THE ATLANTIC COUNCIL

OF THE UNITED STATES

A Marshall Plan for Energy, Water and Agriculture In Developing Countries

Richard L. Lawson • Chairman
John R. Lyman • Project Director & Rapporteur

A Policy Paper

April 2007

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Foreword

The persistence of poverty and extreme deprivation in developing countries prevents the spread of freedom and democracy as certainly as any other factors. Starting points to alleviate that poverty are developing countries' ability to obtain the clean energy and water supplies that are necessary to promote economic growth and public health. Equally, we cannot alleviate hunger unless we tackle a series of agricultural challenges arising from diminishing arable land, the rapid depletion of water resources, and the need for a more nutritious diet. Meeeting these challenges is increasingly central to U.S. foreign policy.

Against this background, the Atlantic Council of the United States launched a series of meetings of business, government and foreign policy experts to discuss an ambitious and, some might say, audacious new initiative – loosely modeled on the Marshall Plan – for the development of energy, water and food resources in appropriate developing countries.

The present report, second in a series, summarizes the conclusions of the experts. (The first report, which focused on the interdependence of energy and water, can be found on the Council's website, *www.acus.org*.) It examines the interrelationships among the energy, water and agricultural sectors and proposes a new approach to the development of these three interdependent basic resources. The report underlines the view that without the availability, accessibility and affordability of clean energy, water and food provided by market-based approaches, the political stability in many developing countries that is a prerequisite for economic growth and sustainable democratic governance will not be achieved.

The criteria identified in this report are based on the World Bank's Governance Indicators data for 2006 as well as per capita income levels and country size. The criteria are designed to help select countries in Asia, Africa and Latin America who are members of the WTO, to be considered for participation in an initial pilot program. The Atlantic Council plans subsequently to propose an action plan for the project and to establish a steering committee which would provide oversight of the development of reports, recommendations and plans emanating from the participating countries and would facilitate the commitment and support of financial institutions, governments and private corporations.

The Council would like to thank all those who have participated in the project to date: our energy program chairman and board member Richard L. Lawson for his vision and invaluable guidance; program director John Lyman for his skill in distilling the major points of the discussions; and all the meeting participants and experts (listed in *Annex 1*) for their gift of time and knowledge. The Council also thanks the generous donors who supported this work: the Otter Island Foundation, the National Energy Technology Laboratory, and the Office of Coal and Power Systems at the U.S. Department of Energy.

Frederick Kempe
President and CEO, Atlantic Council

Executive Summary

Today, hunger, poverty, and desperation remain prevalent throughout much of the developing world. If we are to live in a 21st century more prone to peace than violence, the developed countries must move expeditiously to address the developing countries' requirements for energy, water, and agricultural production. The availability, accessibility and affordability of energy, water and food supplies are vital to the economic development that is required to alleviate global poverty, to reduce global tensions, and to address global environmental degradation.

The challenge ahead is to ensure adequate supplies of energy, water and food to the billions of people currently deprived of these necessities. The needs of the developing countries cannot be met by following the historical pattern of development in the industrialized countries. Growing concerns over resource availability and the potential adverse environmental consequences of following historical industrialization patterns lead to the conclusion that the world is on an unsustainable growth path. In order to address such issues, the International Energy Agency recently concluded that "unprecedented cooperation will be needed between the developed and developing regions, and between industry and government". The magnitude of the challenge is immense and requires urgent actions.

Without a radical change in policies in the developing and developed countries, there will still be about the same number of people without access to electricity (1.5 billion) and the same number of people continuing to rely on non-commercial biomass fuels (2.5 billion) in 2025 as today. This will occur even if the developing countries consume almost 60 percent of the growth in global energy supplies and increase their share of global energy supplies from 30 percent today to over 40 percent in 2025.

Similarly, by 2025, over 60 percent of the world's population will continue to live in countries with significant imbalances between water requirements and supplies, largely in Asia, Africa and Latin America. Today, over one billion people lack access to safe drinking water and 2.4 billion do not have access to improved sanitation.

The UN estimates that only one-third of the world's population of 6 billion enjoys a nutritional food supply, while one-third is severely undernourished and one-third is over consuming. This means that almost two-thirds of the world is facing health problems related to either an inadequate or unhealthy diet. Dietary-related health problems are most likely to be exacerbated by the world's growing population.

Energy, water and agricultural issues are inexorably bound together. Energy production is a major user of water as well as essential to the supply of water. Agriculture consumes over seventy percent of available water supplies in many countries and there is a growing tension between the production of agricultural crops for energy and food. Energy, water and agriculture problems stem from many of the same issues:

Insufficient financial resources
Inefficient usage or production
Inadequate institutional arrangements
Lack of coordination between sectors
Lack of political commitments
Inadequate human resources
Insufficient community involvement
Inadequate operations and maintenance
Insufficient information and communications.

While the UN, the World Bank and numerous other developmental institutions and individual countries are addressing a number of energy, water and agriculture issues relating to sustainable development, it would be timely for the United States to undertake a private/governmental initiative to develop a Marshall Plan for Energy, Water and Agriculture in Developing Countries. Recognizing the many agencies and organizations already working on these issues, the Plan would entail a sharply focused approach, concentrating on individual countries receptive to the concept, and on working in conjunction (rather than competition) with other organizations. In each country a holistic approach would be taken to analyzing the interfaces between the three sectors and an inclusive collaborative dialogue would be undertaken in preparing the specific recommendations and investment programs

The Plan would be developed as follows:

1. Public and private institutions should use proven means of bettering the world through economic cooperation and development.
2. A senior executive corps in the service of creating a better world should provide much of the human resources for the transfer of techniques, procedures and know-how.
3. An extensive list of institutions should be compiled, that could provide capital to support energy and water infrastructure development.
4. Assistance should be provided on a country-by-country basis with specific time frames for assistance in each country.
5. The participating countries would assume responsibility for the development of work schedules, national costs and personnel associated with the development of their individual country reports.
6. In the participating countries, processes and plans would be established for developing energy, water and agriculture resources in a complementary manner increasing the probability that environmentally sustainable economic prosperity can be achieved in a world facing a growing scarcity of resources.
7. Each participating country would assume responsibility for the implementation of plans within its own territory.

The initial proposal for creating a Marshall Plan for Energy, Water and Agriculture has been developed by a working group organized by the Atlantic Council. The proposal should now be refined with input from U.S. government agencies, interested industry groups and private institutions. (At a later date, it might be appropriate to expand input and participation to include key experts from the European Union, Japan, developing countries and development banks.)

Input from the above groups would also be used to determine an appropriate organizational structure for managing the Plan activities. The long-term magnitude of the proposal and its potential to impact relations with developing countries and international lending institutions suggest that the U.S. government should assume responsibility for implementing the Plan.

A steering committee would be established to provide continuing oversight to the process and to the development of reports, recommendations and plans emanating from the participating countries. The Atlantic Council could assume a major role in coordinating the work of the steering committee. Oversight by such a steering committee is critical to obtaining the commitment and support of major international financial institutions, supporting governments, and private corporations and foundations.

The Plan activities are envisioned as creating a network of public and private institutions capable of raising the investment capital required to assist in the development of clean, affordable and viable energy, water and agriculture programs in selected developing countries. The Plan would initially be focused on a few (3-4) countries and over time be expanded to other countries based on success with initial participants.

A Marshall Plan For Energy, Water And Agriculture In Developing Countries

The Challenge

Today, hunger, poverty, and desperation remain prevalent throughout much of the developing world. If we are to live in a 21st century more prone to peace than violence, the developed countries must move expeditiously to address the developing countries' requirements for energy, water, and agricultural production. The availability, accessibility and affordability of energy, water and food supplies are vital to the economic development that is required to alleviate global poverty, to reduce global tensions and to address global environmental degradation.

In today's world of modern communications, the discrepancies in living standards are readily apparent to even the most impoverished. These conditions can only lead to growing resentment and increasing friction between the 'haves' and 'have-nots'. Major initiatives are called for, and the industrial world does not have the luxury of postponing such initiatives.

The challenge ahead is to ensure adequate supplies of energy, water and food to the billions of people currently deprived of these necessities. The needs of the developing countries cannot be met by following the historical pattern of development in the industrialized countries. Growing concerns over resource availability and the potential adverse environmental consequences of following historical industrialization patterns lead to the conclusion that the world is on an unsustainable growth path. In order to address such issues, the International Energy Agency recently concluded "unprecedented cooperation will be needed between the developed and developing regions, and between industry and government"[1]. The magnitude of the challenge is immense and requires urgent actions.

Without a radical change in policies in the developing and the industrial countries, there will be about the same number of people without access to electricity (1.5 billion) and the same number of people relying on non-commercial biomass fuels (2.5 billion) in 2025 as today.[2] It will be so despite a relatively rapid growth in energy consumption in the developing world. Forecasters generally agree

[1] *World Energy Outlook 2002*, page 31. International Energy Agency.
[2] *Ibid.*

that developing countries will consume almost 60 percent of the growth in energy supplies over the 2000-2025 time frame and that their share of global energy supply will rise from 30 percent to 43 percent in 2025. Despite this redistribution in energy consumption, per capita energy use in the developing world will still be only one-sixth that in the industrial counties.

While economic development will not take place without adequate supplies of energy, water is also essential for sustaining life and health. Societies cannot exist and flourish without both energy and water. Today, over one billion people lack access to safe drinking water and 2.4 billion (40 percent of the world's population) lack access to improved sanitation[3]. Moreover, water is scarcest where it is needed the most, namely in the developing countries. By 2025, over 60 percent of the world's population will live in countries with significant imbalances between water requirements and water supplies, largely in Asia, Africa and Latin America. To meet the needs of water supply and sanitation by 2015 for the half of the world's population currently deficient, the following is required:

a) Access to some form of improved water supply for an additional 1.5 billion people (100 million each year); and
b) Access to improved sanitation services for about 1.9 billion people (125 million each year).

Agriculture represents the third leg of the challenge to facilitating economic growth and raising per capita incomes, especially for the very poor, while contributing to significant improvements in health and welfare. Agricultural practices can affect water and energy requirements significantly and must be explicitly taken into account when examining the sustainability of water and energy resources.

In many developing countries agriculture consumes over 70 percent of available water resources. Inefficient irrigation practices are rapidly lowering water tables, and for many countries water withdrawal rates exceed replenishment rates. Often, very low tariffs on water and energy supplies encourage inefficient agricultural usage.

Agricultural practices affecting crops, livestock and fisheries can have a significant impact on the nutritional value of production as well as on water requirements. The UN recently estimated that about one-third of the world's population (2 billion people) are severely undernourished. At the same time, rising affluence has encouraged another 2 billion people to over consume. Both situations have led to growing health problems for two thirds of the global population.

In some countries, such as the United States, the use of corn and soybeans for energy production is leading to a rise in food prices as well as impacting the availability of world food supplies for both human and animal consumption.

Thus, energy, water and agriculture are inexorably bound together. Energy production is a major user of water as well as essential to the supply of water. Agriculture is both a major user of water and a potential source of energy. Moreover, energy, water and agricultural problems stem from many of the same issues: insufficient financial resources, inefficient usage, inadequate institutional arrangements, lack of sector coordination, lack of political commitments, inadequate human

[3] Johannesburg Summit, "Secretary General calls for Global Action on Water Issues," Press release March 22, 2002.

resources, insufficient community involvement, inadequate operations and maintenance as well as insufficient information and communication.

Meeting energy, water and agriculture requirements for all developing countries will take vast investments that go well beyond the developing countries' ability to finance by themselves. These requirements will be particularly large for the energy sector. Societal development will not occur unless these investments are undertaken. Societal development is a prerequisite for the developing countries to attain a level of economic prosperity to enable them to consider seriously climate and other environmental concerns. It is becoming increasingly clear that meeting growing global concerns over environmental pollution and climate change will require "unprecedented cooperation between the developed and developing nations and between industry and government".

The Response

While the UN, the World Bank and numerous other developmental institutions and individual countries are addressing a number of energy, water and agricultural issues relating to sustainable development, it would be timely for the United States to undertake a private/governmental initiative to develop a Marshall Plan for Energy, Water and Agriculture in Developing Countries. Recognizing the many agencies and organizations already working on these issues, the Plan would entail a sharply focused approach, concentrating on individual countries receptive to the concept, and on working in conjunction (rather than competition) with other organizations

Like the proposal by General George Marshall in his 1947 speech, this plan should be against "hunger, poverty, desperation and chaos". As in the original Marshall Plan, the proposed recipients of assistance should be responsible in the first instance for deciding on their approach to addressing their own concerns - in this case, the development and utilization in each country of energy, water and agricultural resources critical for economic development[4].

The Plan should be based on several key principles:

1. Public and private institutions should utilize a proven means of bettering the world through economic cooperation and development.
2. A senior executive corps in the service of creating a better world should provide most of the managerial and technical assistance for the transfer of techniques, procedures and know-how to help participating countries define and meet their needs.
3. The developed world would provide capital, technology and know-how to the 'have-not' developing nations. Additionally, developing country organizations would be requested to provide know-how in areas for which they have expertise, such as the Grameen Bank.
4. Assistance should be provided on a country-by-country basis with specific time frames for assistance in each county.
5. Participating countries would be responsible for creating their own programs and development plans.

[4] See *www. MarshallFoundation. org*

The Plan's overall goals would be to:

1. Strengthen governmental and private sector efforts to help meet key developing countries' needs for energy, water and agriculture. Significant private sector involvement should help expand the level of effort in the individual countries by energizing new players and encouraging a sustained effort by business. Such efforts would facilitate economic development and contribute to improving health and welfare in developing countries.
2. Organize a voluntary professional "Senior Executive Corps" to help participating countries define and meet those needs.
3. Compile an extensive list of institutions that could provide capital to support energy, water and agricultural infrastructure development.
4. Institute a restructuring of policies in developing and developed countries to improve significantly the availability, accessibility and affordability of energy, water and agriculture that is vital to improving economic conditions and general welfare throughout the world.
5. Assist the world's efforts to develop sustainable economic growth.
6. Directly address the developing world's economic aspirations so that political stability can be enhanced.

The Plan over time could create a network of institutions capable of raising the trillions of dollars in investment capital required to meet the rising demand for energy, water and agriculture.[5] In addition, a framework would be created for the provision of modern energy, water and agricultural services to a substantial portion of the billions of people who now lack them.

Proposed Actions

A U.S. working group representing the business community and public policy organizations, was convened to explore the concept of such a plan. The first meeting of the group was held in Washington, DC on September 8th, 2004 and was followed by a Preliminary Report in March 2005. Subsequently, a status report was released in August 2005 to publish the findings of the second meeting, held in July. Numerous recommendations led to another status report in February 2006, in preparation for the third meeting of the working group in Washington DC on April 18, 2006 which included expanded representation by experts on water and agricultural issues. The present report is a distillation of the views of the participants (identified in *Annex 1*).

The working group strongly supports the need to implement a Marshall Plan for Energy, Water and Agriculture in Developing Countries. The goal of improving the world's political stability and attaining sustainable economic growth will not be achieved by accident. Meeting the challenges will require leadership by governments, institutions, business and individuals.

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[5] Energy investments figures are from *World Energy Investment Outlook 2003 Insights*, International Energy Agency. The World Commission on Water estimates that water investments over the next 20 years need to rise from $75 billion a year to $180 billion a year. The World Bank Development Committee, "Water–A priority for responsible growth and poverty reduction. An agenda for investment and policy change," March 17, 2003, presentation at the World Water Forum.

Because of the complexity of dealing with the challenges in each country, it is proposed that the Plan start by focusing on only 3-4 countries from Africa, Asia, and Latin America. A list of 23 potential participating countries was created, based on meetings with the World Bank and The Millennium Challenge Corporation. The World Bank's Governance Indicator data for 2006 was used with the caveat that the measurement on "political stability" was dropped as being potentially misleading because it includes a measurement of third-party terrorist incidents.

The five governance indices used are:

Control of Corruption
Rule of Law
Regulatory Quality
Government Effectiveness
Voice and Accountability.

It was agreed to consider the 109 countries in Africa, Asia and Latin America that are members of the WTO. In order to focus initially on countries with the greatest need for assistance and with a substantial population, only the 52 countries with populations greater than 5 million and GDP-PPP (purchasing power parity) per capita below $10,000 were considered. Median scores for each rating category were calculated for the 52 countries as a group, and only the 26 countries at the median or better on corruption were considered. It turned out that 23 of these countries also scored at or above the median on four or five of the five indicators. The resulting list of potential initial candidates is shown in *Annex 2*.

It is proposed that the Plan activities start by focusing on three or four geographically dispersed countries. If some of the larger countries were to be chosen, a region within the country would be selected, owing to the complexity of the analysis required and the level of interaction that will be needed with regional decision makers. Following experience gained with the initial participants, activities would be undertaken in additional countries.

Each country's mix of resources of energy, water and agriculture is unique and interactions among the sectors will vary widely. In order to handle this complexity, up to five years may be required to develop the initial plans for each country. Sandia National Laboratories has designed a holistic process for completing the 5-year initial project period. The process includes analysis and modeling of resources, requirements and interactions among the three sectors along with extensive interaction with regional experts and collaboration with key government agencies, business, academia, environmental and human rights organizations, development banks, policy makers and citizens. The recommended process is described in *Annex 3*.

With the release of this report the following action steps are proposed:

1) The proposal should obtain the necessary conceptual approval and financial support of the US government to proceed.
2) Governmental input should be obtained to determine an organizational structure and reporting relationships.

3) Non-governmental organizations, including industry groups, private organizations and development organizations, should be given the opportunity to comment and provide financial support if appropriate.
4) Three to four countries should be approached to determine their interest in participating in the Plan.
5) If there is interest, a Marshall Plan Fund for Energy, Water and Agriculture should be established to finance activities during the initial five-year program.
6) A non-governmental advisory committee should be established. While the Plan would most likely be implemented and administered by a governmental organization, the advisory committee could review program recommendations, periodically report back to the administration on progress, and make recommendations on possible adjustments to the process.

The Interface between Energy, Water and Agriculture

Affordable energy, water and agricultural supplies are fundamental to enabling countries to develop socially and economically. Without adequate supplies of all three, the other major problems affecting health and biodiversity identified at the September 2002 World Summit on Sustainable Development (attended by 104 heads of state and government) will not be solved. Energy, water and agriculture are critical to alleviating global poverty and to enabling countries to develop the capability to address environmental degradation.

Solutions to energy, water and agricultural needs require countries to deal with many of the same issues. Firstly, planning and executing a plan to address the resources, technologies and human capabilities needed to build the required infrastructure entail very long lead times, especially in the energy and water sectors. This process necessarily will usually transcend several if not many domestic governmental organizations over many years.

Secondly, in all three sectors, matching the availability of energy and water supplies with demand, and adjusting agricultural practices will involve cultural and lifestyle changes that may be very difficult. The rationale for such changes must be compelling and well understood by the population affected.

Thirdly, virtually all countries are already and will increasingly become more dependent upon trade and international cooperation to meet their energy, water and agricultural requirements. Hence, a more stable peaceful world is seen as both a prerequisite for solving energy, water and agricultural problems as well the goal of the social and economic development that is dependent upon solving the same problems.

Fourthly, the factors that constrain energy, water and agriculture in developing countries call for the following identical major issues to be addressed:

- Insufficient financial resources
- Inadequate institutional arrangements
- Inadequate human resources

- Lack of sector coordination
- Lack of long term political commitment
- Insufficient community involvement
- Inadequate operation and maintenance
- Insufficient information and communication.

Fifthly, energy, water and agriculture are highly dependent upon one another:

- In the United States, up to 80 percent of the cost of pumping, transporting and processing water is for the energy used. Further study might indicate similar results in developing countries.
- In the developing countries, agriculture typically consumes over 70 percent of the water supplies.
- Agricultural practices often lead to inefficient use of energy and over consumption of water.
- A growing dependence upon water from transnational basins and international rivers will increase the need for storage and pumping, which in turn will increase energy consumption.
- The production of electricity requires the withdrawal of almost as much water as agriculture in the United States, and will be a growing issue in developing countries with the very rapid growth in electricity.
- Water requirements for nuclear power are huge, as are those of thermal power plants.
- The treatment of municipal and industrial wastewater requires energy for pumping and plant operations.
- The production of primary energy such as coal and petroleum requires substantial withdrawal of water.
- The pumping of water from underground aquifers for agriculture is dependent on reliable inexpensive power.
- The availability of reliable and adequate municipal water supplies is dependent upon energy.
- In the future, agriculture could become a significant source of transportation fuels.
- Agriculture production for food, wood products and energy are in growing competition for land and water supplies.

Major Energy Challenges

Meeting rising energy requirements is fundamental to ensuring economic development and rising per capita incomes in developing countries. Solutions must address a number of very difficult challenges:

- ✓ The strong energy demand growth (2.7 percent a year) in developing countries for the next 20 years will continue to tighten world oil supplies.
- ✓ This has led to an upward pressure on oil prices that is likely to persist.
- ✓ There will be a growing reliance on the Middle East, which remains politically unstable.
- ✓ There will be a significant shift in oil and gas trade towards Asia, which could lead to greater friction with the industrial countries.

- ✓ The IEA estimates that roughly $8 trillion of investments will be needed in the developing countries to meet energy needs through 2025[6]. This would still leave about 2 billion people without access to electricity. Closing this gap would require a further $2 trillion.
- ✓ Capital investments at this level are well beyond the capabilities of developing country governments to raise on their own.
- ✓ With over 80 percent of the world's oil and gas reserves controlled by national companies, cash flows from the energy sector are frequently being diverted to non-energy related activities, accelerating the likelihood of supply shortfalls.
- ✓ In a number of major oil producing countries, reinvestment in the petroleum sector is being limited as governments divert funds into other activities.
- ✓ All potential economic sources of energy must be utilized in an environmentally responsible manner:
  - o Additional supplies will require greater transnational movements.
  - o Greater coal demand must be accompanied with use of clean coal technologies and more efficient and effective mining and burning.
  - o When economically possible, alternative energies such as wind, solar and biomass conversion to gas should be encouraged.
  - o New transportation solutions such as hybrid cars, hydrogen fuel, and new diesel fuels should be encouraged.
  - o Nuclear plants using new designs and standardized equipment should be developed in order to lead to safer operations and lower capital cost and maintenance.
- ✓ New technologies need to be developed to increase supply options and to improve efficiency of demand as well as of production.
- ✓ Energy conservation and efficiency improvements must be encouraged.
- ✓ Energy intensity in developing countries, as measured by energy consumption per GDP, has been improving over time but remains over double that in the industrialized countries. This partly reflects structural differences related to their stage of economic development, but it also reflects the inefficient production of power and inefficiencies in the utilization of power.
- ✓ The electric power industry needs to become economically viable:
  - o Many power companies do not cover costs.
  - o Tariff structures often fail to fully reflect cost, including a return on capital.
  - o Non payment of bills, lack of metering and losses due to theft are common.
  - o Transmission structures are often inadequate.
  - o National grids that allow the efficient movement of power often do not exist.
  - o Management and technical manpower need training and know-how.
- ✓ Realistic pricing of all energy is necessary. Uneconomic pricing reduces supplies and encourages wasteful consumption. Higher prices could encourage new supply alternatives. Pricing policies should recognize that adjustments will need to be made gradually for the poorest segments of the population.

[6] *World Energy Outlook 2004*, International Energy Agency, 2004.

Major Water Challenges

- ✓ Only 2.5 percent of the earth's water is fresh, and nearly 70 percent of that fresh water is frozen in the icecaps of Antarctica and Greenland.
- ✓ Most of the remainder (30 percent) is present as soil moisture or lies in deep underground aquifers as groundwater not accessible to human use.
- ✓ Less than 1 percent of the world's fresh water (about 0.007 percent of all water on earth) is accessible for direct human use. This is the water found in lakes, rivers, reservoirs and underground sources shallow enough to be tapped at an affordable cost.
- ✓ Underground reserves in arid areas replenish at very slow rates, usually less than 0.5 percent per year. If water is pumped too rapidly from aquifers, it is in effect mined and will deplete rapidly. This is a major issue for many developing countries.
- ✓ In the United States, power plants withdraw almost the same daily volumes of water as agriculture. Together, power and agriculture account for 80 percent of daily water withdrawals.
- ✓ In the United States, when water is withdrawn for irrigation, almost 60 percent is consumed (i.e., not returned to streams after use). When water is withdrawn for power plants, only 2 percent is consumed, but over time this repetitive process consumes substantial reserves.
- ✓ In the United States, the absolute level of water withdrawals stopped increasing around 1980 even with economic growth and a rising population. As a result, per capita consumption has fallen by over 20 percent. It may be possible to achieve similar results in many developing countries.
- ✓ Water is scarce where it is needed the most in developing countries. Sub-Sahara Africa is particularly at risk. The risk is also growing in countries like China and India as ground water replenishment and river flows are reduced from global warming and the shrinkage of ice and snow cover in the mountains.
- ✓ Water supply and availability transcend national boundaries. Over 30 countries in the world receive more than one third of their water from outside their borders and over half these countries are in the developing world.
- ✓ In the developing countries, 70 to 90 percent of water withdrawal is for agriculture. The higher value/benefit generating uses in industry, domestic households and for drinking obtain disproportional low levels of water supply.
- ✓ Subsistence farming is marginal and contributes little to the economy but is a major cause of high water consumption. Subsistence farmers will require assistance during the transitional period.
- ✓ Water lost through lack of treatment or inadequate infrastructure amplifies the problem.
- ✓ In large cities in Asia, Africa and Latin America, roughly 40 percent of water is unaccounted for as meters do not work and pipelines leak.
- ✓ Water conservation is essential, as is the recovery and reuse of water from municipal wastewater treatment plants.
- ✓ Clean potable water must be available to all households at minimal costs. At the same time, consumers requiring clean water above *threshold levels* should pay water rates consistent with the costs of providing their supplies.
- ✓ Both technology and an understanding of water cycles are important to achieving a balanced water system.

- ✓ Providing adequate water supplies is a very long-term proposition. Planning and construction of the infrastructure must be started up to 20 years before needed.
- ✓ Political bodies are inherently reactive, whereas water supply shortfalls require long-range proactive decisions.
- ✓ In most developing countries there exists an urgent need to provide adequate water treatment plants to improve health conditions and to eliminate severe shortages of potable water.
- ✓ Climate change is likely to increase the incidence of some infectious diseases, such as malaria, dengue, cholera and yellow fever.
- ✓ Major water-borne diseases are huge detriments to economies and societies:
  - o Diarrheal diseases lead to 2.2 million deaths per year.
  - o Malaria infects 300 million people each year. In sub-Sahara Africa alone, there are 1 million deaths each year.
  - o Schistosomiasis infects 200 million each year, causing 20 million to suffer severe effects.

Major Agricultural Challenges[7]

- ✓ Three billion people live on less than $2 per day.
- ✓ Hunger (insufficient caloric intake) is a major concern for those living on less than $2 per day.
- ✓ Hunger is mainly due to poverty.
- ✓ The world's population of 6.4 billion will grow to almost 9 billion by 2050 with over 90 percent of the increase in the less developed countries of Asia, Africa and Latin America.
- ✓ World agricultural output will have to double to meet demand arising from greater population and the desire of those living on $2 to $9 per day to consume more animal protein, fruit, vegetables and edible oils.
- ✓ How many presently low-income consumers are lifted out of poverty will be the most important determinant of the future size of the world's food and agricultural product markets.
- ✓ Productivity growth in agriculture is necessary but not sufficient to meet the potential gap.
- ✓ Small-scale (subsistence) farming has limited potential to reduce rural poverty. All the presently rich countries created non-farm rural employment so that farm families earn most of their income off the farm.
- ✓ The creation of rural non-farm income is heavily dependent on the availability and affordability of energy, especially electricity.
- ✓ Arable land and populations are distributed very differently. Fifty-three percent of the world's population is today concentrated in the Far East and Southeast Asia, which have only 29 percent of the world's arable land. On the other hand, OECD countries, the remainder of Europe and Central Asia contain 46 percent of the world's arable land but only 22 percent of the world's population. This picture will be further distorted over time with population growth that will exacerbate the problems in Asia and cause Africa, Latin America and the Middle East to experience a major shortfall in arable land.
- ✓ At most, there is only 12 percent more arable land available to double the world's agricultural production by 2050.

[7] Challenges presented by Robert L Thompson, Gardner Professor of Agricultural Policy, University of Illinois, April 18, 2006 to the Marshall Plan Working Group.

- ✓ Major investments in rural infrastructure, agricultural research and irrigation will be needed to relax some of the physical constraints.
- ✓ Keen competition is coming for available land among food production, commercial forest production, and conservation of forests.
- ✓ The area of land in world food production could be doubled, but only by massive destruction of forests and loss of wildlife habitat, biodiversity and carbon sequestration capacity.
- ✓ The only environmentally sustainable alternative is to double productivity on the fertile, non-erodible soils already in crop production.
- ✓ Farmers use 70 percent of the fresh water in the world. Water is priced at zero for most farmers, leading to very inefficient usage.
- ✓ Agricultural output will need to double using significantly less water than today, as cities are likely to outbid agriculture for available water
- ✓ Historically, public and private sector investments in agricultural research have increased productivity faster than demand growth. Major additional investments in irrigation, fertilizer and biotechnology are required.
- ✓ Biotechnology has the potential to improve the nutritional content of grains, to increase yields and/or planted area under adverse or variable conditions, to internalize resistance to diseases, to reduce pesticide use, and to slow down product deterioration.
- ✓ World agriculture is in disarray:[8]
  - o Most high-income countries subsidize agriculture, thereby distorting returns and investments in agriculture.
  - o Many less developed countries keep urban food prices artificially low so that the agricultural sector underperforms relative to its potential.
  - o Protectionist import policies and export subsidies further distort what is produced where.
- ✓ Developing countries' own policies impede their development:
  - o Corruption and/or macroeconomic instability
  - o Inadequate property rights and contract sanctity
  - o Under-investment in rural infrastructure, education and R&D
  - o Lack of technology adapted to local agro-ecological conditions.
- ✓ With arable land and fresh water not distributed around the world in the same proportions as population, food consumption in many less developed countries will outstrip productive capacity with further population growth, urbanization and broad-based economic development.
- ✓ A more open trading environment is required:
  - o To provide market access for goods in which developing countries have a comparative advantage
  - o To stimulate faster economic growth worldwide, and
  - o To eliminate import barriers and domestic export subsidies, which depress world market prices.

[8] Paraphrased from G. Gale Johnson's book *World Agriculture in Disarray.*

Annex 1

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Annex 2

Potential Country List

	Latin America	*Africa*	*Asia*
Score 5	Brazil Colombia Dominican Republic El Salvador Mexico Peru	Ghana Madagascar Mali Senegal Tanzania	India Philippines Sri Lanka Thailand
Score 4	Honduras (1) Nicaragua (2)	Burkina Faso (3) Egypt (3) Morocco (3) Mozambique (4) Tunisia (3)	China (3)

(1) Rule of Law below median
(2) Government Effectiveness below median
(3) Voice and Accountability below median
(4) Regulatory Quality below median

Annex 3

Process for Implementing a Marshall Plan In Individual Countries

The Sandia National Laboratories have prepared a broad outline of the program that would be utilized in the initial pilot to take into account the complexity of developing a holistic plan for energy, water and agriculture. The approach assumes a 5-year initial project period with five basic components.

Step 1 – Select a **team of 6-10 regional experts on water, energy and agriculture** who spend six months assembling existing data for a country, or region within a country:

– Water experts would assemble data on historic and current surface water and ground water supply and demand, climate and precipitation patterns, trans-boundary dynamics, and storage and transfer facilities.

– Energy experts would assemble data on historic and current supply and demand, energy infrastructure and import/export dynamics.

– Agriculture and food experts would assemble data on supply and demand, diet, cultivation and irrigation methods and import/export dynamics.

– All three groups would examine the linkages between food, water and energy.

Step 2 - Select a **regional collaborative decision-making team**, which would include the 6-10 regional experts but also members of key government agencies, business, development banks, economics, academia, environmental and human rights organizations, as well as policy makers and citizens. This team would be selected over a six-month period and would be ready to meet after Step 1 was completed. An expert facilitator should be engaged to assist this decision-making group.

Step 3 – Establish a **collaborative modeling team** with technical staff drawn from organizations represented by the collaborative decision-making team to work with expert modelers from inside or outside the region. This team would develop decision support, computer simulation and modeling tools to quantify the dynamic interdependencies between water, energy and food systems that are too complex to be quantified by human intuition alone. Initial modeling could take up to two years.

Step 4 – Use the teams and models to evaluate **multiple development strategies** spanning energy, water and food in order to choose a suite of the most effective pilot projects for direct implementation.

Step 5 – As pilot projects unfold, new understanding and data would be generated and integrated into the existing models, yielding new insights and modifications to pilot projects. At the end of

Phase I the ongoing bases for developing further pilot projects and longer-term development strategies would be established.

Parallel to the technical sector assessments and analysis, there would need to be a basis assessment of the economic and regulatory structures impacting business. This activity could be undertaken by a separate team or included in the work of the regional collaborative decision-making team**.** In any case it should evaluate topics such as:

- Macroeconomic fundamentals of the country (GDP, debt, fiscal policy, etc.)
- Overall governmental performance:
  - Rule of law
  - Access to offshore arbitration
  - Respect for contracts
  - Level of corruption
  - Sector-specific regulatory framework, its evolution and direction
- Market conditions:
  - Scale of market
  - Growth of market
  - Private sector *vs.* state participation (too much state control tends to distort markets and pricing signals)
  - Local capital markets (depth and breath).

Annex 4

Charts

Charts for selected countries in Latin America, Africa and Asia are included below for:

1. Political and Economic Criteria (2006 data)
2. Energy (2002 data)
3. Water (2004 data)
4. Agriculture (2001-2003 data)

Political and Economic Criteria
2006 Data

	Population (millions)	Surface Area (millions sq km)	Estimate GDP (PPP) (billions US$)	Estimate GDP Growth (%)	Estimate GDP Per Capita (thousands US$)	Industrial Growth Rate Production (%)	Economic Aid Received (billions US $)	Inflation (%)
LATIN AMERICA								
Brazil	188	8.5	1616	3.1	8.6	3.4	30 (2002)	4.2
Columbia	44	1.2	367	5.4	8.4	5.8	17 (2006)	4.3
Dominican Republic	9	.50	737	7.2	8.0	2.0	.572 (2004)	8.2
El Salvador	7	.21	33	15.1	4.9	2.0	.125 (2003)	4.3
Mexico	107	2	1134	4.5	10.6	3.6	1.2 (1995)	3.4
Peru	28	1.3	182	6.5	6.4	7.0	.491 (2002)	2.1
Honduras	7	.112	22	5.2	3.0	7.7	.560 (1999)	5.7
Nicaragua	6	.129	17	2.5	3.0	2.5	.420 (2005)	9.4
AFRICA								
Tunisia	10	.164	88	4	8.6	4.7	.328 (2002)	4.6
Madagascar*	19	.587	17	5.5	0.9	3	.354 (2001)	12
Mali*	12	1.2	15	5.1	1.2	N/A	.472 (2001)	4.5
Mozambique	20	.801	29	9.8	1.5	3.4	.633 (2001)	13
Ghana*	22	.239	59	5.7	2.6	3.8	6.9b (1999)	11
Senegal*	12	.196	22	5	1.8	3.2	.450 (2003)	2
Morocco*	33	.446	147	6.7	4.4	4	.706 (2004)	3
Burkina Faso*	14	.274	18	5.2	1.3	14	.468 (2003)	4
Tanzania*	37	.945	29	5.8	.8	8.4	1.2 (2001)	5.9
Egypt	79	1	328	5.7	4.2	5.1	1.12 (2002)	6.5
ASIA								
Thailand	65	.514	586	4.4	9.1	6.0	.72 (2002)	5.1
Sri Lanka*	20	.66	93	6.3	4.6	7.1	.577 (1998)	12.1
India	1095	3.2	4042	8.5	3.7	7.5	2.9 (FY98/99)	5.3
China	1313	9.5	10000	10.5	7.6	22.9	N/A	1.5
Philippines	90	.3	443	5.3	5.0	2.0	2 (2004)	6.6

* Millennium Challenge Eligible Country

Information obtained from CIA World Fact Book and the World Bank

Sources for all columns:
https://www.cia.gov/cia/publications/factbook/

Energy
2002 Data

	Primary Energy Production BOE* 1000 B/day	Primary Energy Consumption BOE* 1000 B/day	Surplus/ Deficit (%)	Energy Consumption Per Capita* metric tons of oil equivalent/year	Sources of Energy Production (Fossil fuels)	Electricity Production (BkWh)*	Electricity Consumption Total (BkWh)*	Electricity Consumption Annual Per Capita (1000 kWh)
LATIN AMERICA								
Brazil	1847	2056	10% deficit	1.05	oil, natural gas, coal	359	372	2.0
Columbia	555	265	52% surplus	0.76	oil, natural gas, coal	46	42	1.1
Dominican Republic	.01	125	99% deficit	0.67	oil, natural gas, coal	13	12	1.3
El Salvador	0	42	100% deficit	0.69	oil, coal	4	4	0.6
Mexico	3848	1970	50% surplus	1.50	oil, natural gas, coal	242	225	1.8
Peru	92	154	40% deficit	0.62	oil, natural gas, coal	23	21	0.7
Honduras	0	37	100% deficit	0.53	oil, coal	4	4	0.6
Nicaragua	0	26	100% deficit	0.55	oil, coal	3	2	0.3
AFRICA								
Tunisia	77	88	12% deficit	0.74	oil, natural gas, coal	12	11	1.0
Madagascar	.1	14	99% deficit	N/A	oil	.9	.8	0.04
Mali	0	4.23	100% deficit	N/A	oil	.4	.4	0.06
Mozambique	0	11	100% deficit	0.42	oil, natural gas, coal	10	7	0.53
Ghana	7	42	83% deficit	0.37	oil, coal	6	6	0.22
Senegal	0	30	100% deficit	0.32	oil , natural gas	2	1	0.10
Morocco	4	167	97% deficit	0.34	oil, natural gas, coal	17	18	0.53
Burkina Faso	0	8	100% deficit	N/A	oil	.4	.3	0.03
Tanzania	0	23	100% deficit	0.45	oil ,coal	3	3	0.08
Egypt	744	581	22% surplus	0.61	oil, natural gas, coal	87	80	0.9
ASIA								
Thailand	261	832	68% deficit	1.34	oil, natural gas, coal	110	105	1.6
Sri Lanka	0	77	100% deficit	0.39	oil, coal	7	7	0.35
India	815	2346	65% deficit	0.48	oil, natural gas, coal	600	560	0.47
China	3560	5580	36% deficit	0.88	oil, natural gas, coal	1807	1673	1.6
Philippines	14	334	96% deficit	0.54	oil, natural gas, coal	51	47	0.50
*Source: EIA Country Energy Balances: 2002 Data http://www.eia.doe.gov/emeu/world/country/an_index.html	*BOE: Barrels of Oil Equivalent. May include non-fossil fuel sources of production.		Percent found by the difference between energy production and consumption.	*Based off of 1997 data: http://earthtrends.wri.org/country_profiles/index.php?theme=6	*Billion kWh Source for above three columns http://www.eia.doe.gov/emeu/world/country/an_index.html		*Billion kWh	Source: http://www.nationmaster.com/countries

WATER

	Internal Renewable Water Resources (IRWR) Km^3/year*	Actual Renewable Water Resources (ARWR) Km^3/year*	Dependency Ratio	Total Water Withdrawals Km^3/year*	Suffering from Water Stress/Scarcity (2005 estimate)	Access to Improved Drinking Water Supply (% of Population 2004)	Access to Improved Sanitation (% of population 2004)
LATIN AMERICA							
Brazil	5418	8233	34	59.2	No	90	75
Columbia	2112	2132	1	10.7	No	93	86
Dominican Republic	21	21	0	3.4	No	95	78
El Salvador	18	25	30	1.3	No	84	62
Mexico	409	457	11	78.2	Water Stress	97	79
Peru	1616	1913	16	20.1	No	83	63
Honduras	96	96	0	0.8	No	87	69
Nicaragua	190	197	4	1.3	No	79	47
AFRICA							
Tunisia	4	5	20	2.7	Water Scarcity	93	85
Madagascar	337	337	0	14.9	No	50	34
Mali	60	100	40	6.9	No	50	46
Mozambique	99	216	54	0.6	No	43	32
Ghana	30	53	43	0.5	Water Stress	75	18
Senegal	26	39	33	1.6	No	76	57
Morocco	29	29	0	12.7	Water Scarcity	81	100
Burkina Faso	13	13	0	0.8	Water Stress	61	13
Tanzania	82	91	10	2.0	No	62	47
Egypt	2	58	97	68.6	Water Scarcity	98	70
ASIA							
Thailand	210	410	49	87.1	No	99	99
Sri Lanka	50	50	0	12.6	No	79	91
India	1261	1897	34	64.6	Water Scarcity	86	33
China	2812	2830	1	63.0	Water Stress	77	44
Philippines	479	497	0	28.5	No	85	72
* Km^3/year = Cubic Kilometers per year.	http://earthtrends.wri.org/country_profiles/index.php?theme=2 IRWR represents endogenous precipitation. ARWR includes external renewable resources. Dependency Ratio is the percentage of total renewable water resources originating outside the country.			http://earthtrends.wri.org/pdf_library/data_tables/wat2_2005.pdf	UNEP Vital Water Graphs Based on 2025 predictions These figures are based on Malin Falkenmark's ranking system, which states an area is experiencing water stress when annual water supplies drop below 1700 m^3 per person. When annual water supplies drop below 1000 m^3 per person the population faces water scarcity. Data from: http://www.unep.org/vitalwater/25-waterstress-world.htm	WHO + UNICEF Joint monitoring Program for Water Supply and Sanitation (continued on next column) According to the WHO the following technologies are considered to be improved access: 1) Household connection 2) Public Standpipe 3) Borehole 4) Protected Spring 5) Protected Dug well 6) Rainwater collection Data from: http://www.childinfo.org/areas/water/files/watercoverage2006.xls	WHO + UNICEF Joint monitoring Program for Water Supply and Sanitation According to the WHO the following technologies are considered to be improved access: 1) Connection to public sewer 2) Connection to Septic system 3) Pour-flush Latrine 4) Simple pit Latrine 5) Ventilated improved pit Latrine Data from: http://www.childinfo.org/area/sanitation/countrydata.org

Agriculture
2001-2003 Data

	Agricultural* Productivity Per Capita (tons/person)	Nutritional Calorie* in- take Per Capita	Percent of Unnourished	Agricultural Water Withdrawals As percent of total water withdrawal	Energy* Consumed by Agriculture (Percent of total energy used) (Source year 1999)
LATIN AMERICA					
Brazil	293	3060	8	62	5%
Columbia	86	2580	14	46	7%
Dominican Republic	79	2290	27	66	2%
El Salvador	127	2560	11	59	0%
Mexico	287	3180	5	77	3%
Peru	140	2570	12	82	4%
Honduras	92	2360	22	81	0%
Nicaragua	134	2290	27	83	1%
AFRICA					
Tunisia	N/A	3250	<2.5	82	6%
Madagascar	162	2040	38	96	N/A
Mali	237	2230	28	99	N/A
Mozambique	91	2070	45	87	0%
Ghana	88	2650	12	48	0%
Senegal	113	2310	23	90	3%
Morocco	117	3070	6	90	1%
Burkina Faso	225	2460	17	88	N/A
Tanzania	108	1960	44	93	3%
Egypt	290	3350	3	78	1%
ASIA					
Thailand	472	2410	21	95	4%
Sri Lanka	153	2390	22	95	0%
India	232	2440	20	86	3%
China	331	2940	12	68	4%
Philippines	224	2450	19	74	2%
	*Source: http://earthtrends.wri.org/country_profiles/index.php?theme=8	*Source for above three columns: http://www.fao.org/es/ess/yearbook/vol_1_2/site_en.asp?page=cp			. *Source: http://earthtrends.wri.org/country_profiles/index.php?theme=6

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