



Center for Strategic and International Studies • Sandia National Laboratories
Workshop Two: Technology and Global Water Management
March 8-9, 2005

Hank Habicht,
GETF

Henry Vaux, Jr.,
University of California, Berkeley

Greg Allgood,
P&G

Moderators

Peter Davies,
Sandia National Laboratories

Erik Peterson,
CSIS

Center for Strategic and International Studies

Panel Three: Drivers of Technological Innovation

Wednesday, March 9, 2005

Peter Davies: All right, we're going to start the final panel of this second workshop. And for this panel, the sets of questions that we are working to focus on -- looking at understanding the institutional drivers that push technological development, in both the developed and developing world. We are interested to understand the institutional drivers that govern how technology is applied, and how U.S. policy can be formulated to ensure the most effective development and utilization of that technology.

We have three panelists with us this morning, and we will, as we have in the other sessions, go through in the order that is shown in the agenda. So our first panelist this morning is Hank Habicht. Hank is the Chief Executive Officer for Global Environment and Technology Foundation. And in addition to that role, he plays a key role in the Center's program development and management team. And he previously served as the Deputy Administrator of the U.S. EPA under the elder President Bush, from 1989 to 1993, and following that he was the Senior Vice President of Safety for the Kline Corporation, which provides recycling services to over 400,000 customers. He has been an advisor to the current Bush administration and is very active in business community and he holds degrees from the Woodrow Wilson School at Princeton and from University of Virginia; Hank?

Hank Habicht: Thank you, Peter, and thanks to Peter and Erik, I will probably be repetitive a number of times today with all the great presentations that we've had already, but let me repeat some others in praising CSIS and Sandia and Eric and Peter and Laura, the team that put this together. It's obviously just the beginning, and what I want to do is to talk a little bit about where we go from here, having - looking back on the kind of people that we heard both in this session and the one before, I was reminded of a great speaker once, who said that after coming at the end of a long conference, he said, Well I have the difficult choice of either being redundant or mistaken. (laugh).

So I will try to be redundant in a constructive way, but I do think that this is a great opportunity to sort of pull together. We've had a great collection of experts talking about many dimensions of the issue, and just getting a feel for how multi-dimensional the water challenges that we face are. What I want to talk about is the institutional challenges and the institutional opportunities we have. We've heard a lot about technology, we've heard a lot about individual kinds of projects, about the kinds of technologies that apply to different problems in different parts of the world. I want to talk about the potential alignment of institutions that's necessary in order to move forward, even beginning to address the challenges that we've talked about here.

To follow Bob's analogy, we need a work-around of the kind of institutions that we've been talking about here the last couple of days and I will start with a story that I've told since I was at EPA, working with Gordon Bender and Bill Riley there, about how environmental energy and resource policy is made in Washington. It's a story of two politicians who every year go on a hunting trip out in the North Woods and this year they, they were out hunting and they were particularly fortunate, they each bagged a big moose. It was in season, so it was legal, but they dragged the moose back to their base camp and the pilot was standing by the plane and he said, congratulations, but we have a problem. He says, I have a small single-engine float plane. I can take two hunters and one moose or two moose and one hunter, but I can't take everything. And one of the politicians was indignant and he said, Now wait a minute, last year the exact same thing happened, and your competitor took us so let's go. He said, okay. He piled everything on the plane, he started up the engine and the plane took off and in a few seconds it sputtered and fell into a clump of trees. When the dust cleared one of the politicians said to the other, where are we? The other one said, We did pretty well, we got about 80 feet farther than we got last year. (Laugh)

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- ◆ Not-for-profit organization, est. 1988
- ◆ Mission – mainstream sustainable development with information networks, tools & technologies
- ◆ Bridge between energy & environmental sectors at Federal, State & business levels
- ◆ Focus on partnerships in energy/climate, water, environmental security
- ◆ Leverage resources & partnerships to deploy cleaner technology



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“The Crisis of Opportunity”

- ◆ CSIS-SNL Workshop has established:
 - ◆ Challenges are better defined than ever
 - ◆ Technology and expertise in growth mode
 - ◆ Resolve is strong, execution is lacking
- ◆ How to accelerate deployment of solutions?
 - ◆ Focus on communities
 - ◆ Mobilize global/local institutions
 - ◆ Just do it— deliver real projects



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So that is the challenge, and you know, and I've dealt with, at GETF, I have dealt with a range of - both in my career and then at GETF we deal with a range of issues, and the challenges of deploying clean energy, clean water technologies, to get technologies into the market place. We are a project-oriented non-profit. We'll talk about some of the projects we've worked on. Our president, Monica Ellis is here with us today, she works on a lot of international water issues, including coordinating the upcoming Global Environmental Facility International Waters Conference in Brazil, coming up in June as well as US participation in the fourth World Water Forum in Mexico. And it is daunting, when you

look at whether it's energy policy or water policy it just seems like there's too much for our institutions to bear. Well the answer in industry when you face a challenge like that is not to give up, but to design a new airplane and really, institutionally that's what we have to do and at GETF, we're really focused on institutional relationships, getting organizations that don't have a history of working together, to actually work together for results.

Well, again there will be a bit of a review here, as little as possible, but just to sort of remind us where we are. What we've heard over the last few days is that there are many, many strands of activity, there are many pockets of expertise, there are many kinds of technologies being developed and we've heard that the challenges are better defined than ever, we are beginning to focus on it, while technology is still in a dynamic phase. We do have technologies I think we both have technologies available to solve the problem and we still have needs in technology to really advance the ball. Resolve is strong but execution is lacking. So the goal again is how do we provide an institutional focus.

The Technology “Market”—Opportunities and Challenges

- ◆ 20th century: population grew 3x, water use grew 6x
- ◆ Water technology market exceeds \$500 billion
(GlobalWaterIntelligence, Sept. 2004)
 - ◆ 3.5-5% growth
- ◆ Private equity accelerating (GE, Danaher)
 - ◆ In spite of “obscure market”
- ◆ China (Schwab Soundview Capital Markets, 10/29/04):
 - ◆ 50% of cities lack potable water
 - ◆ 80% of industrial WW untreated
 - ◆ Water-spending growth >20% annually
- ◆ Need major engagement of mainstream private equity and debt



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My bias, I think our bias is, and at the risk of over-simplification is to focus on communities as the theater of action, particularly in the near term, mobilize local and global institutions to support action at the community level and really focus on getting on-the-ground results; not keep planning, not keep studying, but get on-the-ground results, which is happening. We've heard a lot about that, but we need to be able to understand all the things that are going on in these individual projects and learn from that and I'll get into what that all means shortly. Well, there is momentum clearly, we have momentum with regard to the market place, you know, and we've heard a lot of statistics, we know the growth and demand, we know that the water technology market at a minimum is \$500 billion or more, I'd say 3.5% to 5% growth; the fastest, the largest growth rate is in industrial technologies. In other areas it's not quite so clear, but the important thing, and this is something that I follow quite a bit, is that large traditional private equity, as we've heard several times, is really accelerating as participation in this market. In addition to ITT,

obviously general companies like General Electric, another company that you may or may not have heard of, those in the water business have heard of Danaher. Again it's a reflection of traditional private equity focusing on this market. Yet it's a tough market to define and so equity is getting into different segments or components of the market, we can get into that in discussion.

China, we've heard a lot about the dramatic growth in China. Just on an infrastructure issue, I think Bill Riley told me that, he heard that just the road projects, this is not water, but the road projects that are, you know, sort of on the, on the planning horizon for China would go ? would circumnavigate the globe, something like ten times; so, it's just mammoth scale. We also have momentum in the technology area, we've heard a lot about that. I won't even, won't even purport to try to rehearse everything that we've heard about technologies, both on the hardware side -- and when I talk about technology, it is very important to emphasize, technology is not just hardware, but it's processes, it's approaches, it's expertise, it is ways of solving problems. That's why at GETF we also spend a lot of time working with public institutions on developing environmental management systems, because you need a management super-structure which is congenial to new technology, and not just the tried-and-true approaches that we heard so much about in the water sector.

Water Technologies (Both hardware and practices)

- ◆ Information/Analytics
- ◆ Demand-side technologies, cost-effective efficiency opportunities (Postel):
 - ◆ Agriculture: 10-50% (e.g., CIMIS)
 - ◆ Industry: 40-90% (e.g., GEMI)
 - ◆ Cities: 30%
- ◆ Supply-side technologies
 - ◆ Adv. purification (e.g., adv. sewage treatment, nanotech)
 - ◆ Source augmentation (e.g., rainwater harvesting)
 - ◆ Water security
 - ◆ Desalination
- ◆ Next big thing: energy-water interface



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We've heard about the opportunities on the demand side. I'll just mention, well information of course is critical. On the demand side we've heard about - these percentages are just opportunities for cost-effective improvement, and they're often greater. CIMIS is the California Irrigation Management Information System, which is a marriage of information technology and demand-side management that's very exciting.

We heard about 'watergy', you know they -- in this interface between energy and water, very exciting. You're taking not

only the energy-water interface -- it is exciting to me because it both comprehends sort-of traditional approaches, taking sort of the co-generation approach, that's taking an energy to harness otherwise wasted pressure and energy generated in various water processes, and to use that productively, but it also involves the exciting frontier kinds of technology marriages, such as desalination, and ocean-based energy sources as a source of energy for desalination.

So what are the challenges? The challenges are legion. I think the economists succinctly talked about the challenges in their water, their special water section a couple of months ago by saying that the water sector is ill-governed and colossally under-priced. That could summarize it in a nutshell, but from the standpoint of my own biases, my own experience, I want to share what I see as some of the key challenges that we have to focus on if we are going to make progress.

First of all is turf. Anybody who's ever

Technology Challenges/Barriers

- ◆ Fragmentation of information & institutions
- ◆ Economics
 - ◆ Free good vs. fairly priced commodity
- ◆ Investment model
 - ◆ Historically too top-down
- ◆ Project scale
 - ◆ Need better mix of macro and micro
- ◆ Appropriate technology
 - ◆ Match needs and community capacity (Postel)



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heard me talk, I say the number one challenge in the environmental and resource arena is compartmentalization. It's compartmentalization of institutions, compartmentalization within institutions, turf battles within governments, among governments and so forth, but it's also compartmentalization of a perspective, you know because the water chain is so vast that normally institutions focus on one piece of the water chain. It is very important for us to be able to understand all the inter-relationships and have the institutions get some common perspectives.

The economics are a challenge. We've heard a lot about this, we do need a value proposition for water that's a workable value proposition. There is, while energy is a dysfunctional market, there are parallels but there isn't quite the separation between the cost of production and the price, in energy, as there is in water although energy prices do not reflect the real cost of energy and certainly water is a long way from that.

Investment models are barriers. Part of it is inertia, the tried-and-true, the not-invented-here problem, but also the investment models in water, as we've heard, are historically too top down. They usually involve large funding institutions, whether they're government or multilateral institutions and I'm especially speaking about the international arena. And that tends to perpetuate a lot of upfront funding, a lot of construction, but then a lack of O&M, a lack of sustainability in an enterprise. So we need to work on the investment model.

We've heard a lot about scale. We need to have the optimum mix between large and small projects and we need appropriate technology. Heard very many good comments about all that and I totally agree. These are major challenges.

Technology deployment: Critical Success Factors

1. Shared understanding of problem and a sense of need—thirst for solutions
2. Financing mechanisms
3. A business model and partners that support a sustainable enterprise
4. Continuous improvement cycle



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So from one perspective - I offer this as a perspective as we figure out where we go from here: What are the critical success factors for technology deployment going forward? Well first, based on what I've said, you wouldn't be surprised, that we need to develop a shared understanding of the problem, an institutional focal point to be able to come to some common sense of the nature of the problem, and what's happening out there. And, you know, I think that's, I think that's happening. We need, we also need as part of that shared understanding, and number two we need financing mechanisms. We need to have a better sense for where the private sector can and should be appropriately in the leading role.

I think we've seen over the last decade or so, privatization, which was a big movement. When I was in the Reagan administration -- I served in the Reagan and first Bush administration - privatization was definitely the order of the day. And the companies that moved forward with privatization, the French and others, found that privatization as a sterile concept doesn't work, and we've seen the talk migrate from privatization to public-private partnerships because that's really what it's about. There's always going to be a significant public role; we need to define the way the private and public sectors really inter-relate with each other in an effective way. There are some areas that are truly private but we need to look, look broadly across the spectrum.

And related to that we need a business model, and when -- a business model, I mean that in the public and private sense, and partners that support a sustainable enterprise. So we need to identify who are the right parties to be involved, focusing on the community level to get this right.

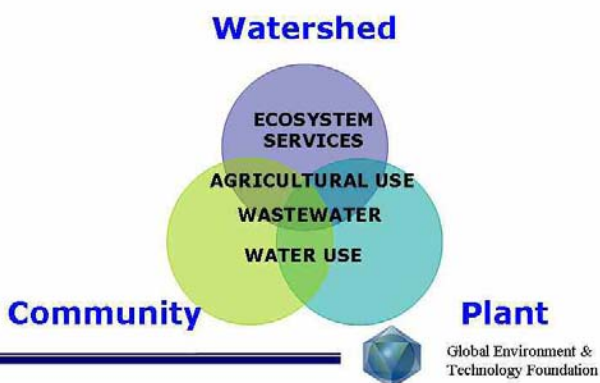
And we need a continuous improvement cycle, and by that I mean -- and this will be the balance of my comments for the next couple of minutes -- what do I mean by this continuous improvement cycle? We need to undertake projects, we need to move forward with projects, as "perfect is the enemy of the good", but when we undertake these projects we need to have an effective way to collect and assemble the results from those projects and get shared understanding of what we've learned, what's worked and what hasn't worked. Why some projects have different characteristics than others, and then have some common protocols for evaluating the results of those projects, making corrections, and moving forward, but continuing to have a base of projects and then building up from that, develop the super-structure that

will support the kind of objectives that we're talking about here today. It doesn't mean that we do nothing at a high level, obviously we need to engage at the highest possible levels. But we need to move forward with projects and really collect our understanding, rather than just have a fragmented set of projects, and just have it be happenstance, when there's a person who has the knowledge of a whole, of a whole range of projects like some of our speakers here today have had.

And I would just add - it sounds like I'm talking primarily about projects outside the United States or in the developing world, but I want to emphasize that I really think that the challenges that I have just described apply equally in United States in different ways, but apply equally in the United States. We've heard about the infrastructure funding gap, I was just involved in a panel that reviewed funding inadequacies in the Chesapeake Bay, and it was pretty daunting. We were just focusing on -- the Chesapeake Bay has made a lot of progress, we were focusing on nutrients and sediments, huge issues there, and there is a big funding gap. We have to be creative, we have to find community-based solutions, we need more engagement at the community level. If you look at all the watersheds, the Everglades, the Chesapeake Bay, the Great Lakes, you are talking about, you know, a multi tens of billions of dollars price tag that the federal budget, as Senator Bingaman said, won't fund. So these really do apply to the U.S. and internationally.

1. Shared understanding of problem and a sense of need

- ◆ Educate institutions and businesses about problem
- ◆ Use *H2O value chain* to see the full field of play
 - ◆ Watershed-> Community-> Plant-> Watershed



So let me just quickly run through these critical success factors. The shared understanding of the problem involves education, it involves a landscape-wide perspective on what the water value chain is, this is sort of a rough approximation that we use with companies that are operating in countries around the world, to begin to understand how their water needs relate to the needs of the entire watershed and the community in which they're involved. I won't spend a lot of time on that, and this is really, this is review, but I think it's important. Just looking at this list reminds us that if we're looking at the whole water chain and all the interrelated issues that affect the quality and

quantity of water, you are talking about first being able to, to do monitoring diagnosis including using remote sensing. It's ? we're talking about ecosystem management and everything that that implies, dealing with natural hazards, agriculture practices, non-point source, you see it all there, these are all relevant -- doesn't mean that any one institution is going to master all these or any one water project involves all these, but certainly if you're talking about the drinking water supplies in key parts of the world, the watershed and the water value chain is critical to understand.

As I mentioned, the only way to provide focus on these issues is to look at the community as a focal point. That's why we have the community as the center, and then many supporting

Water Value Chain: multifaceted approaches

- ◆ Landscape-scale monitoring and diagnosis
- ◆ Ecosystem management
- ◆ Natural hazards (floods, drought)
- ◆ Agricultural practices/technology (drip irrigation)
- ◆ Non-point source/stormwater management
- ◆ Drinking water treatment and delivery
- ◆ Wastewater treatment
- ◆ Efficiency and re-use (GEMI)
- ◆ Infrastructure financing



The Partners



institutions or participating institutions that surround that community -- again, the right mix depends on the problem and the location, but we need to have governments, financial institutions of all kinds, and we need, you know, the kind of local capacity-building that we have heard a lot about here. Well, let me talk about a couple of examples.

The first example - we work with a number of companies, and as Jeff Seabright said when he was here earlier, we've been working with Coca Cola as they have been understanding the water challenges that they face around the world and determining what makes

sense from their business standpoint to deal with those issues, and Jeff has talked about a couple of the, the challenges, a couple of the -- rain water harvesting and other projects that they are undertaking.

One of the most recent projects we have been involved with is a partnership between Coca Cola and USAID in Bamako Mali. In Bamako Mali, like in many parts, similar parts of the world, one out of four children won't make it past the age of five, and yet this is a significant market for Coca Cola and they have a bottling plant in the area. So they recognize the need to marry, you know, as they're dealing with their waste water and their water treatment needs, that by co-funding a broader investment they can help to fund an infrastructure for the village, for the entire community, with AID and help to build an infrastructure of

people to pick up on that. And Coke doesn't plan to go anywhere, so they'll be around and it is just important to them that this move forward in an effective way, with the right capacity and governance, and that they not be expected to foot the whole bill, but they intend to be investors for a while going forward. And this is just coming to fruition and it's showing a great deal to promise and ultimately their cost will be lower and their security of supply will be higher.

Mali: Coca-Cola Bottler Community-Watershed Partnership

- ◆ Coca-Cola focuses on its local water value chain and targets water technology opportunities
- ◆ **Technology:** wastewater treatment, point-of-use purification, bio-solids land applications
- ◆ Partners: Coca-Cola, USAID, local bottler, local community
- ◆ Benefits throughout the value chain (Coca-Cola corporate, bottler, and community)
- ◆ Leverage funding: achieve more at the same or less cost to the bottler, Coca-Cola, donors, and community

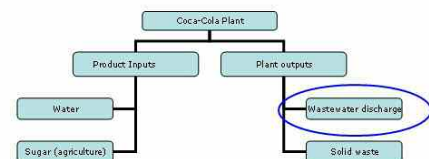


Photo Credit: USAID/Mali

2. Financing mechanisms

- ◆ Stimulating private investment
- ◆ Partnerships leveraging resources
- ◆ *Example:* EPA partnerships in Kazakhstan providing clean water to rural villages
 - ◆ *Approach:* unique self-sustaining financing mechanism leads to development of clean water supply infrastructure
 - ◆ *Partners:* US EPA, GETF/ICEF, local villages



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We also, I talked about financing mechanisms and we've had a lot of good discussion about that, it's critical for us to engage the private equity and banking community. One example that we've been involved with --- I just want to run through these examples. Here is an example of really engaging financing at the local level. We have - GETF doesn't do a lot of these projects, but we undertake them to really, to really gain experience in the dynamics here. We have been working with the International Center for Environmental Finance, which we created with EPA, and some federal funding, focusing on South Asia and Eastern Europe and the former Soviet Republics. In Kazakhstan the villages are -- there are many villages that

have no public water supply whatsoever, and Al-Gabus is the first village where we started. What happened here in a nutshell was that we worked with the local community to convince the local community that with a relatively small investment, although it's not small for them, and a sustained investment they could build water systems and water delivery systems. The town created a water committee, then they created a regional financial cooperative, and the mayor of the town as well as other project leaders went from door to door to collect money for this water delivery for sinking the wells and stand pipes in the water delivery project.

We now have three villages which are supplied with water for the first time, we have sustaining funding coming from every single villager and the goal is at least six villages and have this be a model for local funding. We've also worked in Russia with using the model of revolving funds to sustain projects. But part of this of course is to convince the local populace, which in this case they were convinced, that they needed to invest in this, and I know many parts of the world aren't quite ready for that. But we've learned a lot from that example, and these are just pictures of, this is where the residents are actually ponying up their money.

Another example in the energy water interface that we've been involved with is solar light for Africa. This model is an NGO-based model where in fact, all the initial services are donated. Solar light for Africa is a church-based organization that obtains donations of PV, photovoltaic equipment, and then they get volunteers to come for various periods of time during the year to install PV systems that are primarily designed to deliver clean water to hospitals, orphanages and so forth. And what happens, they now have fifteen hundred installations in East Africa, primarily Uganda and now also moving into Rwanda, and an infrastructure that's beginning to develop to support this and build these systems themselves.

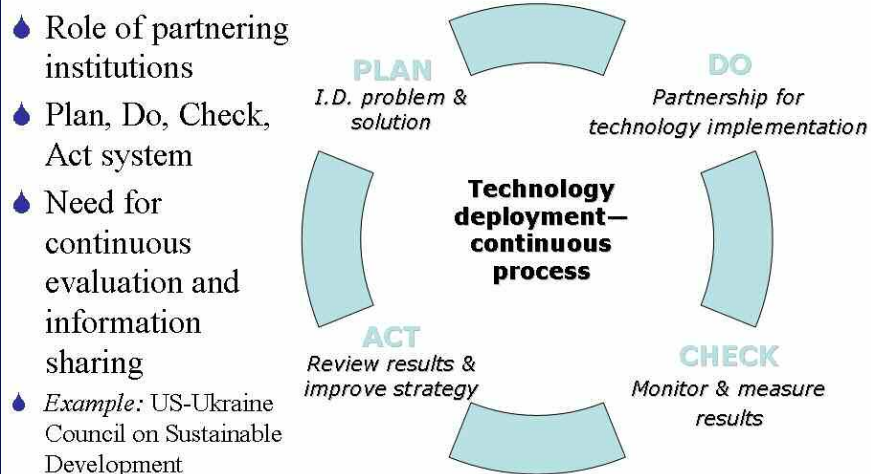
I also talked about a continuous improvement cycle and

3. Business model that supports sustainable enterprise

- ◆ Role of partnerships and local buy-in
- ◆ *Example:* Solar Light for Africa (*Energy-Water nexus*)
 - ◆ *Technology:* decentralized energy sources provide needed electricity to remote clinics and schools (including energy for well pumps)



4. Continuous improvement cycle



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I used 'Plan Do Check and Act' because the ISO process, ISO 14,000 total quality management is internationally recognized, it is an internationally recognized process, and without belaboring it, 'Plan Do Check and Act' is what this is about. One example that we cite here, the U.S. Ukraine Council on Sustainable Development, this is a place where many principles of environmental management systems were applied and in Lviv, Ukraine, the World Bank finally decided to make a loan for a significant infrastructure upgrade in Lviv, Ukraine because of the fact that with participation of U.S. companies -- ITT may have been involved, I know Dupont was involved -- the capacity was built and the confidence was built that the city would meet the kind of standards that the World Bank required for a major infrastructure.

We talked a lot about desalination. I won't belabor it. We can talk about it as we get into the discussion, but I think desalination is not only exciting, but it's a wonderful model on a very large scale of some of the challenges of taking an outstanding idea and actually getting it accepted in the market place. You know, we've all heard about the valley of death, the learning curve, the catch-22, that a great idea, you know, makes all the sense in the world, but it's too expensive. And in order to get the cost down, you have to get sales volume up, and getting sales volume up is a challenge, and desalination -- there have been a number of challenges, I think some of them are economic, some of them are sort-of policy-oriented, sometimes I know some groups feel like desalination is a cop-out, you know, in many parts of

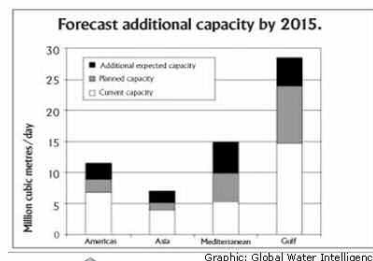
The Frontier: Desalination



- ◆ 101% increase in capacity by 2015
 - ◆ \$95 billion market
- ◆ Still costly but water demands will increase desalination supply (e.g., hybrid vehicles)
- ◆ Have demand-side options been exhausted?
- ◆ Increasing use of membrane processes; less thermal desalination
- ◆ Combine with clean energy?



Jubail plant in Saudi Arabia—world's largest



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the world through savings and better management, we don't have to, to go to the ocean and spend all this money, sometimes it looks like it's more money than needs to be spent, but I think we are coming to a very positive part of the curve on desalination. Monica and I were talking about hybrid cars, hybrid cars were a very exciting idea, they now are catching hold in the marketplace because the quality has been demonstrated, as the quality's demonstrated and through HOV opportunities and things like that, the volumes are up, the costs are coming down, the quality's going up, some

very exciting trends here.

So where do we go from here? And I'll leave this so that we have time to discuss, but the important points just quickly are credible information, and harmonized information, we need national points

The Path Forward

- ◆ Credible information and harmonization
- ◆ National points of coordination
- ◆ Partnerships deliver early wins
- ◆ Reliable sources of evaluation, best practices and partners
- ◆ Policy drivers:
 - ◆ R&D
 - ◆ Pricing
 - ◆ Standards
 - ◆ Financing
 - ◆ Trading
 - ◆ Privatization
- ◆ Communication; celebrate successes and best practices



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of coordination for this information, partnerships that deliver early wins and then to be able to evaluate those wins, and then to have feedback loops between the projects and the policy community, particularly the R&D community in the labs, and policy -- we need key policy focus not only on R&D but on all these issues of pricing and standards, privatization and so forth.

There are a lot of institutions that can pick up some of this opportunity, certainly CSIS, a number of federal agencies, we need a focal point in the federal government. I

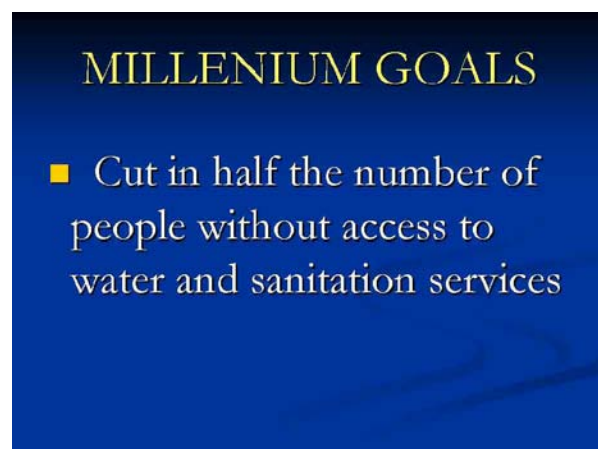
think a lot of NGOs like Water Environment Federation - Bill Patera's here, other organizations we've heard about -- I think the multi-level development banks have a lot of opportunity to help us synthesize information and project experience. In a nutshell we probably need, I thought we need a Bloomberg for water, some focal point that everyone will go to rather than five thousand websites, some place that's an accepted source of information so we can continue to learn from experience and then we need to effectively educate, communicate and celebrate success and compare best practices.

So just to wrap up, as I mentioned, volume drives private investment and innovation. Volume is being held back I think because of compartmentalization and turf. Local partnerships will help us break down these walls of compartmentalization, and then the successes from those partnerships effectively communicated will in turn help build the volume, help bring in the kind of capital that we need and move forward toward the very daunting but critical goals that we all face. And I think together we can get that plane flying. So I'll stop. Thank you very much.

Peter Davies: Thank you. Now I would like to welcome our second panelist of the morning. Dr. Henry Vaux is Associate Vice President for Agriculture and Natural Resources at the University of California. And he is also a professor of resource economics at UC Riverside and he has been a past vice president of the UC Water Resources Center. He is the immediate past chair of the Water Science and Technology Board of the National Research Council, and he is also the President of the California-based Water Education Foundation. Now addition to these somewhat more domestically, U.S.-focused activities, he is also very active in international affairs. He is co-chair of the Rosenberg International Forum on Water Policy, and he has over his career offered over seventy publications on the economics of water resources and in particular the economics of irrigated agriculture in water marketing.

Henry Vaux: Thank you Peter, and thanks for the invitation to join here with you for these two half days. In the time allotted to me, I want to talk about four issues, and let me just review them upfront for you. First of all what is technology, we have been talking about technology for nearly a day now and until a few minutes ago with Hank no one had bothered to define it. Secondly, what are the public and private roles in advancing technical innovation? Thirdly, what are the mix, the appropriate mix of fundamental research and in Pasteur's words, applications of that research. And finally, fourth, a cautionary word, or a cautionary set of words about the export of technology.

Now I was going to begin with a minute or so of dialogue or soliloquy if you will, to refocus your attention on the seriousness of our national and international water problems, but I felt that Robert Ayers did such an outstanding job of that, that I could not possibly improve on it, save to share with you a little bit different take on the millennium goals, which again have been referred to here a number of times. But it's certainly, it's probably the case that at least one or two people in this audience have forgotten what they are.



The millennium goals call for the cutting in half, of the number of people in the world without access to water services and sanitation services, by the year 2015. And I simply want to share with you the information that, in order to accomplish that goal of cutting in half the number of un-served people, people who are un-served with water and sanitation services, by the year 2015, will require of us that we bring water services to 200,000 new people each day and sanitation services to 400,000 new people each day. It will take no small commitment of resources and knowledge to solve problems of this magnitude-- that is each day between now and 2015.

1. What Is Technology?

technology includes the sum of all of our knowledge of water and the means of solving our water problems. There are at least two reasons why it is important to think of technology in this broader sense when talking about water resources. First, it is not only misleading but wrong to think that water supply enhancing hardware will be sufficient to solve our national and international water problems, and I think that Mr. Ayers spoke eloquently, far more eloquently to that point than I can.

Secondly, the second reason for embracing a broad definition of technology is that we need to use, we will need to use all of the weapons, all of our knowledge and every means available to us if we are going to be successful in addressing these very, very serious national and international problems. And what this means, among other things, is that knowledge of the natural sciences and of the social sciences is likely to be every bit as important as knowledge of the engineering sciences. Just as we can not rely solely on hardware, we can not rely solely on supply-enhancing technologies to produce ever larger quantities of fresh water. We will need to learn how to do a better job of managing water demands and to think in terms of both simple and sophisticated technologies.

Now let me turn to the issue of why public sector research and the development will be more important, will be important in finding the means to address our problems, and in talking about these next two questions, I will interlace my discussion with identification of some of the drivers of technical change. That was what I was told to talk about, and you know college professors get told to talk about all kinds of things, and then they talk about what they want to talk about, and I make at least an attempt to do what I was told.

What about research as a public good? The need for research at the nation's universities and

RESEARCH AS A PUBLIC GOOD

colleges, as well as at other public research institutions, rests with the fact that much research -- and indeed much water resources research -- has the characteristics of a pure public good, or a public good...((what have I done, can you back me up, there, thank you)) A public good can be defined as a good that is indivisible in consumption, or in joint supply, and that's just economist-speak for the fact that when the good is provided to one person or to a small group of people, it is inherently provided to a larger group of people irrespective of whether they

are willing to pay. In other words, people can not be excluded from consuming the good, some people can not be excluded from consuming the good by their refusal to pay for it.

Thus in the case of some research, results become freely available to many, or all, irrespective of whether they pay for them. The consequence is that those who produce research with pure public good or public good characteristics are unable to capture all of the returns from the research investments, because the results are not patentable or licensable. The result is that the private sector typically under-invests, or fails to invest at all, in the production of public goods because it cannot capture or appropriate

So with that in mind, let's turn now to my four questions, the first of which: What is technology? Often, and I think often in the course of our discussions here, technology is thought of as hardware. It is far more than that, and again I think Hank was the first one that acknowledged explicitly that it was far more than that. Webster defines technology as the application of scientific methods, knowledge and research to industrial and other productive endeavors. When this broad conception of technology is applied to water resources,

DRIVERS

1. Appropriate Economic & Financial Environment
2. Adequate Public Investment
3. Educated Workforce

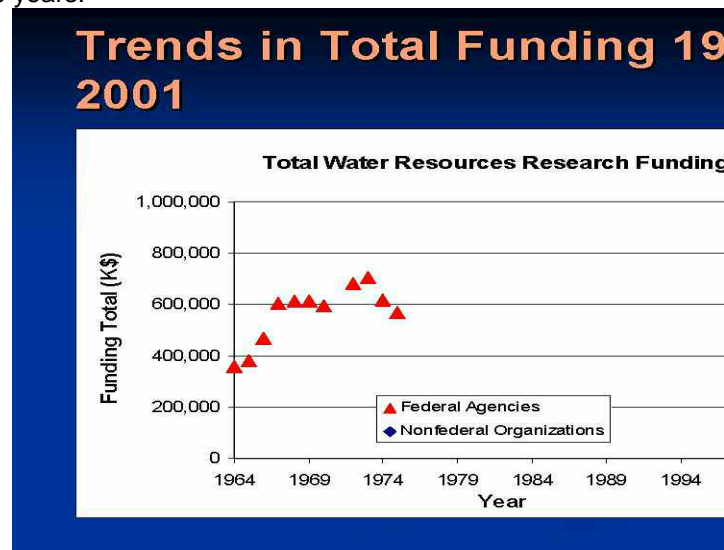
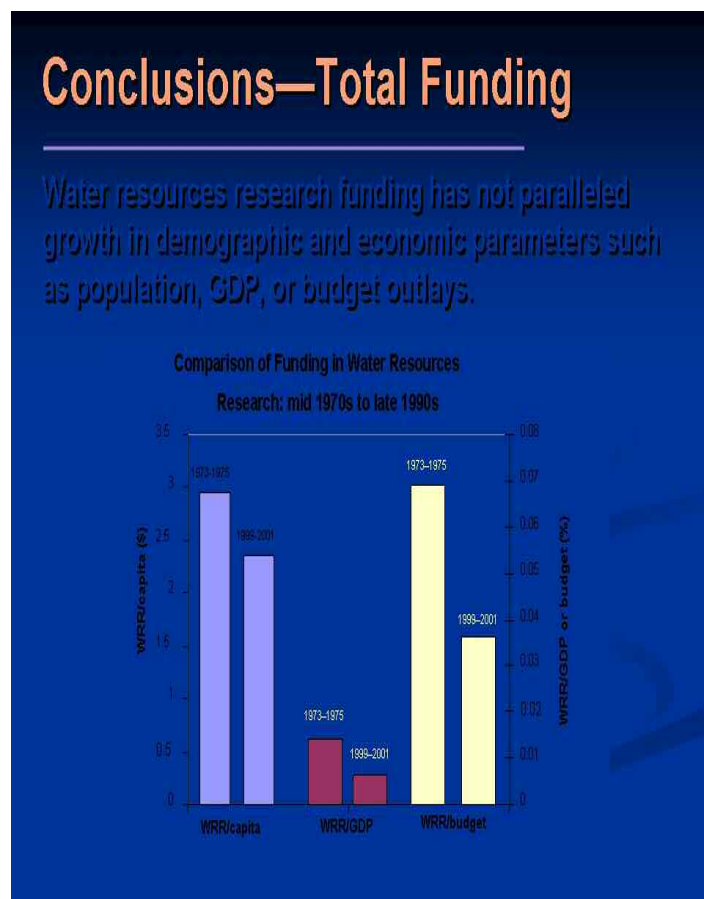
all the returns to the investment. Perfectly understandable economic fact of life, and for this reason public support is required if research with public good attributes is to be carried out at optimal levels.

In addition, there is the problem of lack of appropriability with water resources since water is a publicly held resource. Nobody, no individual person has a right to the corpus or the body of the resource, rights are use rights, or what lawyers call use of _____ rights. The lack of individual appropriability combined with public ownership of resources makes the justification for public support of water resources research especially compelling. Now this does not mean there is no role for the private sector. There are plenty of cases in the private sector, where research in technical development yields products which can be licensed and can be patented and yields products for which all the returns can be captured by the entrepreneur, and I expect that the private sector will continue to thrive in the water resources technology field.

Now since the development of technology, as I've defined it broadly, is virtually always based upon research, it's possible to conclude that the fundamental drivers of technical innovation are the economic and financial circumstances surrounding investment in R&D. And these three drivers are first, an appropriate economic and financial environment in which private sector investment and risk-taking are appropriately rewarded. Second, adequate public investment in research and development. And thirdly an appropriately trained and educated work force that is capable of conducting the Research and Development related to water resources.

Now let me take just a moment, to report to you on the adequacy of public investment and research and development related to water resources in this year 2005 in the United States. A recent study in which I was involved by the National Research Council examined the current levels of federal investment in water resources research, and came up with several surprising conclusions. The first of these conclusions is that for the years, fiscal years 1999-2000, 2000-2001, the annual federal investment in water resources research was \$700 million. That was I think a lot more than any of us expected to see. The second startling conclusion is that when adjustments are made for inflation, and comparisons are made to the period of the early and mid 1970's, there has been no change. Federal investment in water resources research has been relatively static over the past 30 years.

**FEDERAL INVESTMENT
=
\$700 MILLION/YEAR**



By virtually any criteria then, one would include that federal programs of water research have not been accorded much if any priority. Now consider this next picture and there is something wrong with it, I hope you can see it. What I have, you can't see it; you can only see the bars. There are 3 pairs of bars and the bars on

the left are for the period 1973-1975 and the bars on the right are for the period 1999-2001. The first set of bars in light blue are water resources research per capita. The second are water resources research per dollar of gross domestic product and the third are water resources research per federal budget dollar. The point of all of this is that federal water resources research expenditures have lagged behind population growth, behind economic growth and behind the growth of public sector financing over the last 30 years. This is not a picture that one would expect to see of defense research, defense related research or medical related research. That might be anticipated but what you might not anticipate is the fact that federal spending on water resources research has lagged over the comparable 30 year period behind spending on transportation research, agricultural research and research on energy.

Nevertheless, \$700 million annually is a substantial investment in research and it can be argued with some reason that sums of this magnitude should be sufficient to allow the nation to meet its needs for new knowledge and technology related to water. The NRC committee came to the conclusion that this \$700 million was spent in a highly fragmented and uncoordinated way with the result that the public, the tax payer, are not getting their money's worth for the \$700 million being spent on water resources research. It also noted that the topical areas, in which current water research is focused are badly out of balance with current national, to say nothing about international, water priorities.

This committee made a recommendation that an additional \$70 million be devoted to those categories that are deemed to be underfunded, which include water demand and use, water supply augmentation and conservation, and most importantly, water institutions where we see federal funding approaching zero asymptotically over the last several decades. Someone, and I don't know if she's here or not, asked a question at the end of our session last night about the behavioral sciences, and why there wasn't more work and more help coming. One of the reasons is because there isn't very much federal funding for behavioral science issues related to water, and one of the explanations for that is that no agency has that mission in its mandate and therefore no agency has much interest in doing that kind of work. The NRC report suggests, then, that a well-coordinated, carefully reviewed and frequently prioritized program of publicly sponsored research would also be a key driver of technical innovation.

DRIVER:
Well-Coordinated &
Reviewed Federal
Portfolio

**BALANCING
RESEARCH
INVESTMENTS**

Now a few words on balance. There are different categories of definitions, or definitions of research, and it's important to understand the distinctions between them and be mindful of the need to achieve a balance among them if we are to find a robust and comprehensive set of solutions to our water problems. First, it is important to distinguish among research that is done on different time scales. Short-term research is generally defined as research that is prioritized on a five-year time scale, and accomplished in two to three years, and then almost immediately applied directly to a current problem, short-term research.

Long-term research, by contrast, is identified and prioritized over time frames greater than five years and carried out over relatively longer time frames. The results are expected to be applicable to management or to additional research over much longer time scales, short term versus long term. The second distinction is between fundamental and

**SHORT-TERM
v.
LONG-TERM**

**INVESTIGATOR-
DRIVEN
v.
MISSION-DRIVEN**

applied, and here again I do prefer the Pasteur point that there is no such thing as applied research, it's just research and the applications of research to problems. The applications of research are typically designed to solve specific problems, whereas fundamental research is usually inspired by curiosity and occurs to generate new knowledge. Fundamental research is conducted without respect to any practical application and, importantly, fundamental research is almost always a public good, almost always a public good.

A final distinction then is between investigator-driven and mission-driven research. Investigator-driven research is typically conceived by an individual investigator or group of investigators. It is sometimes characterized as curiosity-driven research and is typically supported only after extensive peer review. Mission-driven research is research focused on specific problems identified by agencies that are consistent with the agency mission or consistent with some congressional mandate.

Now there is considerable overlap among these categories. Long-term research tends to be fundamental and is frequently investigator- or curiosity-driven. Short term research is usually, though not always, applied and mission-driven research. And although these correlations are clear, the categories sometimes combine in other ways. The point here is not to sort of dip you into the arcania to which university research vice presidents are exposed on a daily basis but to indicate that it will be critically important to balance the national research portfolio as among these categories. And most especially it will be critically important to balance the portfolio as between fundamental research and the applications of that research. Again, returning to the NRC committee, that committee was quite clear about what constitutes an appropriate balance and recommended that between a third and a half of the federal dollars appropriated to support water resources research should be invested or allocated to fundamental research.

The current research portfolio is not well focused on fundamental research, both because of the structure of incentives faced by agencies rules against it, and because of the fact that such research does not have immediately usable or obvious results or applications and that makes it very hard to judge its effectiveness. This means in my view that the increased involvement of academic scientists and other independent scientists in peer-reviewed research is probably the only way to correct this shortcoming with regard to fundamental research, and I would simply remind you again that without that fundamental research, and without the commitment to do it today, we are going to be without the scientific means to solve our water problems a decade hence. So in conclusion for this category another driver is an appropriately balanced research portfolio as between these three different categories of research that I've described for you.

Finally, a cautionary word about exporting water technology. Both because the United States is an enormously wealthy country, and because the federal government has been extraordinarily generous in supporting water development with public funds, some (not all) of our water technologies have not always been subjected to tests of efficiency and cost-effectiveness. When we export such technology abroad the results are often less than successful and this shouldn't be a surprise because developing countries do not have the resources to devote to technologies that are inefficient and wasteful. Moreover in many instances, and as we've seen during this past afternoon and morning, the need is for simple inexpensive technologies such as treadle pumps and sodis bottles and not for highly sophisticated technologies that require substantial economic resources and a well-trained labor force to operate.

Also I want to reiterate a point that Jerry Galloway made to me last evening and made again to you this morning, and that is when we export technology we often have no sense of what the unintended side effects are going to be, or if we do have a sense of what the unintended side effects are, we have no sense of how to deal with them. We need to be very careful not to repeat the mistakes of the past in exporting technologies and make sure that the bundle that we export with the technology includes all of our sometimes hard-won knowledge about side effects and sometimes hard-won knowledge about how to deal with those side effects.



1. Define Technology Broadly



2. Acknowledge Public & Private Roles

So my concluding comment, basically answers to those four points, questions I said I would address: define technology broadly; acknowledge that both the public and private sector have very important roles to play and that neither is particularly well-equipped to play the roles of the other; that the research portfolio needs to be balanced and particularly among basic research and applications of that research; and finally, don't export technology which is inefficient and expensive and has a whole lot of unwanted side effects. Thank you.

3. Balance the Research Portfolio

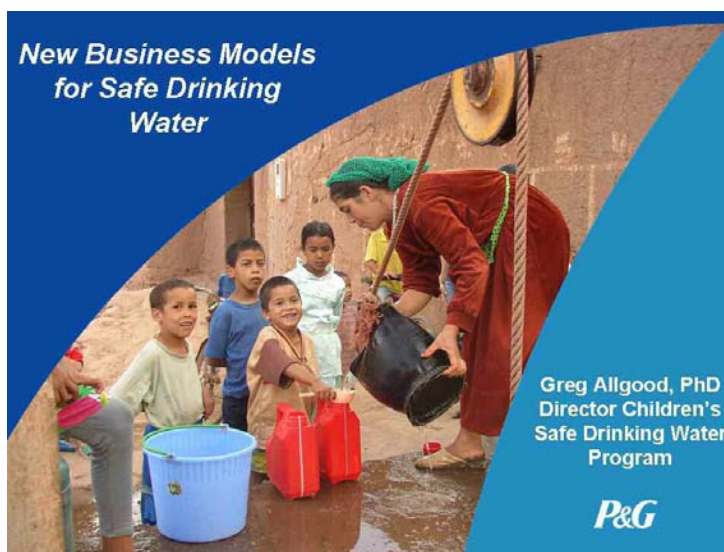
4. Don't Export Technology Which is Inefficient and Expensive

Peter Davies: Our final panelist for this morning and for this series of two workshops is Greg Allgood. Greg is the Director of Safe Drinking Water Program at Proctor and Gamble. And he has been with P&G for 19 years and currently leads their partnership efforts to bring safe water systems to the developing world. Those of you who were here for the first workshop had the opportunity to see a demonstration of the pure product that Greg has worked with. His background is a PhD in toxicology from North Carolina State University and a Master of Science in Public Health from the University of North Carolina in Chapel Hill. And he has been working in this water area both from the side of industry application but certainly in the field as well. So, Greg.

Greg Allgood: Thank you, Peter. It's a pleasure to be part of this panel and I was here, for those of you were at the last gathering in February, I also presented and there I talked more about our general partnerships but Eric and other organizers asked me to present again and to go more in depth about our specific efforts on our Safe Drinking Water Technology. It's sort of an example of just doing it and so we've had some successes but we've also had probably more failures and so we want you to get more in-depth in what we've done so you can understand those and hopefully reapply those lessons to other projects.

So with that I'll start. Let me first, and since I'm obviously with the private sector talk about the role that we think the private sector can play in this global water challenge. We think that we can bring obviously new technologies, but in innovation it's also in business approaches, and we firmly believe that if we develop new technologies that meet consumer needs and are affordable that there will be a market demand for them. And that that can reach a vast majority of the people who have low incomes in the developing world, certainly not everybody so we need other mechanisms as well, but we think we can reach a lot of the people that need safe drinking water.

However, the private sector can certainly not do it all. We don't have the knowledge or the capacity that we would need in public health. And for many new interventions, reaching people in the developing world requires a public help intervention, public health education, so partnerships are absolutely necessary. Now I'm going to focus on a specific technology that's in household water treatment, and the panel yesterday afternoon did a great job of introducing you to different household water technologies and their importance. For those of you who were not here, there is an international network



that's formed around household water treatment safe storage. Susan Murcott a great job of introducing us to that yesterday, and there are brochures about it and there is a website, so if you don't know about it, seek out one of us who are members of the network, and hopefully you will be interested in joining us. But our specific work has been with the CDC, and Eric Mintz from the CDC presented yesterday about their work on the safe water system. We've been working with them now for a decade on complimentary technologies.

And essentially what we found in helping the CDC with dilute bleach technology is that there was room for a complimentary technology. And it's sort of two-fold. We're a consumer products company, so we went into consumers' households and talked to them about bleach and some of them told us, particularly when they had dirty water, is that they wanted to see something happening, they wanted to see their water getting clearer. And then the CDC told us that in turbid waters, there is a need for a complimentary technology that reduces the organics and that it would be nice at the same time if you remove some of the things that bleach alone doesn't kill, for example parasites are highly chlorine-resistant. So what we did was, work with our scientists and essentially develop a new product and importantly it's a product that's specifically designed for people at the base of the pyramid.

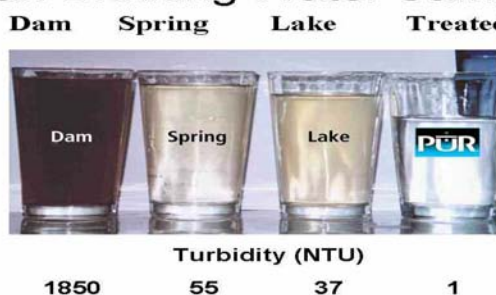
If you have enough money, you're going to trade up, and you're going to pay the high price for a bottled water, you are not going to go through the process of treating water in your home, in most cases. What we did was we simply reverse-engineered what treats our water. We thought that, you know, why not give people in the developing world the same access to the same technology that treats our water, they deserve that. And so we essentially created a little mini water treatment plant ((oh there's my metro ticket, there's my card)) - we essentially created a little sachet, it's a mini water treatment plant. It treats ten liters of water in your home, you add it to water, stir it up, the water gets visibly clean, you pour it through a cloth and it's safe to drink. It treats ten liters and it's available, the little sachet costs between eight to ten cents with a fully cost-recoverable business approach, where you're paying for the distribution infrastructure as well as the cost of the product.

P&G's Safe Drinking Water Program

- Developed a product specific to needs of people in the developing world
- Uses same ingredients as municipal water system
- Reverse-engineered to create small sachet that treats 10 liters (2 ½ gallons) of water
- Affordable cost of ≤\$0.01 per liter



P&G Kenyan Drinking Water Samples



You can see that it's very robust. These are Kenyan water samples. All of the samples were treated with one sachet for ten liters, and all of them resulted in clean safe water as you see on your far left. So then we tested it with the CDC and other groups, we found that it's very effective at removing pathogenic bacteria, viruses and parasites. As you can see, it's very good at removing turbidity. This slide, for example, is representative unfortunately of the type of water that lots of people in the developing

world have to drink. If you were here yesterday we talked about the Society for Women and AIDS in Kenya. This is where they operate in the Nianza province of Kenya, and it's very effective in making that water crystal clear while making it also safe to drink, removing the pathogens. It will also remove pesticides and will remove heavy metals like arsenic, it's very effective, low-cost technology to do that. Then we wanted to show that it did reduce the diarrhea and so there have been five studies, large health

intervention studies, randomized control studies that have now been conducted and roughly show a disease reduction of about 50%. So, you can do the math with, you know four and five thousand kids dying everyday. Technologies like this can provide a huge public health gain.

Now the next thing is, and what I'll move into now, is more-- so we've developed the technology, we've proven that it works; how are we going to get it out there to help people? And there are a couple of different ways that we will talk about. The first is used for emergency use, it's a small, light-weight sachet. Even though it has calcium hypochloride in it as the disinfectant, you can ship it as non-hazardous, has long-term stability, so why not get it into areas that need it during emergency situations. And so we did that after hurricane Gene hit Haiti and the rest of the parts of the Caribbean in September.

We worked with USAID's office of foreign disaster assistance, with PSI, a large social marketing company, and with CARE, and also with a church in Iowa, United Coraville Methodist Church that provided funding to procure the sachets, and we went into that area, PSI and CARE deployed the product, and independently CDC went in with their positions, the IS positions, and monitored the use. They already knew that if people used it in developmental situations, we reduced infant diarrhea but the question was, in an emergency situation, will it be well accepted? We talked a little bit about this yesterday, the chlorine taste. Do people know how to use it correctly? And as you can see, the study showed that it was well-accepted, and even these illiterate consumers that were really only exposed to the product by seeing one demonstration or hearing about it from one of their neighbors, they knew the critical steps of using the product correctly.

And then similar to that, John Hopkins University School of Public Health went into a Liberian refugee camp and measured the same sorts of things, and found that it was well-accepted and easy to use. But they also measured, and this was the fifth health intervention study, they measured diarrheal disease reduction, and so one group got the safe storage vessels that you see here. The other -- and that was the control - and the other group got the same vessels plus the sachets, and they found that most of the diarrheal disease burden was from water, because we saw a 94% reduction in diarrhea in those refugees. So we had this information, we had the

Independent Testing Shows Practical for Emergency Relief

- Johns Hopkins Bloomberg University SPH monitored use in refugee camp in Liberia (2,100 people, 9 weeks)
 - Well-accepted
 - Easy to use
 - 94% reduction in diarrheal prevalence



Massive Intervention for Southeast Asia Tsunami

- 15 million sachets procured for tsunami relief
 - Sri Lanka Partners: AmeriCares, PSI, Samaritan's Purse, WorldVision, UNICEF, Red Cross
 - Indonesia Partners: Samaritan's Purse, AmeriCares, IRC, CARE
 - Maldives Partner: UNICEF



sachets, and then the Tsunami hit, and there has been really a massive intervention of household water technology for the Tsunami, not only pure but more than a million bottles of safe water to dilute bleach have been made available in Indonesia.

And as you can see here, the partners that are doing the deployment -- our role is really to provide the technology and help share what we know. In some cases we played a role and helped mobilizing different groups to work together that maybe wouldn't have worked together otherwise. But our partners are the ones that are in the field doing the deployment. You can see them here and I also learned last night that it's also going into India in the Tamilnadu area where the Tsunami hit. So we found

that emergency relief seems to be an area where the product can work, but before that, since we're soon to be the largest consumer products company in the world, we tried to make a commercial go of it, make it available like we do shampoo and other consumer products in the little shops, and see if we can make a

profit. And we did that in a number of countries. We didn't try it once, we tried it twice and we tried it three times, and we tried it four times, and we have not been able to make it successful.

From a public health standpoint, we didn't do too bad. We achieved long-term repurchase rates of about 5-13%. It wasn't enough for us to pay for the introduction and for us to make money. And essentially what we learned is that consumer habit change that's necessary to teach people about how to use the product, and the importance of treating their water on a daily basis is public health work that takes time and we are not equipped to do that by ourselves and we look on different time frames and so we think that new approaches are needed. 'Cause I mentioned we don't have the capacity or capability for doing that ourselves. Some places that need the water the most like this picture of Malawi, it's risky, there's not the distribution infrastructure for a commercial enterprise. And the time frames that you need to be successful aren't six months or a year, they're longer than that, and so instead of giving up I am grateful that the company has continued and we focused on two different things that we are going to continue this project on: emergency relief, and we've already talked about that, and a social marketing approach, which is a bit unique in the fact that we will provide the product to NGOs that are locally based, and they will provide the product working with a network of key influencers, and this will be an approach that we will do, we will do not for profit, but importantly there will be profit in the local workers that do the work, not

Why are New Approaches Needed?

- Capacity and capability needed for public health education
- Local instability and lack of infrastructure
- Timeframes needed to reach significant scale



P&G's but the local infrastructure.

Now to kick off this work and to learn, we've partnered with several groups: one being the global development alliance part of USAID; also with Johns Hopkins, and they've been the prime in this, Rob Ainsley's in the corner over there, and their group has played the lead role in our safe drinking water alliance; CARE; PSI; and P&G. It involves us going into Haiti together and PSI is using their local distribution infrastructure and Johns Hopkins is doing non-branded education efforts. CARE is doing emergency relief work, more emergency relief work, this time in Ethiopia, incorporating the product into a nutrition feeding program. Our hypothesis is that when you give nutrition, but the children have persistent diarrhea, they're not going to get a lot of the nutrients. And so we're seeing if when you provide safe water with nutrition you can improve the therapy and we have already seen from that work that similar to Liberia and in Haiti that the product is easy to use and well accepted.

Now let me say a little bit more about the social marketing approach. This is a unique model and the way we're pursuing it so far is we provided the product



at cost; PSI of course is a not for profit social marketing company, but then in the generally three steps of the distribution chain, the wholesalers, the retailers, they make a penny a sachet. And then it's available in the local shops and that commercial enterprise is what keeps it in distribution. Then we'll build a network of key influencers, local NGOs, local church-based groups that can provide the credibility that's needed to educate people on a long-term basis in these communities. Hopefully that will also provide future opportunities for us to enter on a commercial venture with perhaps other P&G projects. Some countries it's very unlikely for a lot of years, others it's perhaps more likely.

P&G's Safe Drinking Water Program

- **Emergency Relief:** Provide at cost to relief groups for emergency relief
- **Social Marketing:** Provide to local NGOs to distribute product using a business approach but not-for-profit for P&G

Partnerships for Implementation of Safe Drinking Water

- Created Safe Drinking Water Alliance with USAID GDA
 - USAID/P&G funding and technical support
 - PSI social marketing
 - CARE emergency relief
 - JHUCCP monitoring & behavior change



Efforts to Make Available

- Available in Uganda, Haiti, Pakistan through social marketing
- Available in Western Kenya through a small women's group
- P&G is seeking partners to expand efforts for both emergency relief and for sustained social markets



And we're expanding it, so we're in Haiti as you've heard but now we have expanded national using the social marketing model throughout Uganda. And also we're in a large part of Pakistan and planning to expand throughout Pakistan later this year. You've heard about the Society for Women and AIDS in Kenya, it's a sustainable enterprise, it's very small scale now but their work has been going on now for about a year and half and they routinely sell about a thousand three hundred sachets and make some local income and they sell several hundred, about three or four hundred bottles of dilute bleach every month, and as well, a sort of a market basket of other goods. I have been there several times and you know I hear, if only I had a bicycle I could reach five times the number of people. So we have - it's not very sophisticated, there's lots of opportunities for improving that work. Burberry (?) Atlanta has agreed to help us strengthen and expand the work, and so we are looking for other partners. We are looking for other partners for all of this work. P&G has said that, that we'll go into one or two new countries every year and expand our efforts. And that's really limited only by having enough partners to do it in other places so, we're focused now on Haiti and sub-saharan Africa, we think sub-saharan Africa is the right place to focus because of the needs and we are hoping that partners like USAID will join us there.

Conclusions

- Household water treatment has a significant public health impact, is cost effective, and should be part of policy to meet MDGs
- New business approaches are needed leveraging public private partnerships



So in conclusion, and it's a broader conclusion I'd like to make and that is sort of following up to the panel yesterday, we know that household water treatment can provide dramatic health benefits, and in any policy discussion about how we're going to be effective in global water futures, it must be included to be representative of the public health gains that can be made. And the second is that in these approaches that we need new business approaches, we need private sector investment, but partnerships involving bilateral donors as well in order to be successful. Thank you.

Peter Davies: Now I would like to open the floor for questions of the current panel.

Bob Ayers: Oh there we go. Thank you. Two points I would like to make. I thought it was an excellent presentation by the panel. I go back to what Hank said initially, and there's a couple of comments that I would like to add. You know, this problem is immense, it's so fragmented in so many

niches that when one begins to talk about it, one gets lost sort of in the miasma of the whole thrust. It's really necessary and I encourage CSIS and Sandia and others to try to break this down into meaningful bites and look at segmenting it so that we could really have more of a focus in solving the problems.

Bob Ayers: And the other thing that Hank said that I thought was interesting, you know several years ago, during probably 4-5 years ago, we worked with the water academy in Oslo, Norway, and we tried to use the power of the web to solve the problem of the emerging markets, if that makes sense. What the idea was, was we wanted to have the practical applications that people could put on a website and would be accessible to whoever, throughout the world. We thought that, realizing a lot of developing regions, they don't have the access to the web, but we still thought there were enough people that were assisting and helping, whether be it NGOs or other organizations, that they would have this accessibility.

Bob Ayers: We also believed that when you've traveled around, and I've been in international business now for close to forty years, it is surprising to me how many of the problems you see everywhere are just re-invented, over the time, and some of the really innovative and unique solutions that would go a long way in solving the problem elsewhere, somebody else has already solved it. And how do we tackle that problem. Unfortunately, we were greatly unsuccessful at getting this website up and started. We just couldn't find enough interest, and I've often wondered if the Water Academy was the right place to start now, see we, the Stockholm International Water Institute had started something somewhat similar called The Water Hut that if any of you haven't visited, especially those that are involved with those organizations involved in emerging markets, I would encourage you to visit. But it would also be a point of interest for us, if someone like yourselves would also take interest, and it would give that portal where people could go and begin to really be a center of excellence for solving these specific water issues.

Female Speaker: The WHO network, the international network that you've heard spoken of, has a website and one of the action tasks for the first year was to put -- we're just talking now of the household drinking water treatment and safe storage technologies, but to have that on a website and we've been working on that and hope to have that by June by the Bangkok Conference time. So if anyone's interested in what that website is, I can reiterate it.

Male Speaker: Susan, I just want to add something. Those are great points and I took note of this WHO network, and I want to learn more about it because I think even though it takes a very important, but still a piece, of the issue, it'd be very good to learn institutionally how it started, why it's accepted, you know, the key thing is to have a site be accepted by people and not have institutional jealousies and other things keep people from using it. The people have embraced it and say, okay this is the focal point, it'll be very important to learn how that works.

Female Speaker: Well and another point is to have open access, to have open access, like MIT has open courseware. And we need the water knowledge to be spread widely if it's going to kind of reach the developing world.

Peter Davies: Questions back here.

Question: Thank you very much. This was an excellent series of presentations from the panel. Regarding the balance of the R&D portfolio that Henry Vaux discussed, I have two questions, the first kind-of balancing two other dimensions. One is what I'll call the scale of the project, not over time but kind-of this household versus large infrastructure kind of scale question. Are we allocating, well what is the current allocation of our R&D resources, and what might be an optimal allocation across that dimension? And my second question has to do with, again, the social, economic and behavioral sciences. Time and time again when we talk about technology drivers and then we say, well there are these barriers and a lot of the barriers have to do with social acceptance and things like that and does our research portfolio, again, is it properly balanced along that dimension?

Henry Vaux: I'll take the second question first, Craig, because it's easier to answer. And I'm sorry if I didn't make that clear in my presentation that the social sciences issues related to institutions, that whole package of topical areas is clearly substantially under-funded in the current federal research portfolio. And indeed if you look at the time trace of funding on a proportional basis what you see is that the funding for that sort of research is approaching zero asymptotically. We recommended a minimum augmentation of the funding pool for that research of \$20 million. And I think the feeling was that that was just a start, and you heard with the comment that was made at the end of our session last evening, what some of the consequences of not attending to that research are. With regard to the scale of technology, I think the question has very different answers depending upon the locale. Clearly if you're working in developing countries as Susan and others who've spoken here are, decentralized small scale technology

is really the only thing that's likely to be feasible right now. For our particular purposes, larger scale -- when I look at what Orange County, California is doing with their wastewater reuse program, an enormous water reuse project that threatens to submerge the entire membrane-producing capacity of the world just to supply this one project. Large projects I think make sense in that kind of a setting. So as to the balance, I think the balance has to be guided by the extent to which you're focused on national problems and the extent to which you're focused on international problems. Or maybe I would say that a little bit differently, and say the balance ought to be guided by the extent that you want to be focused on international problems and the extent to which you want to be focused on more regional, local and national problems.

Peter Davies: Thank you. Other questions back here?

Question: Yeah, for Greg. We've had a lot of comment about the social circumstances that need to be overcome. And I was just struck that, I mean you had a very concrete example. You had a product that was delivered, that worked, and you only had five to thirteen percent buy at all. Now it seems to me there must be a fundamental reason why they wouldn't spend ten cents a day perhaps, or every two days to deal with the problem, and I'm wondering, were you able to pin it down to some very fundamental question. For example, don't they perceive that having diarrhea is a bad thing? I mean, why is it they... they had a solution in front of them, but they wouldn't take it, for a low cost.

Greg Allgood: It's a pretty complex question. So, but I will start with telling you that that low repurchase rate was after having success on a smaller scale. So we have been successful in having high percentage rates. The majority of people in communities used it for extended times, close to a year in our pilot tests. It's then when we tried to scale it up, and tried to replace a community-based approach with a broad-based market approach, so essentially community presence with radio or TV copy, that it didn't work. So I think the answer lies in a combination of the two: a broad-based approach to get awareness and build scale, but you also have to have local community efforts in order to be successful. That doesn't get into the specific messages, which are also important points which we can talk about but...

Question: Could I just follow a little bit? But again, you might say that... well, if you looked at that original group of people, the smaller group, where it was successful, did they also continue to use it afterwards? And again, I'm trying to get back to, was their perception that the problem that they had wasn't significant enough to spend a little money to deal with it?

Greg Allgood: No, they became, there are communities with these community-based approaches where people do become very loyal users and they understand the importance for health. It's a combination of factors, I mean most people do not treat their water even though they know boiling is the gold standard. You know that's a generic statement but most people in the developing world know they should boil, but they don't, because it's a hassle, because of the time, so it's more in them seeing a benefit and they understand the benefit generally for their children or other vulnerable people in their household.

Peter Davies: Thank you. We'll take one last question over here.

Question: Not a question but a follow-up. I think in terms of behavior, we're looking at Pure also and other water treatment, and it's the behavior around water treatment that's complex. People know that they could treat their water, they don't for many reasons, including time it takes, costs, or that they just don't see diarrhea as a problem. They've had it, they grew up with it, everybody else they knew grew up with it. And so you have these great ideas and great technologies, we have to better understand how to use them, how to scale them up. I think in the one presentation about export of technologies, it's great ideas, how do they work in other settings. And what's good, we've heard in the last two days, of all the technologies out there, whether they be small point-of-use technologies, cheap or expensive, the reverse osmosis, we need to start getting data at the community level. How do you scale up all those great ideas that Susan's students are coming up with? We got them in one community. How do we get them in fifty communities to a hundred communities and understand what the factors that drive or debilitate those processes. And it goes back to putting the funding in, and getting the groups to support understanding the technologies and how they work in communities. I think it's a really important next step. We have the technologies, we're going to continue getting technologies, how do we make those technologies work at the local level?

Question: Thank you. Just one quick point because I took note of Henry's comment also about export. This is just a data point, that EPA has had historically a program called the environmental technology verification program, and there's been a running debate about you know obviously small water businesses that have worked in the technology area have wanted, you know, know that EPA's quote seal

of approval is extraordinarily valuable. Well EPA can't and shouldn't give a certification of technology, but a verification program like that, it deserves to be looked at, EPA has a lot of credibility and that could be one institutional mechanism to start to deal with the issue that Henry raised.

Peter Davies: Thank you. At this point, I'd like to have you join me in thanking this final panel for the workshop. And before I pass the floor back to Eric to bring a closure to this workshop, I'd like to express my personal thanks to all the panelists who are here and not here, not only from our workshop today and yesterday, but from the one that we held back in February, and I'd also like to thank all of you. Because the dialogue that has been part of this process has been extremely important. And finally I'd like to thank not only our partners at CSIS for helping to bring this into reality, but also the support that we've had from ITT and Coca Cola and P&G. And I'd like to take a line from the last presentation. I like the way you started out, Greg, by saying, "This is a presentation about just doing it." And so now one of the challenges that we have is what are we going to just do with the information that we have gathered through these workshops. And I'm going to hand that nice assignment over to my partner, Eric, to talk about where we're headed.

Erik Peterson: Thank you, Peter. Just a few words. First of all, as you know, the purpose of this meeting today and yesterday, as well as the first workshop a month ago, was to do two things. To undertake an audit of innovation in the case of our February meeting in policy, and in the case of our meeting yesterday and today, in technology. And then to assess what we can do, how we can apply or plug in whatever innovation we can define. And I think we've come up, thanks to the insight of a number of very dedicated and insightful speakers, we've come up with a number of ideas that we'll be massaging in the days and weeks to come.

Erik Peterson: I need to say, however, and drawing in a different context from the remarks of Tom Hinkelbein, that I'm feeling, and I quote here, a little bitterly centrifugal, about all the comments that have come out here. The complexities are tremendous. This is exactly what Bob Ayers said earlier. And it strikes me that we need to think anew about balancing, work-around to use his expression, in a number of areas, the mix between small and big projects, the mix of high and low technologies, the mix of emergency and short-term responses relative to structural longer-term responses, the mix of water access, sanitation, economic development and other dimensions of the challenge, mix of rate of return, risk return, the mix of public perceptions that's come up time and time again, the mix of organizational approach to avoid the compartmentalization that Hank mentioned earlier, and the mix and the nature and the balance of research as we've discussed it on this panel. I think we've come up with a number of very critical indices, questions, case studies, a library in fact that we can draw on as we try to digest and post-process all of the valuable comments that we've had in the last couple days. Now what are we going to do with all this?

Erik Peterson: Well, the first thing is that we're developing a white paper, and many of you have already made very helpful comments on this. The white paper is to summarize many of the points that have come out in the context of these workshops, as well as the research of both CSIS and Sandia National Laboratories. We are developing a website, and we already have a significant chunk of our February meeting up on the website, and we will move expeditiously to try to get our proceedings over the last two days up as well, and we encourage you to visit and to help us develop that. Beyond that, we'll be looking to develop sets of recommendations that we hope will continue to animate some of the important legislation and draft legislation that's moving in this capital as well as more general approaches, partnerships, opportunities that we may identify going forward. And I think we'll have to be mindful of avoiding the king hits that we talked about this morning, as tempting as they may be, to look for longer range, more systemic answers here.

Erik Peterson: In moving forward, we hope to have some kind of a next generation effort soon. There are three areas that strike me, obviously I'll have to talk with Peter and others about this, but one idea, is that it seems to me that we could all move the ball forward by zooming in, regionally; a number of specific case studies have come up here. But it would be very helpful, I think, to mine specific experiences in a range of different parts of the world to help us illuminate the way forward. Beyond that, it's come up in a number of contexts here that this country could benefit from a more nearly integrated national strategy with respect to international water issues. We've heard that policy is moving along with respect to the legislation introduced by Senator Frist, Senator Domenici, no doubt there'll be others, and that might be very helpful in terms of pushing along that process. And finally, it strikes me time and time again on hearing the discussants here, that there's this iron triangle between energy and agriculture and of course, water, that needs to be understood more fully, and there may be some interesting follow-up work that we can do in that regard.

Erik Peterson: I would like to thank a number of people. I'd like to thank Peter and his team. It's been absolutely terrific for us to partner with Sandia in this effort. And Les Shepard is here in the back, thank you Les for being with us. And we were delighted to have Ambassador Robinson with us here yesterday. I'd like to thank my own CSIS team at the Global Strategy Institute, and above all Laura, would you stand up? This young lady has dedicated a big portion of her life to making not only the February but the March event possible. I'd also like to thank a number of informal advisers, who are here, and some who aren't, who have been a kind-of a quiet kitchen cabinet for us, as we push forward our deliberations. And finally I'd like to thank again our sponsors, ITT and also the support that we've received from Coca Cola and Proctor and Gamble.

Erik Peterson: Yesterday morning as Eric Webb read the statements from Senator Domenici, there was one statement there that I tried to scribble down verbatim, I think I got it. I think that the senator said, It is inappropriate and unacceptable to allow these conditions globally to continue. That is our task to try to unwind, to untangle this massive tangle right now, and to move things forward, and I thank you very much, all of you who have dedicated your time to being here with us, in helping us move that forward, and we hope to involve you in future occasions. So with that we close this conference. Thank you so very much for your participation.