footprint of fossil fuel use.
- At the same time, developing Asian countries must ensure that incremental gains in energy provision and economic progress are not offset by unchecked population and insatiable future demand growth.
- Multilateral agencies can play a particularly important role in catalyzing such action and facilitating countries in devising and financing complex structural and policy changes, suited to local conditions and capacities, required to realize more optimized and sustainable scenarios.
- Asian countries have achieved impressive energy intensity improvements through technology leapfrogging, but in other respects, particularly in transportation, industrial and residential use, is following the trail of energy-intensive developed economies, which need not be an unavoidable option.
- Strategies that aim to replace traditional biomass with modern energy fuels should receive the greatest attention, as the health, gender, and productivity costs of the former can be debilitating for the poor.
- Rural energy requires the most serious attention, and modern fuels and energy for basic cooking, electricity, and mechanical power needs of such communities should be a mandatory objective of national planning. Rural supplies need to allow flexibility for rapid future escalation in consumption levels.
- The provision of reliable electricity is key to moving beyond the basic needs for modern lifestyles and economic growth. Access to grid supplies, or equivalent off-grid solutions, at rates that are affordable for all is essential for mainstreaming the poor into national economies and productive employment, while raising their living standards and development status.
- Tariffs relative to incomes are central to electricity use and other forms of energy consumption among the poor, and the linkage must be factored into energy pricing and subsidy programs in developing countries.
- Dispersed, off-grid solutions represent a potentially greater economic and poverty reduction payback among the vast rural populations of Asia, and should be given priority, while grid-connected generation should be based on least economic cost considerations, taking externalities into account.
- Greater public resources need to be diverted toward energy service provision, especially for dispersed supplies and network expansion. The former can be facilitated through well-designed capital grants to help lower the high up-front costs of renewable energy applications for the poor (PV systems, small hydro, biogas digesters, improved cookstoves, micro wind turbines, etc.), making such energy

access possible for the millions that are otherwise able and willing to sustain their recurring costs.

- Taxes on excessive energy use (and pollution) can help check energy waste, induce cleaner and efficient use, and create supplemental financing for system expansion and improvement for the poorer market segments.
- Service delivery standards, in terms of availability, reliability, and fuel quality are particularly important for the poor, who cannot afford the hidden costs of inferior supplies.
- Increased intra-regional energy trade can enable Asian countries to exploit their indigenous energy resources more optimally by enabling them to share the benefits of economies of size, while also increasing their fuel choices through competitively priced external supplies.
- Increased technology research emphasis into emerging energy resources and conversion methods is required, in which developing Asian countries need to actively participate. Commercial adaptation of new technology and fuels should be an objective of Asian economies, given the large potential gains to be achieved.
- Overall economic stability and growth is essential for achieving the income-affordability of modern energy by larger proportions of the Asia's poor. Developing countries cannot achieve one without the other, and need to open their economies and markets to sustain sufficient investment and growth—and rapid poverty reduction.

215. With an unambiguously energy-centered development strategy that fully recognizes the need and extent of modern energy inputs, far greater economic prosperity could lie in prospect for all Asian countries, not just the few that have done relatively well recently. Such energy-driven growth would not only greatly reduce endemic poverty levels in the region within a generation, but would itself be derived from integrating the previously economically peripheral poor into the productive, mainstream commercial market.

216. Most of all, it would finally enable the billions of Asian poor with an opportunity of realizing their unlimited financial and human potential.