# From the Laboratory to the Marketplace . . . and the Policies to Make it Happen

A Joint Workshop of the International Energy Agency
Working Party on Energy End Use Technologies (EUWP)
*and the*
Working Party on Energy Efficiency (EEWP)

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Summary Paper


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## Summary Paper

**Introduction**

The road that a technology follows from basic science to deployment is complex and not widely understood. Rather than a linear progression, the pathway includes multiple mechanisms that integrate basic science, applied research and development (R&D), demonstration, commercialization, and deployment in a cyclical process. In addition, both end-use markets and public policies significantly impact the technology development pathway through feedback and direct governance. Many of these interactions are often overlooked by the scientific and policy communities.

The workshop was held on October 8, 2003 in Washington, DC. It was co-sponsored by the International Energy Agency (IEA) and the Office of Energy Efficiency and Renewable Energy in the U.S. Department of Energy (DOE). Sixty experts from 19 IEA Member Countries as well as officials from the IEA attended the workshop.

The purpose of this workshop was to assist the IEA and its member countries to obtain a clearer understanding of the various linkages and feedback mechanisms that exist along the technology development pathway and the policies to help move technologies to the marketplace. In addition, the workshop was designed to identify transferable lessons useful to IEA member countries, as well as opportunities for further collaboration across the Energy End-Use Working Party (EUWP) and Energy Efficiency Working Party (EEWP). Participants discussed topics both in the abstract and through case studies. For each session, key points made by the speakers are summarized. Observations made by participants from the audience are also presented. Suggested IEA Actions Items, for consideration as follow-up activities to the workshop, are presented in the appendix.

**SESSION 1: Workshop Overview**

The speakers were Richard Moorer, Deputy Assistant Secretary for Technology Development, U.S. Department of Energy; François Moisan, Director of Strategy and Communication at ADEME and EEWP Chairman; and Peter Cunz, Head of the Economics Section at the Office Fédéral de l'énergie and EUWP Chairman.

Deputy Assistant Secretary **Richard Moorer** gave the welcome and opening remarks for the workshop. He remarked that the United States supports international collaboration on energy issues. He expressed his appreciation for the EEWP's and EUWP's focus on solving common problems that can be solved in the spirit of international collaboration. Richard Moorer said it has also been clear to many at the IEA and to member nations that the intersection of policy, technology development, and deployment is often critical to the success of collaborative ventures. He believed that the workshop would allow the delegates from each Working Party to share experiences about ways to better integrate basic science, applied R&D and deployment, and the use of policies to drive technology development and implementation. He believed the workshop would be a success if participants could take three objectives as their own – (1) learn about the experiences of others in advancing energy efficiency, (2) take what they learn about successful actions back home to implement in the next 3 - 6 months, and (3) plan to influence their governments to take advantage of the lessons learned and support implementation of identified IEA actions by the IEA working parties.

**François Moisan** offered the energy efficiency policy perspective to help set the stage for discussions during the workshop sessions. He reminded the participants that success with "technology" is a combination of R&D, market "know how," and appropriate policy. Besides R&D, we need to take into account market expectations (what consumers want) and appropriate policies.

**Peter Cunz** provided the technology perspective to help stimulate discussion in subsequent sessions. He noted that the EEUP Implementing Agreements (IAs) are not unified in their treatment of deployment; some have undertaken studies while others have not. He expressed the view that it does not make sense to develop technologies without knowing how appropriate policies will help achieve successful market penetration. For a given technology, it would be helpful to better inform the R&D community on "how much policy is necessary and when?" Peter Cunz noted that a consideration of behaviour during the technology research cycle is another important issue. The IAs are encouraged to make the links between research, deployment and policy.

Several early messages that emerged from the opening remarks are:

- ***The nature of R&D is changing***. There is growing recognition that the nature of R&D has changed significantly. The pressure on technical product developers to get their products "to market" has increased dramatically along with the growth in worldwide R&D competition. As the technical content of products grows increasingly complex, financial requirements may outstrip the resources of many companies and some governments.

- ***Innovation is a socioeconomic compromise***. New products result not just from technological innovation itself, but a compromise between technology, market climate, and social factors. Over time, R&D and experience with technology decreases cost while increasing performance and market penetration. Overall "time to market" depends on the speed of both the R&D and market turnover (if there is an existing economical alternative, adoption will be slow). This can be circumvented through either a more rapid introduction of energy efficient technologies or regulations or incentives that promote replacement of old technology.

- ***Behavioural changes are central to the adoption of new technology.*** These changes must often be spurred by policy or economic incentives. Identification of the behavioural attitudes of the public about energy use and the environment can highlight areas for policy change and facilitate acceptance of new technologies.

**SESSION 2: Panel Discussion - Technology and Policy Interactions**

The speakers were John Millhone (Director of the Office of Weatherization and Intergovernmental Activities Program, DOE); Tony Marker (Manager, Energy Appliances and Transport, of the Built Environment and Communities Branch, the Australian Greenhouse Office); and Hans Otto Haaland (Advisor, Industry and Energy, the Norwegian Research Council).

**John Millhone** commented on the roles the IEA plays in facilitating technology innovation and diffusion, discussed opportunities for the IEA to work with developing countries, and made suggestions for future IEA goals. He noted that the IEA provides a forum for idea exchange, brings together emerging concepts about energy efficiency, and facilitates continued progress in technology innovation and diffusion -- from identification of needs and concerns common to many countries (so that replication of past successes in IEA nations may be instituted), to developing metrics (identification of current markets and ways to quantify current scenarios), to implementing standards (where to place regulations and what to regulate), to conducting research (increase top-end), and to final market transformation. It is important for IEA to continue to function in these roles.

**Tony Marker** presented the energy efficiency element of the Australia's National Greenhouse Strategy, focusing on the National Appliance and Equipment Energy Efficiency Program. Australia has nationally consistent product energy end-use standards and labels. These regulations (i.e., minimum standards, labelling) rely on technical details for products to be set out in Australian standards called up by State laws. Although regulation can influence markets, regulation is often complex and testing and compliance monitoring can incur substantial costs. Though there is some debate on the effectiveness of using standards to bring a technology to market, Australia has seen great success with its labelling program, and consumer focus groups have expressed a desire for labels for gas and water use and other products similar to the current energy label. The labelling program is dynamic; it is restructured or recalibrated as new technologies are developed. In one example, the government made a policy decision to increase refrigerator efficiency through standards and labelling. Tony Marker stated that Australia intends to put a "high-performance" standard into the first set of efficiency standards promulgated. This would convey to the market that, in 4 to 5 years, the minimum performance standard (part of the first set of standards) would increase to a level that is not more than the already-known high-performance standard. This will provide security for companies to support an 8-10 year window for (research and product) investment.

**Hans Otto Haaland** reported on the Norwegian government's response to recent increases in Norwegian power costs due to a shortfall of water in hydropower reservoirs. In 2003, the Ministry of Petroleum and Energy launched an ad hoc conservation program offering investment aid to households for the use of air-to-air heat pumps, wood pellet stoves, and energy management systems. The choice of technologies for the program was not based on standard requirements for cost-effectiveness and energy pay-back. The program could have been better designed had the research, development and demonstration (RD&D) community been better prepared to analyze alternative policy responses.

Hans Haaland noted that the IEA offers some of the "best" tools" to spread knowledge about policy solutions. He mentioned three examples.

- The IEA book "Creating Markets for Energy Technologies"
- Participation in Implementing Agreements
- The OECD / IEA case studies on innovation in energy technology

He also described several challenges the IEA still faces:

- Develop and share knowledge and experiences about successful market solutions, technologies and policies to reduce negative environmental impacts and decrease energy consumption
- Give greater attention to small scale solutions that are seldom considered (such as, distributed generation and energy-efficiency investments)
- Develop more activities to combine technology R&D (innovation systems R&D, technological systems) with research on cultural and behavioural aspects of energy use and new technology, policy analysis, and demonstration and dissemination.
- Demonstrate more sustainable solutions aimed at achieving less energy intensive structures, decreasing consumption, and combining technology/innovation/behavioural aspects (e.g., EU "eco-cities").
- Provide greater access to knowledge for users of IEA output, through national representatives in Implementing Agreements, a network of technology and policy experts, written reports, analysis, recommendations, information centres, and improved transfer of knowledge (here the challenge lies in synthesizing the lessons learned and making them applicable and useful in a national setting).

## SESSION 3: First Case Study: Building Technologies for the Future

**Egil Öfverholm**, Expert, Department of International Affairs in the Swedish National Energy Administration (STEM) presented a case study on building technologies for the future**.** He provided a portrait of the issues and challenges facing researchers and policy makers in the buildings sector. The vision for 2050 is a future with nearly zero environmental impact from buildings. Demand for new buildings will closely follow population growth, which will be cantered in urban areas and in developing countries. Climate challenges include global warming and the creation of urban heat islands due to concentrations of population in urban areas. Between now and 2030, air conditioning will become widespread, solar thermal and photovoltaics will be used more commonly and will become integrated into building design, micro-turbines and fuel cells will be installed in buildings, and the use of artificial intelligence for energy management will become more common. Between 2030 and 2050, local renewable energy systems and underground storage with district heating will become more common. Beyond 2050, urban renewal will take place alongside of a sophisticated wireless electric grid infrastructure. For basic R&D, the current gaps are in the areas of indoor air quality, materials by design, and life cycle analysis. For applied R&D, the current gaps are systems integration and applied materials. The major obstacles to buildings technology development are the fragmentation of the building industry, the inability of the industry to pay for R&D, and building codes (often cited by industry as creating bureaucratic barriers).

Egil Öfverholm suggested that the IEA pay attention to the new EU building energy regulations (energy performance directives in the EU) which will drive the creation of many efficiency codes, labelling efforts, etc.  This can have a dramatic impact on the price of houses, and therefore on the market overall.  The IEA is encouraged to follow this "story" as it progresses.

Egil Öfverholm concluded his presentation with some observations about the relationship between research, demonstration, and deployment.  He noted that although the ideal relationship is illustrated in Figure 1, in practice (for most countries) the typical relationship is depicted in Figure 2, where stages of technological research, development, and deployment are loosely connected and sometimes oriented in different directions.

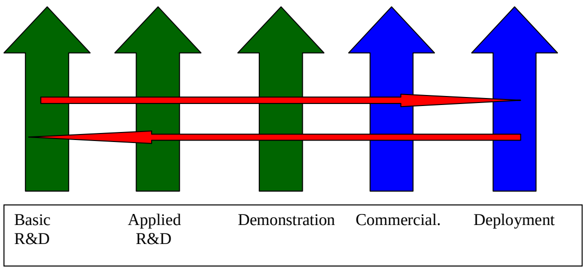


**Figure 1:  Ideal Relationship**
(Source: Egil Öfverholm's presentation)

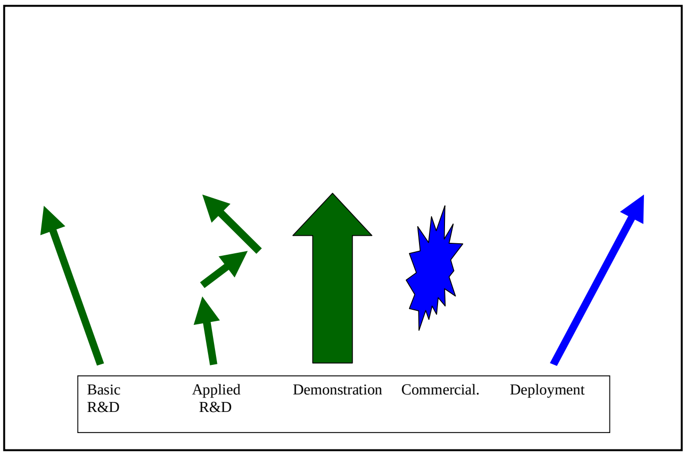


**Figure 2:  Typical Practice**
(Source: Egil Öfverholm's presentation)

Additional points raised by Egil Öfverholm during this session include**,**

- ***R&D produces choices for policy***.  It is critical to understand the cyclical nature of R&D and (as necessary) set policies before R&D occurs, not after; without appropriate policies the path to successful commercialization of R&D may be doomed.  However, policy should not get too far ahead of current technology/knowledge.  Once policy has been established, it is important to consider social as well as economic and technical factors in setting the R&D agenda.  Coordination of the five R&D pathway stages, a very difficult proposition, is necessary to keep goals aligned.

- ***Between demonstration and commercialization lies the "Valley of Death***."  The "Valley of Death" is so named because it is the state where developing technologies are most often abandoned.  There are very few examples of technocrats escaping the "Valley of Death" in the buildings sector.  In one successful example, the Swiss are using public commissions and commissions from banks as a reward for energy efficient buildings – this has greatly stimulated architects to examine new options, as well as R&D and implementation, after which standards can be raised. One has to address the integrating relationships between basic R&D and deployment; in this example, it would be the relationship between architects and engineering students.

- ***Participants along the R&D pipeline have different motivations.*** Differences in perceived problems between participants at different stages of the R&D pipeline can undercut the pace of development and effectiveness in implementation. For instance, in basic R&D, many participants are driven by the desire to be published in journals and achieve individual recognition for their accomplishments, while product promoters are attempting to maximize profits, and policy makers are striving for public benefits, such as energy savings. This disparity in objectives often leads to redirection of technologies along the pipeline, which is very difficult to control.

- ***Commercialization is the most difficult part of the R&D pipeline process.*** It seems easier to solve a very complex technical issue such as putting a man on the moon than to solve climate issues through energy efficient technologies (e.g., energy-efficient buildings). The reason for this is that the "moonshot" was only a technical issue for NASA; there were no products to commercialize.

- ***Successful market mechanisms require an informed consumer.*** To aid the development and introduction of new technologies, an informed consumer is necessary. Labelling and ratings are crucial for consumers to differentiate between products. An adaptation of the labelling concept may be applicable to the building sector, which is a special sector in the marketplace because of its long capital turnover rate (between 50 and 75% of today's buildings will remain in 2050) and the fact that buildings sector R&D is a magnitude lower than in comparable areas such as energy production systems. Two examples were provided.

    - For commercial space, energy costs should be disclosed to the tenant by separating them from the rental cost. This would add an incentive to build energy efficiency into rental cost calculations and illustrate to the tenant what costs/savings were related to energy efficiency.

    - In the residential sector, energy ratings for plans/houses would increase the incentive to purchase an efficient structure. These standards must be enforceable; compliance is critical, and it is not enough to simply have the standards in place if they are never met. One concept is to use "stars" or some other signifier to characterize the energy efficiency of a house, so that when the owner sells the house, he must obtain an energy rating, and that information will be used by the purchaser to make an informed decision.

- ***User behaviour is an important part of performance measure formation***. In order to determine building performance measures, one must first take into account both technical characteristics and behavioural information. The technical side is the "easy part." A technology focus will not get us to environmentally neutral buildings – behaviour is a critical factor to be addressed. Ninety-five percent of the energy efficiency potential is fixed by design before the construction drawings are produced. Many billions of dollars could be saved by considering user behaviour. Building designers, occupants, and business leaders should be consulted to determine behaviour in buildings.

- ***A systems approach to R&D can either help or hurt technology commercialization.*** Nations must be careful not to gear policies too closely to one particular technology or else subject themselves to a high level of risk. A preferable approach will allow for an integrated portfolio of technologies. "Technology push" is problematic in this regard and suggests a systemic approach. On the other hand, it can create a perceived "free rider" problem among component manufacturers. For example, in the building industry, the government can require windows to have a certain "U" value (market push) and enforce such standards. Yet if a systemic approach is used, and the entire building envelope is assigned a mandatory "U" value, it is often unclear to the window manufacturer why it should make windows of a certain "U" value. Manufacturers must be encouraged to understand and react to the entire market and how their components interact with others, especially in a market with little emphasis on R&D.

## SESSION 4: Second Case Study: Lost Foam Metal Casting

**Robert (Buddy) Garland**, Director, Industrial Technologies Program in the U.S. Department of Energy, presented a case study on lost foam metal casting. The presentation covered the basics of using a lost foam process for casting complex metal parts. According to Buddy Garland, 30-40% of DOE's work with industrial technologies is in searching for revolutionary technology; 20-40% in evolutionary technology; and 10-20% in "marketing" (i.e. technology transfer and outreach activities.) He discussed the history of DOE's activities in lost foam metal casting, and the lessons learned, including:

- ***Policy, technology and markets are linked.*** Success in the development and implementation of a new technology requires the coordination of three distinct groups: policy, technology, and market. The impetus for development can originate from any of these three (a stipulation for improvement though policy, a desire from the technical community to improve or simplify process, a market demand for more efficient processes), but coordination of all three is ultimately essential to realize the desired goal, as indicated in Figure 3 for lost foam casting. In the case of lost foam, a government action helped move forward a particular technology where the R&D process had broken down and the product may not have been deployed. The industry members alone would not have been able to achieve this success.

- ***It is critical to demonstrate cost savings to equipment suppliers.*** The government can play a role by providing equipment suppliers with information that demonstrates real cost savings through energy efficiency to make up for imperfect information in the marketplace. This is a very important factor in getting a company to carry through a technology to demonstration.

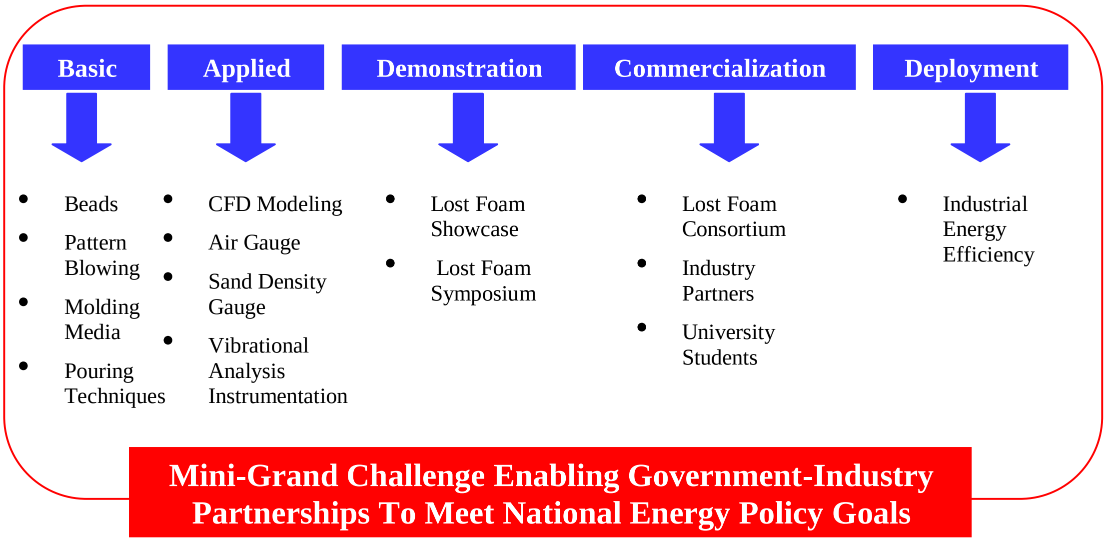


**Figure 3. Full Cycle of Government-Industry Collaboration for Lost Foam Metal Casting**
(Source: Buddy Garland's presentation)

- ***Federal risk reduction, both technical and financial, is key to commercialization***. In the past, the U.S. Department of Energy has helped to address risks by setting goals and instituting programs to help move technologies to market. Additionally, industry is more inclined to reduce energy use if government provides funding for primary R&D and new equipment. In the case where the government provides R&D funding support, it is not directed to one particular company, but is provided for the development of a technology in general. By providing funding to universities and making results available to all industries, the government may unite efforts without funding already thriving industries, and support industry efforts while staying neutral when markets overlap. The government could potentially secure the commercialization of the product within the marketplace before the R&D process even starts. The government's role may continue even after technology is operational and commercialized, as basic and applied research and demonstration for advanced 'next generation' technology is pursued.

## SESSION 5: Third Case Study: White Certificates and Their Impacts on Energy Efficiency Research

**Hans Nilsson**, Chairman of the IEA Demand Side Management Program, presented a case study on energy efficiency certificates (White Certificates). White Certificates are tradeable (to improve cost efficiency), their value is derived from imposed scarcity, and they release hidden potentials (opportunities not realized by laissez-fair markets). They are neutral to technologies and delivery and use market mechanisms for delivery.

Hans Nilsson made the point that markets select the winning technology, but only from among the options available; technologies that are not being marketed are excluded from being selected in a certificate market even if they provide benefits. He discussed the implementation options for White Certificates, and gave some examples of actual applications in Italy, New Zealand, and the U.K., with discussion of the impact of these programs on adoption of new technologies.

Hans Nilsson suggested two ways (among others) that White Certificates could have an impact on technologies and applied R&D:

- Impact on R&D could be induced by volume, and by attracting more (and some new) actors to the scene.
- By changing the willingness-to-pay for challenging technology in target or niche markets, as indicated in Figure 4.

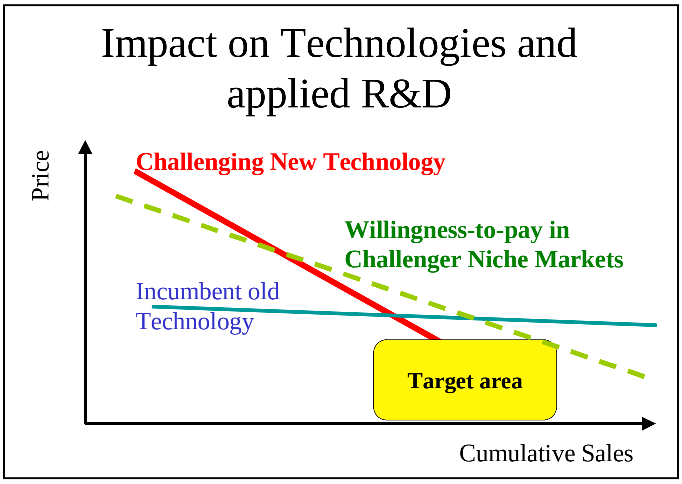


**Figure 4. Impact of White Certificates on Technologies and Applied R&D**
(Source: Hans Nilsson's presentation)

Hans Nilsson emphasized the importance of engaging end users to ease market penetration and ensure the participation of industry. Pay-back gaps can lead to missed opportunities for technology deployment. White Certificates can address this problem by increasing volume and/or investment.

He also emphasized that before beginning a research effort, the research organization should identify how the market works, including market dependencies and value chains within the market, in order to understand how to approach the industry. In His discussion of value chain of energy efficiency products he pointed out that at least 2/3rd is handling (installation, distribution, operation, service, etc.), and this handling is full of technology, both hardware and software.

From the perspective of technology learning and demonstration, organizational learning is an important issue. Understanding "who is there to learn from" and "what there is to learn" warrants greater attention. Because few research organizations have the expertise necessary to assess industry organization and business economics, there is significant potential for problems in research and technology transfer efforts. This raises several questions -- "How should behavioural, policy, value chain considerations be treated by the IEA working groups?" and "Who should conduct value chain analyses – the EEWP or EUWP?"

Hans Nilsson concluded that,

- Success in achieving energy efficiency is only partly a technological issue.
- Organization and business economics are more important and should be subject to specific research efforts.
- Focusing on low-cost and neutral instruments will never release “learning investments” for *new* technologies.

**<u>Discussions From the Floor During Sessions 1 Through 5</u>**

After each of the speaker presentations, participants from the audience shared their own experiences and made additional insights. The following are some of the key points made during discussions in sessions 1 through 5. These points are not tied to any particular presentation, although reference to specific end-use sectors is made in some cases.

*Policy considerations* --

- It is important to distinguish between policy instruments where the point of entry is technology-specific and policies whose development is motivated by broader national interest. Policy instruments cannot necessarily be selected on a technology-specific basis; variety of policy instruments are often needed to address broad national challenges. Member countries have to be flexible in choosing policy options based on changing market conditions. It is important to identify national policy priorities and criteria for energy efficiency to guide R&D investments.

- Participants noted that policies necessary to ensure success of a R&D program may need to be considered before the research and development is concluded, not after. It may be necessary to perform research design with consideration of policy along the way. This may be especially true for new technologies and for technologies that require new and different supporting infrastructure. Several key questions to consider are:
    - "When is it appropriate to initiate standards development, labels, information and other policy measures in the timeframe of R&D?”
    - “Why and when is it appropriate to introduce policies to help move technology from the research laboratory to the marketplace?”
    - “Is there a natural order for introduction of different types of policy instruments?”

- Nations should not forget the dominant role that price plays within the marketplace. One study mentioned at the workshop shows that price is the dominant consideration (50%) of the buyer of any energy-intensive product, followed by energy consumption (40%). Keeping in mind that price plays a dominant role, successful approaches to the deployment of an energy-efficient product must include a way to dramatize the energy efficiency, environmental, and life cycle benefits to the buyer.

- In promoting technology development and policy, countries have to consider how best to avoid interfering in the market, so as to be fair to companies not participating in government initiatives.

*Integration among craftsman* –

- Integration among sector craftsman can lead to great savings. For example, in the buildings sector, architects can strongly influence the need for heat/air conditioning energy consumption if there are more opportunities for them to interact with the builders during critical design stages. Through better integration engineers & architects working together to reduce energy consumption may well succeed in finding profitable ways to link energy efficiency to high standards of living. This does not happen much in the building design and construction industry, however, due to the fragmentation of the industry and component nature of craft work. Integration of architects, engineers, and home builders could be done in universities, to lay groundwork for integration in future generations of professionals.

*Partnerships* –

- There was some discussion of ways to manage research partnerships. A partnership approach works to get different industry players (preferably including both large and small companies) to work together toward a set of common objectives. Broader partnerships increase the probability of technical and market success. In order to get buy-in, it may be easiest to start with R&D on technologies with a short-term payback, and then get industry to continue the work with longer-term efforts. Partnering with leading companies in industry helps government-developed technologies gain more credibility in the market. Getting industry buy-in early in the R&D process improves chances for successful commercialization. By identifying barriers and objectives and finding areas of common mission, partnering can lead to areas for logical collaboration and identify the pathways to achieve success. In addition, for some countries, engaging universities in partnerships helps alleviate intellectual property concerns. Engaging end users increases the likelihood of market penetration.

*Financial incentives* –

- Many governments provide financial incentives/ disincentives, such as low interest loans or tax policy, to encourage industries to collaborate on developing and using energy efficient technologies.

    - For industries where energy is a relatively small proportion of costs, such as rubber and plastics, it may be difficult to get companies' attention. One way of gaining their interest is the provision of low interest loans.

    - Tax policies, such as credits for specific technologies, favourable depreciation, capital allowances, and taxes for non-compliance penalties, can be a very effective way to encourage technology changeover or to stimulate energy efficiency investments. The UK utilizes an enhanced capital allowances program which offers low interest loans for companies with low energy use.

    - In some countries, the threat of imposing taxes if voluntary action is not taken is a sufficient incentive.

It is important to tailor the use of financial tools to the stage of development/deployment of technologies. Tools such as loan guarantees and financial assistance may be more cost-effective at intermediate stages of development than R&D grants because they are more effective at leveraging private sector investment.

*Negotiated/voluntary agreements* –

- Negotiated and voluntary agreements using ‘sticks’, or ‘carrots’ or both are in wide use in many IEA member countries. Negotiated and voluntary agreements have broad and varied application in different countries. Switzerland has introduced $CO_2$ emission laws with a threat of a carbon tax. This threat has enabled the government to work cooperatively with industry to lower carbon emissions, and has generated good partnerships in industry. Other countries have forms of voluntary agreements that aim to gain industry commitment to develop and use energy efficient technologies. Governments may provide incentives, such as fund or co-fund energy audit teams, to help companies identify energy savings and emission reduction opportunities. In this situation, it may also be helpful to use energy auditors to identify opportunities for cost sharing the risk of implementation, in order to ensure compliance with the agreement. Audit support to companies could also help facilitate tracking/assessing the impact of the agreement on participating parties.

*Small companies* –

- Special efforts need to be made to engage small companies who lack the resources that larger companies have. For smaller businesses, technical assistance in the form of financial planning for investments can provide the incentive needed to develop interest in new technology. Also, smaller businesses can benefit from third-party financing and best-practices workshops. Government programs could also establish integrated small & large company teams and provide funding for post-R&D information dissemination. This would encourage large and small companies to team together on R&D solicitations.

*Aggregation* –

- Aggregation of purchasing power (through mechanisms such as technology procurements and the Clean Development Mechanism) both for components and systems are approaches that have shown some success. For example, government purchasing (large and early purchases) helps drive down cost for the public and is widely used in IEA Member countries and elsewhere.

*Information dissemination* –

- Having ample resources devoted to educating industry decision-makers of the relative merits of energy efficient technologies is an important success factor. This could include, for example, best practices workshops, conferences and trade shows to convince small companies that energy efficiency technologies really work.

*Industry champions* –

- In order to penetrate an industrial sector, it is very helpful to find an industry champion to work on introducing the technology.

*Intellectual property rights and licensing* –

- In some countries, intellectual property law and licensing could be used to enable financial gain from research.

## SESSION 6: Synthesis and Wrap-Up

The speakers included Peter Cunz (EUWP Chairman), François Moisan (EEWP Chairman), and Buddy Garland the DOE host of the workshop.

**Peter Cunz** said the workshop participants had provided many good ideas, and that it was clear that different countries operate in different environments, but all have experienced a "Valley of Death" along the pathway from basic research and technology development to commercialization. He noted that IEA has a role to play in helping to identify technology and policy solutions to national energy and environmental challenges. He noted that his own country, Switzerland, being a small country, always looks to see what other countries are doing as a first step, and usually find that other countries' experiences do not apply to Switzerland. Peter Cunz noted that a strong dialogue is needed across diverse areas – he called it dialogue a between continents.

**Francois Moisan** remarked that it is too early to draw conclusions from the workshop. He noted that, during the discussions, technologies were often the "entry point" for discussions, more than markets, with market/economic instruments addressed toward the end. Understanding that there is a complex relationship between policy and technology, that technology does not drive policy, and that broader policy considerations are technology-neutral, Francois Moisan remarked that workshops such as this are essential and need to be continued.

**Buddy Garland** thanked presenters and facilitators for their work in making the workshop possible. He said that the coming together of the Energy End-Use Working Party and the Energy-Efficiency Working Party generated much productive information/experience sharing and exploration of possible future collaboration opportunities. This event reinforced his belief that "far from needing to be compelled to work together, perhaps the two Working Parties are finding that they simply can't work apart.".

### Ideas Suggested by Workshop Participants for Follow-up IEA Action

The Appendix provides a list of general ideas suggested by workshop participants for IEA collaboration. The Working Parties have to take the next step to move from general to more specific notions of collaboration. This will require (1) reviewing the ideas listed and further defining them, (2) prioritizing them, and (3) developing one or more joint EUWP-EEWP projects (perhaps for the 2005-2006 Programmes of Work) that have greatest potential for benefit to IEA Member Countries.

# Appendix/

**List of IEA Action Items Suggested by Speakers and Audience Participants**

Ideas are organized into four categories.

- EUWP/EEWP Coordination on R&D Stages, Deployment, and Policy Integration Issues
- Social and Behavioural Dimension
- Collaborative EUWP/EEWP Workshops and Use of Work Products
- Organization, Communication, and Dissemination of Information

## A. EUWP/EEWP Coordination on R&D Stages, Deployment, and Policy Integration Issues

***Work Together to Identify New Collaborative Ventures to Incorporate in their Respective 2005-2006 Programmes of Work***

- The *EEWP and EUWP* should assess their tools and strengths to determine the best ways to integrate stages of R&D and streamline the pipeline process. The intersection of policy and technology development is also critical to success; this is especially true for new energy technologies. Increased attention to integration issues can help to advance progress on global energy and environmental problems.

- The EEWP-EUWP could conduct a joint survey to identify "specific" opportunities for improved policy-technology collaboration. Collaboration begins with knowing what the specific opportunities are. The EUWP and EEWP could move from general to more specific notions of collaboration by surveying their work products to identify which technologies and policy study areas match up across the two Programmes of Work. For example, a useful initial step could be to survey the EUWP Implementing Agreements (IA) and work products to identify where specific policy issues are critical for "deployment" of the targeted IA technologies.

***Link IEA Technology and Policy Databases.*** Creating mechanisms to enable communication between technology and policy databases should be pursued where possible. The working parties could explore the potential for linking existing IEA technology databases with its extensive energy efficiency and climate change policy databases. This would help experts from the R&D and technology development community discover what policies might be applicable for targeted end-use markets. Connected databases would also help shed light on several questions –

- "When is it appropriate to initiate standards development, labels, information and other policy measures in the timeframe of R&D?”

- “Why and when is it appropriate to introduce policies to help move technology from the research laboratory to the marketplace?”

- “Is there a natural order for introduction of different types of policy instruments?”

***Increase Sharing of Experiences and Knowledge on Feedback Loops in R&D and Integration across Commercial and Research Communities.*** The IEA is encouraged to promote increased sharing of experiences and knowledge among IEA Member Countries on feedback loops in R&D. This can help member countries better understand the ties between technological advances and policy decisions, which in turn leads to energy and environmental benefits. Also, better integration of activities across the commercial and research communities is desirable. Mechanisms for sharing technology and policy experiences and knowledge across different communities and disciplines should be pursued wherever possible.

***Strengthen Interaction Between Building Sector Craftsmen.*** As noted in the workshop discussions on the buildings sector, fragmentation in that sector is a major barrier to innovation and accelerating market penetration of technologies. The integration among craftsman in the buildings sector can lead to great savings. However as previously noted, this is difficult to achieve in the building design and construction industry due to the cost of producing buildings and housing. The IEA could potentially play a role by developing resources/tools, and creating collaborative learning opportunities, for member countries to use to achieve better integration among architects, engineers, and home builders. This can be done early, in universities, to lay groundwork for integration in future generations of professionals.

## B. Social and Behavioural Dimension

***Conduct Studies on Consumer Choice and Value Chain, and Promote Exchange of the Results across the Engineering (e.g., EUWP) and Economic (e.g., EEWP) communities.***

- The IEA is encouraged to undertake studies of consumer choice for selected end-use markets and developed new and improved choice models. It is imperative to understand consumer choices. Most consumers do not weigh externalities or public good considerations (environmental and social issues) in their decision making. A better understanding of consumer behaviour along with improved consumer choice models will benefit the IEA and its member countries.

- Understanding the value chain is critical for advancing technologies and products. Given the importance of value chain of energy efficiency products in the overall technology story, the IEA could undertake original research (in a defined narrow technology and market area for a sample of countries) or conduct a review existing value chain studies, to better understand the roles of manufacturers, suppliers, etc. in the entire value chain and the impact they have on technology adoption and R&D feedback. Reviewing existing country studies on value chain might be a useful initial step. This increased understanding may help member countries handle business dynamics better for relevant technologies and markets. Value chain analysis could be tied to technology market risk assessment. The target audience for such studies would be both economists and engineers.

- The working parties need to consider who should conduct value chain analyses, even though both engineers and economics will clearly benefit from the knowledge gained from these studies. Should it be the primary responsibility of economists (e.g., the EEWP) or engineers (e.g., the EUWP)? One possibility is for the EEWP and EUWP to establish a small interdisciplinary team comprised of members of each working party to oversee the conduct, and dissemination of the results, of value chain studies.

***Promote Better Communication with Social Sciences Experts when Conducting Energy Technology and Policy Studies.*** Increased communication between engineers and economists with experts in the social sciences may be necessary if nations are to solve some of the major energy and environmental challenges they face. Social science can bring to the process a fuller understanding of how technologies move from research laboratories to the market, the process of innovation, and how to make policies more effective. The examination of the innovation process and related sociological aspects could prove especially well-suited to EUWP/EEWP working party collaboration.

## C. Collaborative EUWP/EEWP Workshops and Use of Work Products

***Promote Cross-Use of Implementing Agreements and other Working Party Products.***

- The EUWP and EEWP could periodically host collaborative "special topic" workshops for selected technologies and policies, organized by Working Party Chairpersons (and EUWP's Implementing Agreement Chairpersons), where both EUWP and EEWP delegates are invited.

- The EEWP could strive to make better use of findings from EUWP Implementing Agreements in their studies, and likewise the EUWP could strive to utilize findings from EEWP policy studies and publications in their work products

For the above two activities, each Working Party could challenge their representatives to actively identify linkages between the R&D, deployment, and policy studies, and regularly report relevant linkages at their respective working party meetings. To some extent, this is already being done.

## D. Organization, Communication, and Dissemination of Information

***Take the Lead in Organizing and Disseminating Information About the Experience of Individual Nations.*** Individual nations can learn from the experience of other countries. However, the environment in which research, deployment, and policy occurs is complex.

Countries tend to have a different balance in R&D focus and priorities, with some focusing on the early stages of R&D (high-risk) while others pursue technology development and the intermediate stages of commercialization. The fact that the "Valley of Death" between research and deployment is different in every country makes learning from one another even more difficult. Nations can still learn from each other, and IEA could lead this effort. In such an immensely complex environment, a dialogue lead by the IEA is crucial, and its representatives are the unifying link.

***Bring Energy-Efficiency Issues into Greater Focus for Facility (and Corporate) Managers.*** As noted in the workshop discussions, a successful approach to the deployment of an energy-efficient technology/product must include a way to dramatize the energy efficiency, environmental, and life cycle benefits to the buyer or end-user. IEA could facilitate member country efforts to bring energy-efficiency issues into focus for facility managers. Facility managers make important decisions on retrofitting and repairs that impact energy efficiency of systems. Corporate decision makers make critical decisions on capital investment in new technologies and, as such, they are also a key target audience for IEA communication and dissemination efforts.

***Develop and Share Best Practices in Public Education Programs/Tools.*** The IEA could collaborate on the development and sharing of best practices in public education programs/tools in member countries for adults (at different educational levels) and children. In addition, such IEA education products could be disseminated to developing countries where most of the new energy consumers will be in the coming decades.

***Engage "Technology Perspectives" Brokers.*** Create an experimental study or program to have scientists and engineers (retired professionals) from industry act as brokers between those who have the technologies and those who could use it. Brokers could talk to companies and discuss their technology needs and also identify technologies the companies did not know were available and cost-effective.