

“...AND PROMISES TO KEEP”

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Good morning everyone. It is indeed a great privilege to be here to address you today. As the keynote speaker, I feel that I should provide some ideas and thoughts which you will keep in the back of your minds as you listen and participate over the next few days.

I have chosen to title my address "...And Promises to Keep" which I am sure you recognize as coming from Robert Frost's famous poem, Stopping by Woods on a Snowy Evening. I hope after I have finished speaking, the thoughts that prompted me to select that title will be understood. I liken my address to the poem because, like Frost, I cannot help but feel that we, you and I and the country we so dearly love, have not kept our promises... promises made in previous years, by us in the technical community and by our national leaders.

What were the promises? Why did we not keep them? And what shall we do about it? This is my theme. In 1977, then President Jimmy Carter declared a "War for Energy Independence" and we, the keepers of the energy grail said, "Yes, we can" Recall what we said we as a Nation would do. I quote now from the National Energy Plan of 1977 and the follow-up of 1979. By 1985, we would reduce our annual energy use growth rate to less than 2 percent per year.

We were going to reduce our dependence on imported oil to one eighth of our total energy consumption. We were going to reduce gasoline consumption by 10 percent. We were going to aggressively promote the development of new technologies for renewable energy with an expectation of achieving near 20 percent of our domestic energy from renewables by the year 2000. Two and one half million homes in the U.S. were going to use solar energy by the year 1985. We were going to reduce our energy consumption by 1/2 % through conservation.

Have we achieved any of these goals? The results are mixed. Some we did... but most we did not. Why not, you ask? Well there are several reasons, but the main reason is simply we, the technical community, didn't deliver. We didn't make the technological breakthroughs we promised. We have been successful at holding our annual energy demand growth to below the goal of 2 percent per year, primarily through conservation, BUT today, imported oil accounts for 40

There is growing evidence for a new type of energy which is neither nuclear or chemical. This has been called Zero Point Energy.

EDMUND STORMS,
PHYSICIST

percent of our total energy consumption, and it's expected to climb to 58 percent by the year 2010. [These figures give reality to the importance of Operation Desert Storm.]

Our gasoline consumption has decreased by only 2 percent, despite the introduction of more fuel efficient vehicles. In 1991, we consumed an average of 16.7 million barrels of oil per day, up from 7.3 million barrels per day in 1976. In 1990, renewable energy accounted for only 8 percent of the energy consumed in the U.S.

Today less than 1 percent (or less than 1 million homes) in the U.S. use solar energy. We had promised utility sized photovoltaic power systems and roof top residential systems. Where are they? We said by the mid 1990's, we would be producing photovoltaically generated electricity at a cost of around 5 cents per kilowatt-hour. The actual cost, for terrestrial applications is still about an order of magnitude higher today. We are 1000 percent from our promise.

For wind systems, we promised economically viable systems. Without the benefit of legislative mandates and tax incentives, these systems fall well short of viability. Again we failed our promise.

We said we could produce efficient, environmentally benign electric vehicles. Where are they? We still don't have a good, affordable electric vehicle battery and not much on the horizon even though a number of you are working hard in that area. We have fortunately begun to reassemble teams for their development, but cycle life and energy density still remain the challenge. Perhaps variations on the nickel-hydrogen battery which is now flying reliably in space systems can offer some reason for optimism. No matter that ideas like this were being worked 15 years ago.

We talked of modular fuel cells for utility application, converting natural and/or coal derived gas efficiently and cleanly for making electricity. Did we deliver? Are they commercially available? Almost? What of nuclear power? Fusion reactors may well be the ultimate solution to all the world's needs. Are we closer or are we farther away?

This summer engineering work began on the International Thermonuclear Experimental Reactor (ITER) Program, an international effort to achieve the long sought "break-even and ignition points." An exciting undertaking, but as Paul-Henri Rebut, the ITER Director said, "If ITER fails, fusion will be delayed a half-century or more.

"And what about hydrogen? It was promised as the energy fuel of the future... clean, abundant, non-polluting... to fuel our homes, factories, cars and airplanes. We seem to have lost interest.

These are a few of the things we promised over a decade and a half ago. Like vote hungry politicians, we promised easy solutions to hard, hard problems, and, perhaps like some of those candidates, we didn't deliver! Not our fault you say? "The marketplace didn't want these solutions" or "The price of oil dropped and remains too cheap," you say, or maybe it's because "our national political leadership abandoned the quest." Then whose fault is it... Mr. and Mrs. American Citizen's? No! It is not their doing, it is ours! You, and yes me, the

A new scientific truth does not triumph by convincing its opponents and making them see the light, but rather because its opponents eventually die, and a new generation grows up that is familiar with it.

20TH CENTURY. MAX PLANCK (1858-1947), FORMULATOR OF THE QUANTUM THEORY HAS LAID A NEW BASIS FOR PHYSICS, IN HIS SCIENTIFIC

technical community dropped the ball. We gave up! We lacked the will to lead and fight for the longer term benefit when the tide turned, and we went off in other directions like mercenary soldiers looking for the next war.

A lot of us who were in this army seeking efficiency and energy independence (perhaps the community that holds the long term viability of earth in its hands), found new tables to feed from... we changed our hats, embraced new goals and saluted new flags. Do I really blame you for this? Of course not! I am a realist too, as well as a sometimes hopeless romantic and optimistic futurist. The need to support graduate students, keep a healthy bottom line, keep the tyranny of Wall Street at bay, and pay the bills made us, maybe reluctantly, into a different kind of warrior.

How many kinds of warriors have you been or will you be in your career? How many times have we turned our backs on our former passions to seek new relationships with some new and glitzy newcomer whose allure is measured by the size of its purse? But has this been necessary? Are you and I obligated to forgo our beliefs and commitments? Are we forever going to abrogate our promises? Are we forever going to let our dreams die, our technical expertise wither, our passions cool?

That, my colleagues, is the crux of the real question you need to address. Let me rephrase it very simply. Do we believe and care enough to do what is right... what is right for our nations... what is right for our world? I think you and I have an obligation we have not delivered on.

We have an obligation to our nations and to the world to provide leadership. We have an obligation to make the hard choices and propose and demand, yes demand solutions, even difficult and unpopular ones.

In many ways we are at the junction in the path that Frost talks about in another of his poems, The Road Not Taken. In that poem Frost talks of two paths in a woods and says, "I took the one less traveled by, and that has made all the difference." To draw the analogy, think of the path we have been traveling. A journey begun with a rousing sendoff at the start. A sendoff characterized by national pronouncements, brass bands, press conferences, lofty goals and national commitments, and yes, even resources!

But after we had trod down the path for a kilometer or two, the voices of the critics and the naysayers begin to whisper from the dark woods through which we travel. Soon the whispers grow to an ebullient chorus, singing the critical song of discontent in an ever rising crescendo. You have heard their voices and the ever ringing echoes, the verses of their songs becoming more and more petulant, more caustic, more negative. These songs soon are joined by the brass instruments of those with other agendas... those who see profit in stopping your journey so they can plunder your carriage.

Soon we once again are debating the wisdom of the journey we are on. "Why," the chorus and band assembled shout, "are we doing this

Science and technology have raised human living standards for millions beyond all expectations, but social inequities, political stresses, and unreflective uses of technology have polarized humanity and degraded nature. They are creating problems of planetary dimensions. Global warming; the attenuation of the ozone shield; the menace of deforestation and desertification; the destruction of many species of flora and fauna; the extensive pollution of air, water, and soil; and the poisoning of the food chain are threats that all of us share.

WILLIS HARMAN

when we have so many other urgent needs? Why are we doing this when it is the responsibility of others? Why are we doing this when I could be using your carriage for MY special journey to MY destination... one, they assert loudly, that offers far greater reward than yours?" And so we debate again, endlessly it seems.

What is so interesting is that when we ask the same questions we asked previously, we now get strikingly different answers to the same questions. Now we have plenty of oil... now we have plenty of natural gas... now we have plenty of everything! No need to do anything. Let's move on to other more pressing priorities! So it goes, we start, we travel a little way, and then we quit. That is the path we are on my colleagues, and this is a path that is well trodden by others before us... their tracks visible in the clay of history.

Unlike Frost, we are taking the path trodden by others...a path well worn, littered with discarded commitments, broken promises and decaying ideals. Frost takes the path less traveled. That, I suggest to you, is what we should do as well. Maybe we need to take the path that is rocky and steep and not well lighted, and stay on our path no matter how loud the whispers from the woods become, no matter how bitter the environment, and no matter that the journey may be longer and harsher than we first thought and no matter that hidden behind the rocks are those who would ravage us and plunder our purses to fatten theirs.

Think of the journeys we have begun in the recent years. I have already mentioned the "War for Energy Independence." Two decades ago we went to the moon, not once but several times. Why did we go? Well, John Kennedy said it so well: "We go not because it is easy, we go because it is hard." The keys were leadership and commitment.

We had them then... we set tough goals, we met the challenges, we overcame the setbacks. We went to the moon and then [pause]... and then we quit. That is something people hundreds of years from now will never understand. We have now lost that capability. We now are farther away from being able to go to the moon than we were 25 years ago!

Remember the Solar Power Satellite concept? With its huge solar collectors orbiting the earth, beaming power down to an energy hungry world... a bold concept, utilizing space for terrestrial needs. Relegated to our bookshelves or file cabinets now. Why?

Was it too grand, too visionary, too hard? [A footnote: I have just returned from Japan at the International Space University where 100 of the world's brightest young professionals from across the technical, business and social disciplines in 29 countries are busy with a comprehensive design project on all aspects of this concept... There is hope! These ideas will be kept alive in many countries.

Remember our attempt to build an American supersonic transport... again we quit... it got too hard... the road was too long... the path too dark to see clearly. All these years later, we are starting over with a new supersonic program, the High Speed Research Program. So many years lost! Where might we be now if we had seen

If you know how it works – it's not new. If it's new – you will not know how it works.

Allow yourself to watch these new devices work! We will figure out how they work – later...

DR PATRICK G BAILEY

it through? And what about hypersonic flight, broadly supported or faltering??

Look back to this summer. The superconducting supercollider, an investment to penetrate the most fundamental properties of matter, is near termination. Another big start... another abandonment or pulled from the fire? How many of you know that NASA actually built and flight tested nuclear space power systems in the late 1960's.

But we stopped, we quit, we gave up. Now, more than two decades later, we have to start over. Will that be sustained? Do you remember our commitment to eradicate poverty in America? That journey has been halted and in fact the travelers on that path have retreated... as the echoes were too loud and the challenges allegedly too great.

What about our goals of civil rights and true equality? The wardens of distrust and bigotry seem to have halted that journey. How about the International Space Station Freedom? Boldly, we invest in the future to take a permanent habitat into space using the first electric utility in orbit. True to our recent history, we repeatedly downsize and re-scope the effort, pairing the capability down to the bone (at an even greater total cost by the way). And now we talk of quitting and push it almost to the brink. Not, my colleagues and fellow citizens, atypical in our world today!

We are now embarked on other national crusades. In the United States, education, as it should be, is in vogue right now. We have an Education President and Education Governors and Education Mayors and others. We all know how vitally important an educated citizenry is to our society. We are, we are told, going to be first in science and mathematics, assure that better than 95% of our children graduate from high school, and assure functional levels of competence in the basic skills.

Remember the Williamsburg Education Summit with its big press conferences and media events, the pronouncements, the speeches, the trumpets blasting that Wagnerian-like overture entitled a "New National Commitment." Will we see this commitment through either?

Schools in both rural and urban America are laying off teachers and staff, cutting programs as budgets are cut and tax levies fail. We even hear calls to challenge the public school system, once the bedrock of the American culture, in favor of a network of private schools. History will cast its harsh light on that question and its answer will be part of our legacy to those who will inherit our world.

American business has often been criticized for being short sighted, for only looking at this quarter's "bottom line." We have seen advanced technology, often paid for by tax dollars, abandoned to foreign competition by our business leaders because the time frame was viewed as too long. I am personally familiar with several examples... one, developed to the state of potential commercial application by the government, was pursued by an American company but then dropped when the buyout barons arrived on the scene. The Japanese are now pursuing its commercialization feasibility.

People see things as they are and ask why. I dream things that never were and ask why not.

GEORGE BERNARD SHAW

Coal-based Integrated Gasification Combined Cycle (IGCC) was developed and first demonstrated in this country in the mid-1980's.. but the first commercial prototype will be installed in the Netherlands next year. These are not uncommon stories and you each can add your own vignettes I am sure. The wisdom of establishing an American Industrial Policy (the politically correct term) is evoking intense debate and whatever evolves may be a factor in the way American business operates in the future.

It was once believed that government had that special obligation to invest in our longer term needs... it was acknowledged that major national commitments were often decades in duration. We once accepted and practiced that belief... but now the pressures are intense for government to focus more and more on current needs and to sacrifice the strategic investments in our future.

Like Mr. and Mrs. American citizen, our national bank account is being overdrawn so we can consume now rather than invest for tomorrow... and the bill is being sent to our children. "Please pay promptly," it will say, "or your privileges will be suspended." A question that begs to be asked: To whom will they make out the check? I don't know if you enjoy and read history like I do, but any examination of past civilizations, in particular those that flourished and prospered, shows they practiced boldness and commitment. But history also shows that when doubts creep in and the whisperers begin to have the ear of the leaders, when the naysayers' and the exploiters' voices are so loud that their shrill drowns out the reason and rhetoric of the committed, decline finds its point of entry and begins to fester in the timbers of the society... that the pervasive fog of negativism blocks the light from reaching into the debate, and as soon as the last flicker is extinguished, the cold night swallows them forever.

Perhaps I am getting too philosophical here for the keynote address to a technical conference... but I hope you bear with me and don't take my admonitions for other than what they are intended to be...an alert, if you will. A clang or maybe in the words of a popular TV commercial, "a Cha-Ching," a loud noise designed to get your attention... not to sell you hamburgers, but to sell you a notion. A notion that we must take a far different path than the one we have been following.

We must because, my colleagues, the path we are on is not getting us to grandmother's house, it is the road to the wolf's lair! It may be very appropriate to give time to these issues right now as we in the U.S. are embarking on our quadrennial presidential campaign season. The issues of leadership and national commitment ought to be on the menu of discussion and debate. And if the candidates are timid in discussing these issues, we should demand their views and demand they share their solutions to our crisis of commitment.

We should ask why we are afraid to be bold, why we are afraid to make hard choices, why we are afraid to lead, why do we succumb to the forces of negativism and doubt? We have seen changes of profound and yes, epoch defining proportions in the world in recent

The very greatest things, great thoughts, discoveries, inventions, have usually been nurtured in hardship, often pondered over in sorrow, and at length established with difficulty.

SAMUEL SMILES

years. Changes that the pen of history with its indelible ink, will record and put into context.

But we react strangely to this new world. We are simultaneously optimistic and pessimistic. We rejoice in our successes and then demean our motives. We praise our technology but then damn it in the next breath. We clamor for more but deny our responsibility to pay and persevere through the difficult times. We stress the here and now, and ignore the hereafter. We ask for faster, better, cheaper but will not quench our appetite for big and expensive.

In my mind there is no question about our abilities to find solutions... no questions of our technological acumen... and no question about our needs. The only question is: Are we going to take the path less traveled? For my colleagues that will "make all the difference!"

In this brave new world we face, we must find new ways of doing our business. We are going to be faced with increasingly scarce resources in a time of increasingly severe problems, not only in the energy arena, but in many aspects of our lives. To enable us to continue viable and productive research and technology programs, in order to avoid quitting yet again in mid-journey, we the technical community must find new economies, new approaches and new ways of "getting on with it."

In NASA the words are "Faster, Better, Cheaper, Without Compromising Safety." I think those words may be applicable here as well. We must collaborate more, share our ideas, share our facilities and yes, even our people. To quote Edzard Reuter, Chairman of the Board of Management at Daimler-Benz, talking about future technologies, he says, "The technologies vital to our future can be researched and developed only through global cooperation, which calls for pioneering strategic business alliances unhindered by bloc mentalities... and it will be not so much policy, as technologies and markets that will cross borders and promote integration the world over."

That broad based technology has been and will continue to be the engine of economic growth and the catalyst for human progress is, I think, acknowledged by most of us. However, as the mathematicians say, "That is a necessary but not sufficient condition." By itself, technology will not assure success. That team of horses that pulls Robert Frost's sleigh along the path less taken, must pull together for the common good on the journey. Like a solitary horse, technology cannot pull the sleigh alone. It must work in harmony with others on the team... others with names like leadership, government-private sector partnerships, national will, environmental commitment, international cooperation, and social justice, to pull us up the steeper hills.

As we follow the path, we will be guided by a combination of our intellect, our training, our experience, our instincts, and the driver's gentle tugs. Please let us work together as colleagues to set the direction and keep our journeys, once undertaken, on the path of progress, moving forward, regardless of the steepness of the path or the

**Whoever
undertakes to set
himself up as a judge
in the field of truth
and knowledge is
shipwrecked by the
laughter of the gods.**

ALBERT EINSTEIN

whispers from the trees. The generations that will follow us depend, critically on you and me. We must engage ourselves and look beyond our perceived limits of influence. That is the legacy we should leave... that is the duty we have.

I trust that the conference will provide you all the opportunity to discuss and share, challenge and debate, define the problems and suggest the solutions. Our obligations as technical leaders and innovators are real and of more importance now than ever.

Thank you for the opportunity to speak this morning and for your willingness to listen to me struggle with reality as a humanist, and yes, still an optimist. In closing, ponder the challenge, symbolic of [Slide]: America at the Threshold and the poet's closing line: "But I have promises to keep, and miles to go before I sleep..."

Although I am convinced of the truth given in this volume...I by no means expect to convince experienced naturalists whose minds are stocked with a multitude of facts all viewed, during a long course of years, from a point of view directly opposite to mine...but I look with confidence to the future, to young and rising naturalists, who will be able to view both sides of the question with impartiality.

CHARLES DARWIN
(1809-1892), FOUNDER
OF THE THEORY OF
EVOLUTION BY
NATURAL SELECTION,
IN HIS ON THE ORIGIN
OF THE SPECIES.