BREAKING THE SOLAR IMPASSE

A Briefing from

GREENPEACE

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Written and Edited by Karl Mallon, Iain MacGill and Nick Milton.

Energy Solutions Unit,
Greenpeace International.
Keizersgracht 176, 1016 DW Amsterdam, The Netherlands
Tel: + 31 20 523 6291
Fax: + 31 20 523 6200

karl.mallon@ams,greenpeace.org

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Greenpeace believes that given the environmental imperatives now facing all countries the stage is set for explosive growth in the market for solar electric power. Why is it still not happening?

Neither government nor industry have made meaningful progress towards creating a mass market for photovoltaic power. Given this failure, Greenpeace commissioned global financial advisors KPMG to analyse whether a competitive mass PV energy market could be achieved today, and if so, what barriers are holding back its development.

The results of the KPMG report conclude that grid-connected PV power can be made competitive with standard domestic electricity by simply using economies of scale applied to today's standard PV technology. The outcome would be a four-fold drop in the price of solar energy and the opening up of the enormous grid-connected electricity markets of the developed world.

This briefing outlines the links between energy and environment. It illustrates the main findings of the report and includes examples of the role of the key players in maintaining or breaking the present PV impasse; moreover, it provides case studies for the Netherlands, the United Kingdom and the United States.

Why Now ? A Confluence of Changes.

Liberalisation: In power markets around the world, the most significant changes to the electricity industry since its inception 100 years ago are now underway. Large monopolies are being broken up, states are divesting themselves of ownership and customers are being given a choice of suppliers. The right to supply power to electricity grids is also being wrestled from the exclusive domain of big conventional power plants. In the short term, changes of ownership, price wars and floods of cheap power from coal or even nuclear plants could create volatile and environmentally damaging markets. However, there is growing awareness of the need to remove the enormous existing government subsidies to fossil fuels and nuclear power, and to properly account for the environmental costs of their pollution.

Climate Change: Pressure from the imperatives of climate change on the use of fossil fuels have only just started. In Kyoto, 160 governments agreed to reduce emissions of greenhouse gases. However, in order prevent catastrophic climate change, deep reductions in the use of fossil fuels will have to take place.

> ***"How far is it sensible to explore for new hydrocarbon reserves, given that the atmosphere may not be able to cope with the greenhouse gases that will emanate from the utilisation of the hydrocarbon reserves discovered already?…….. Undoubtedly there is a dilemma."***
>
> **Heinz Rotherman, Managing Director of Shell UK Exploration and Production, 19th May 1997.**

The impact of these pressures may be reflected in new energy taxes, carbon trading, emission quotas or other mechanisms, but the net result will be the same: The value of fossil fuels will diminish and the cost of using them will increase[1].

New Renewable Energy: The new renewable energies such as solar and wind power are the fastest growing energy technologies in the world. In 1998, solar photovoltaics experienced growth of over 20% and wind power of 35%[2]. The price of these new renewables continues to fall. Wind already provides energy more cheaply than many oil, coal and nuclear fired power plants.

> ***"…the world is in the early stages of an inevitable transition to a sustainable energy system that will be largely dependent on renewable resources…"***
>
> **International Energy Agency, 1999[3].**

Solar photovoltaic power has the unmatched advantage of being able to by-pass the entire electricity infrastructure by going straight to the point of use on the roof-top of its customers. For example, there are houses in cloudy England which are net suppliers, rather than consumers, of energy to the grid. An extraordinary new market exists for photovoltaics - ***providing the price is right***.

Energy and Environment: Harmony or Conflict?

> ***"The natural flows of energy are so large relative to human needs for energy services that renewable energy sources have the technical potential to meet those needs indefinitely."***
>
> **Paul Appleby, Director of Strategy and Planning, BP Solarex, UK.**

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[1] Royal Dutch/Shell's decision to divest itself of international coal interests. Coal is the most carbon intensive of all of the fossil fuels. 30th August 1999. Australian Financial Review newspaper.

[2] IEA*: The Evolving Renewable Energy Market*, 1999.

[3] IEA*: The Evolving Renewable Energy Market*, 1999.

There are many historical reasons for the current situation where the developed world is dependent upon sources of energy that damage its environment and health. Fortunately, technologies are now available to allow the transition to sustainable renewable-based energy systems. Unfortunately our energy markets appear paralyzed and unable to begin this transition.

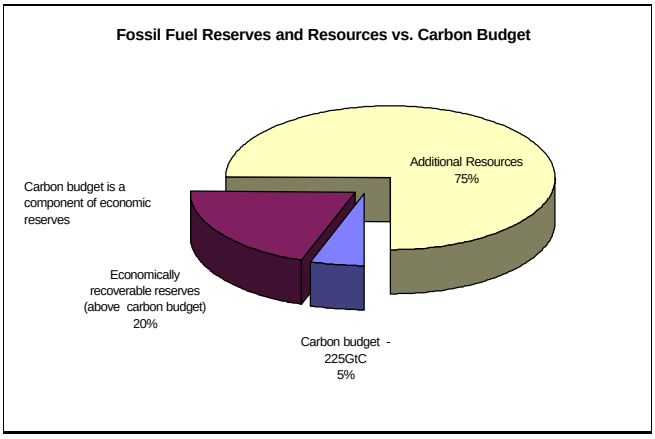

Figure 1: Fossil Fuel Reserves and Resources Vs 'Carbon Budget'[4].

Greenpeace believes that society's energy requirements can be accommodated without environmental damage. Analysis by Greenpeace concludes that we can only burn one quarter of the current economic reserves of fossil fuels before risking catastrophic climate change. At the present rate of consumption this carbon budget will be used up within 40 years.

Greenpeace has fought nuclear power for two decades. It is now locked in a battle with the oil industry to force a shift from exploring for new fossil fuel reserves to investing in sustainable energy. Greenpeace has endeavored to showcase energy efficiency options and renewable energy to demonstrate the wide public support for clean power. In the past year nearly 70,000 people have responded to Greenpeace projects to supply renewable energy and solar power[5]. Greenpeace has also highlighted the growing cost-competitiveness of these new technologies.

There are three players in the energy market: industry, government and consumers – the people who use the energy. There are clear gaps between the desire of the public for a renewable energy transition, governments who are not seriously acting to reflect the public interest and an energy industry that is still largely resistant to change. Greenpeace believes that by bridging these gaps the interests of society and the environment can be protected and promoted.

Solar PV provides an excellent example of energy market inertia. The sun is the primary source of all energy on the planet (including fossil fuels). Solar PV enjoys the support of major corporations such as Shell and BP; each own large PV companies. Solar is trumpeted by governments in schemes such as the US and European 'million solar homes' programmes. Yet its contribution to world energy is almost negligible. Building integrated solar electricity from roofs and facades has the potential to replace a substantial part of the residential, commercial and public sector - demand currently met by conventional generation (largely fossil fuelled). These sectors are responsible for about half of global electricity consumption[6].

[4] *Fossil Fuels and Climate Protection: The Carbon Logic*, Greenpeace Report, Bill Hare 1997

[5] Solaris Campaign, Netherlands : http://www.greenpeace.org/~nl/solaris1.html
Stromwechsel Campaign, Germany : http://www.greenpeace.de/GP_DOK_3P/THEMEN/C04UB01.HTM

[6] IEA, *Key World Energy Statistics*, 1998.

The KPMG Report, *Solar Energy: From Perennial Promise to Competitive Alternative.*

Greenpeace consulted financial analysts KPMG in order to establish why there is difference between the stated commitment to solar power by government and industry and tangible results from these commitments. The following questions were put to KPMG:

> ***Can the large-scale production of solar panels lower the price of solar energy to such an extent that solar energy can compete economically with conventional forms of energy? And if it can, what action is necessary on the part of government, customers and industry to break through the current impasse?***

Their results are presented in the report : Solar Energy: From Perennial Promise to Competitive Alternative[7].

The report comes to the following key conclusions:

1. The price of solar power could be made competitive for domestic and small scale grid connected users by increasing the scale of production using convention PV technology to 500MWp per year – about 3 times the size of world sales in 1998. In the short term, up-scaling can deliver the required price reduction more readily than subsidies or waiting for improved technologies to be commercialised.

2. The market is held in a deadlock that is preventing the opening up of the potential mass market. *"As long as demand is small, production of solar energy will remain small-scale and expensive, and as long as the production is small-scale and expensive, the price will remain high and the demand small: catch 22."*

3. There are three players: Industry, Consumers and Government. Of these only industry and government (exercising the collective will of consumers) can break the impasse.
   - Industry could proactively invest in the 500MWp factory with the intention of 'pushing' open the market through the price reductions achieved.
   - Government could provide higher incentives in the short term or use its regulatory powers. Each of these would quickly establish a mass market and pull down sharply the price of PV.

Unleashing the Market.

In order to interpret the key findings of the KPMG report it is necessary to look at the current trajectory of solar PV and the impact that up-scaling could have on that trajectory. Investing in substantial mass production now would bring forward the development of competitive domestic PV power by approximately 25 years.

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[7] KPMG Bureau voor Economische Argumentatie, Hoofddorp, Netherlands. Project No. 2562, August 1999

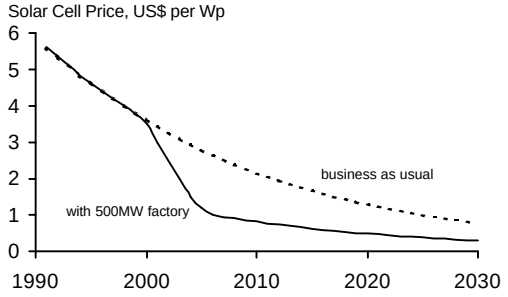

Figure 2: The Step change in PV capital cost resulting from 500MWp factory construction between 2000 and 2005, compared to 'business as usual' decline[8] [9] in price at 5% per year.[10]

In terms of the price of power to the domestic and small-scale consumers, the KPMG results show prices compare favourably with the price of domestic power in the OECD.

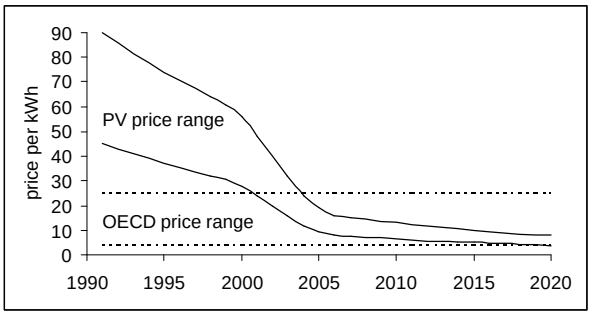

Figure 3 : Price reduction of solar electricity achieved through economies of scale compared with OECD electricity price range (Euro cents)[11] (IEA, Key World Energy Statistics, 1998).

The potential market for grid connected power would be vast following the four-fold reduction in price that would come with 500MWp per year mass production.

- Based on the PV price calculated by KPMG, people in Germany, Japan, Austria, Denmark, Belgium and Spain would be able to procure solar energy at a prices similar to conventional power. This would instantly open up a potential market of 160 million people[12].
- Based on a 'business as usual' scenario, 5 years later solar PV could start to match the price of domestic electricity in the United Kingdom, Italy, Portugal, Switzerland, Ireland, the Netherlands and Luxembourg, based on 1998 International Energy Agency (IEA) prices.

Industry – Rhetoric or Reality?

> ***"One day this industry [solar] will be as big as oil."***
> **Head BP Solar, The BP Shield Magazine, 1997.**

There is stated support for solar energy from many companies in the conventional energy sector, including heavy weights such as Shell, BP Amoco and Siemens. Each have solar power manufacturing divisions. This is manifest in full-page advertisements, solar arrays on top of petrol stations and new small scale solar factories being opened in showers of publicity.

KPMG estimates that construction of 500 MWp/year production will cost of the order of $660 million. The question of who will make this scale of investment and take on the associated risks needs to be answered.

[8] Maycock 1996, Photovoltaic Industry Competition Analysis, Report PC-10, Nov. 1996

[9] Appleby, P. Renewables in the Future Energy Supply. Renewable Energy World, July 1999.

[10] Also in keeping with 18% price reduction per doubled cumulative production under 15-20% growth rates.

[11] Based on solar radiation in NL representing the approximate upper limit, with double this solar resource in the middle latitudes.

[12] OECD Demography Statistics 1997. IEA, Key World Energy Statistics, 1998

However, the investment required to break the solar "catch 22" is equivalent to about half of 1% of the US$89 billion spent by companies on exploration and production from new oil and gas reserves in 1998 alone[13]. Furthermore, each year governments directly subsidise the conventional energy sector with tens of billions of dollars. These subsidies not only represent money that could be better spent by the energy industry, but they also distort the energy market in favour of the fossil fuel based status quo; consequently industries resist inevitable change.

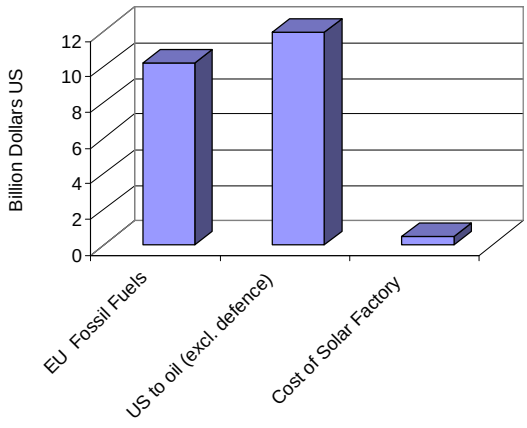

Figure 4: Average annual direct subsidies (1990-95, EU and Member States[14] and US[15]) compared to total capital investment required for 500MWp solar factory

[13] Oil and Gas Journal, Report of Salomon Smith Barney, April 5th, 1999.
[14] Energy Subsidies in Europe, An Analysis by the Vrije University of Amsterdam, for Greenpeace International. 1997.
[15] Koplow and Martin, Industrial Economics Inc.. Fueling Global Worming, Federal Subsidies to the Oil Industry. report commissioned by Greenpeace, 1998.

Governments – All talk and no action.

> ***"We will work with businesses and communities to use the sun's energy to reduce our reliance on fossil fuels by installing one million more roofs around our nation by 2010. Capturing the sun's warmth can help us turn down the Earth's temperature"***
> **US President Clinton, UNGASS Conference, June 1997**

In the appendices to this report we present case studies of how solar power has come to the same impasse in the UK, the USA and the Netherlands despite apparent government support.

The International Energy Agency (IEA) has pointed out that the transition to renewables is inevitable. If the change is delayed there is a greater overall cost to society:

- The effects of climate change through flooding, drought, health, forest fires and other impacts.
- Money is spent developing and adopting the unsustainable technologies long after it is clear change is necessary.
- The sustainable technologies stay more expensive for much longer than they need, requiring their consumers to pay more in the interim and government to spend greater subsidies than would otherwise have been required.

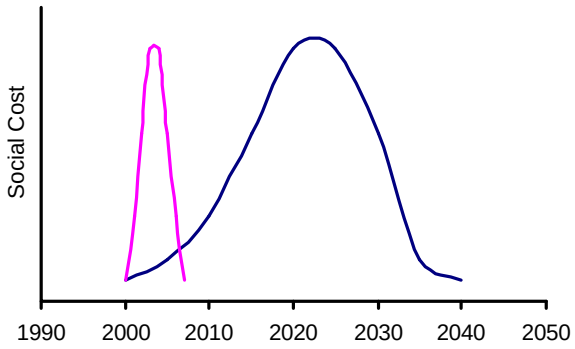

Figure 5: Annual cost to society. The total cost of transition is represented by the area under each graph - which is the sum of government subsidies, industry investment and higher prices paid by consumers until mass production is achieved. [16]

Breaking the Impasse - What Role will Industry Play?

> ***"Investment is the key to unlocking the potential for renewable(s)"***
>
> **Heinz Rotherman, Managing Director Shell UK Exploration and Production, Parliamentary Renewable and Sustainable Energy Group (PRASEG) Conference Nov. 12th, 1997.**

Given the investment resources available, it would appear that commercial commitment is missing. The same commercial commitment that allowed Sony to make the Walkman may be required to drag solar PV down from a satellite technology to an everyday appliance.

For comparison, the cost of the 500MWp solar factory is equivalent to half BP Amoco's investment in the new Foinaven oil development off north-west Scotland - the UK Atlantic Frontier.

The required commitment may not in fact come from the most wealthy players either. For instance, Kyocera of Japan is now the world's largest fully integrated PV company and production has risen 3 fold in 3 years[17]. The capacity and ability for growth is significant.

Breaking the Impasse - What role will governments play?

Government plays a key role in regulating all sorts of markets that affect its citizens and in many ways can reflect the collective will of the consumer. Analysis by KPMG illustrates that in the Dutch context government could create a 500MW per annum mass market for PV and thus pull down the price by regulating its incorporation into new housing. Appended to this briefing are three case studies that summarise the PV impasse and its possible solution for the United Kingdom, the USA and the Netherlands.

It is quite common for government to use its regulatory power to protect the interests of its citizens. In the case of lead free petrol, we have the example of a commodity that does its job perfectly well, but has undesirable environmental impacts. Initially the public became aware of the problem, and though unhappy with the situation had no alternative available. The market provided lead-free petrol and lead-free engines, but these were more expensive so their adoption was limited. Then government intervened. First it provided a positive price differential between leaded and unleaded petrol using taxation measures ~ equivalent to subsidies for solar home systems. Then it regulated that new cars must run on lead-free petrol ~ equivalent to regulating solar on new houses. Finally the new fuel became so widely adopted that a total phase out of the old fuel was possible.

[16] KPMG Private communication.

[17] *PV News, June 1999.*

Here we can see that it is possible for government to protect the interests of its citizens and yet provide a transition of the related industry. This could have significant lessons for the potential role of government in regulating solar power on new houses. As both the UK and the Netherlands' case studies show the low cost mass production of PV can be justified through simply regulating that new buildings be solar powered.

Conclusions

The KPMG report demonstrates that the price of solar electricity could be as low as conventional energy in first world homes across the globe. Today, PV is still five times more expensive than it need be.

The KPMG report explains that it is not technology or financial barriers that are holding PV out of a mass market, but a simple 'demand and supply' catch 22.

If the impasse is not broken, solar PV will gradually find its way into a mass market. But this may take 30 years where as KPMG show that it could be achieved in the short-term.

The KPMG report identifies that only two players can break that impasse – government that regulates energy and building, and the industries that own the technology. Greenpeace believes that the onus now rests with these two parties to break the solar impasse.

C A S E S T U D Y : THE UNITED KINGDOM

The market for solar energy

In the UK the current amount of electricity generated from solar is very small. By the beginning of 1999 760 kWp[18]of PV were installed equating to an area of 6688m^2 [19]. This contributed approximately 570 MWh [20]or roughly 0.0002 % of the UK's total electricity consumption[21].

The potential for solar in the UK is vast. The Energy Technology Support Unit, the Government's energy advisor, has calculated the potential resource to be 208 TWh a year, assuming that PV is applied to all domestic and non-domestic buildings. This was 63% of the UK's total electricity consumption in 1997.[22]

Despite this huge potential the Government's PV program is unambitious. In 1999 the Department of Trade and Industry announced three initiatives on solar power including a "field trial" for 100 homes - a total Government investment of just £5 million [23]. In comparison the budget for solar in Germany was 97 million DM in 1996 and in Japan 20 billion yen in 1997.[24]

The impasse

Despite a five fold decrease in the price of solar electricity and a 60% improvement in the efficiency of solar panels over the last twenty years[25], the market for solar in the UK has remained very small. This impasse is because neither Government nor industry have taken action on the supply side to reduce the price of PV to a level where it can compete with electricity produced from conventional sources. Both Government and industry have also failed to generate sufficient demand to bring the price down via economies of scale.

Breaking the impasse

If a 500 MWp factory were to be built it would produce 5 km^2 [26]of solar panels a year. This would equate to less than 0.3% of the roof area of existing domestic properties and under 40% of the roof area of the annual new build properties in the UK[27]. Such a level of uptake could be achieved by requiring solar to be installed on all new properties. Possible mechanisms include using the review of the 1995 Building Regulations or by making PV an integral part of the Governments projected house building target of 3.8 million new households between 1996 and 2021[28].

The effect of building a 500 MWp factory would be to bring the price of solar electricity in the UK down from 39 pence to 10 pence per kWh[29] (assuming that the price of solar in the Netherlands and the UK is approximately the same and all other costs are equal). This would bring the capital cost of a 1.1 kW solar system for a home down from £6433 to £1649[30]. This would leave only a small difference between the price of solar and conventional electricity.

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[18] PV-UK 26 February 1999 Memorandum to House of Lords European Communities Committee Sub-Committee B (Energy, Industry and Transport)

[19] Assumes a 2kWp system is 17.6 m^2 based on 20 Siemens panels rated at 100W

[20] Based on a 2 kWp system delivering 1500 kWh a year.

[21] Based on a total UK electricity consumption of 330 TWh in 1997

[22] ETSU 1992 The potential generating capacity of PV-clad buildings in the UK

[23] DTI/EPSRC 1999 John Battle's speech to PV conference at Manchester on 17 February

[24] PV-UK 1999 Photovoltaics in the UK: facing the challenge

[25] PV-UK 1999 Photovoltaics in the UK: facing the challenge

[26] KPMG 1999 Solar energy from perennial promise to competitive alternative

[27] Based on 1995 figures 24.6 million domestic properties, 188,300 new build properties and an average pitched roof area of 70m^2

[28] CPRE 1999 pers. comm

[29] Based on figures in KPMG 1999 Solar energy from perennial promise to competitive alternative and Greenpeace financial information from installing a 3.3 kW solar system on three homes in Silvertown, London, April 1997; £1= 0.66 Eur

[30] Based on Greenpeace financial information from installing a 3.3 kW solar system on three homes in Silvertown, London, April 1997

CASE STUDY: THE U.S.A.

The present US energy system

The United States has less than 5% of the world's population yet is responsible for nearly one quarter of world fossil fuel use. The nation consumes around 27% of total world electricity generation.[31] Fossil fuels – coal, oil and gas - supply over 70% of this electricity which now accounts for over one third of US energy consumption.[32]

The problems of the nation's present energy system are receiving increasing attention, as is the potential of renewable energy sources. Around 88% of the US public say that it is important for the US to take action to reduce CO2 emissions.[33] Americans also see solar energy as better for the environment, better for the US economy and more promising than any other energy source.[34]

The potential of PV in the US

The U.S. is blessed with a good solar resource. Practically all regions of the country other than the Far NorthWest and Far NorthEast receive average annual solar radiation of 4 kWh/m2/day or more.[35] This means that a 2 kWp PV system, easily fitting on a standard house roof, will generally provide at least 3000 kWh a year. This represents around one half of a typical US household's electricity consumption.[36] This solar resource is over 80% more than that of the Netherlands and approximately doubles that of the United Kingdom. A PV system with a square area of around 100 miles by 100 miles could theoretically produce the entire electrical energy used by the US.

The current US PV market

PV remains an insignificant energy source in comparison to fossil-fuelled electricity. In 1997, cumulative installed PV power in the US was estimated at 108 MW with grid-connected PV on buildings totaling 14 MW and showing annual installation rates of only 3 MW.[37] PV therefore provided less than 0.005% of total US electricity consumption.

US PV production in 1998 is estimated at 53.7 MW representing around 35% of world production and a growth rate of 5.3% from 1997 shipments. Over 60% of this production was exported. Among major manufacturers in the US, Siemens shipments decreased from 23 to 20 MW, Solarex shipments increased 7.4% to 15.9 MW and AstroPower increased shipments by 63% to 7 MW.

There is a range of market projections for PV in the US. One study by the US PV industry projects an 'upper case business as usual' annual growth rate of 15% for the US PV industry. This would mean that the nation's annual production would not exceed 500 MW until 2011 with cumulative production reaching around 3000 MW.[38] Around 40-50% of this production would be installed in the US. The Federal Government's Million Solar Roofs Initiative has a similar goal.[39]

The price impasse

A PV system in the US will typically generate 80% more electricity than the same system in the Netherlands because of greater solar resource. Currently, grid-connected PV systems cost approximately $6.5/Wp installed. Under US conditions and KPMG's chosen financing arrangements over 20 years, the price of this PV power is around 29 cents/kWh.

The average consumer electricity price in the US is currently around 6.75 cents/kWh although the price for households is currently 8.3 cents/kWh. Despite the US's superior solar resource, PV

[31] International Energy Agency, *Key World Energy Statistics*, 1995 data.
[32] Energy Information Administration, *Annual Energy Outlook*, 1998.
[33] Mellman Group for World Wildlife Fund, 1998.
[34] Poll by The Wirthlin Group, July 1993.
[35] NREL, *Solar Radiation Data*.
[36] Energy Information Administration, *Residential Energy Consumption Survey*, 1997.
[37] IEA, *PVPS International Survey Report* (compiled by Paul Maycock of PV Energy Systems).
[38] NREL, *Industry-developed PV Roadmap*.
[39] Million Solar Roofs Initiatives Goals: Benchmark results.

electricity is therefore still around four times more expensive than existing grid supply.

Breaking this impasse

KPMG has calculated that up-scaled PV manufacturing of 500 MW/year can reduce installed PV system costs to approximately $1.8/Wp. This corresponds to a price for PV generation of around 7.8 cents/kWh which is approaching that of existing grid supply.

US market and export demand for PV at that price of less than $2/Wp could easily meet the 500 MW/year supply and its total annual cost of under $1 billion. In comparison, the nation's total energy expenditures are currently around $500 billion per year.[40] The country also now spends $322 billion on new housing each year while annual expenditures for renovating and improving residential properties are estimated at over $119 billion. In terms of available roof space, annual installation of half this 500 MW production (50% for export) would only require that one in ten new US houses install a 2 kW system.[41]

Who will break the PV impasse?

KPMG estimates that construction of 500 MWp/year production will cost of the order of $660 million and poses a number of technical, production and market risks. The question of who will make this scale of investment and take on its associated risks needs to be answered.

The US PV industry's present growth strategy is far from what is required to rapidly expand production capacity to 500 MW/year. However, a number of the major industry players are business units of some of the world's largest corporations. These companies are clearly in a position to commit internal resources to significant up-scaling of PV production. For the smaller PV companies the role of securing aggregated contracts for PV demand in order to obtain project finance is clearly far more important; moreover the task is significantly more difficult.[42]

The US federal government has both the public mandate, indeed obligation, and widest range of options to break the PV market impasse. Its present plans and financial and regulatory commitments are, however, entirely inadequate for the task. While the US government spends roughly the same as Japan and Germany on research and development it spends far less on commercialization; $3 million in 1997 compared with $109 million by Japan and $45-50 million by Germany.[43]

The Million Solar Roofs Initiative was launched by President Clinton in June 1997 as the federal government's visionary commercialization strategy for PV and other solar technologies. However, there has been little financial commitment to the programme. DOE allocations for developing MSRI were only about $1 million for 1998.[44] Projects of the UPVG TEAM-UP program have been significantly cut back because of Department of Energy budget cuts.[45] No tax credits are available to homeowners to install systems while financing options are largely limited to existing programmes offered by other Government departments and agencies.[46]

There are further failures in the Federal government's own purchasing of PV. In 1995 it was the nation's largest electricity consumer and spent $3.5 billion on power.[47] Having the Federal Government install enough PV to supply just 1.5% of its electricity consumption would require 500 MW of new PV capacity. The Federal government also happens to own around 600,000 buildings on which PV could be installed. Unfortunately, the Federal Energy Management Program that is supposed to lead government Million Solar Roofs Initiative efforts has so far only contributed around 100 PV systems installed or under construction.[48]

Clearly, far greater federal government efforts will be required to break the US PV market impasse.

[40] US Department of Energy, *Comprehensive National Energy Strategy*, 1998.
[41] US Commerce Department's Bureau of the Census.
[42] REPP, *Financing PV Production Capacity Through Risk Management*, 1998.
[43] *Solar Industry Journal*, vol. 9, no. 1, 1998.
[44] Photon International, *Is Million Solar Roofs Real?*, 1998.
[45] Strategies Unlimited, *Global Analysis of Photovoltaic Markets*, 1998.
[46] US Department of Energy, *The borrower's guide to financing solar energy systems*, 1998.
[47] Renewable Energy Policy Project, *Expanding Markets for Photovoltaics*, 1998.
[48] NREL, *Renewable Energy Deployment in the Federal Sector*, ASES 1999.

C A S E S T U D Y : THE NETHERLANDS

The market for solar energy

In the Netherlands the current amount of electricity generated from solar is still very small. In 1996 3.3 MWp of PV was installed equating to an area of 41000m^2. This contributed approximately 2.6 GWh or roughly 0.004 % of the Netherlands total electricity consumption.

The potential for solar in the Netherlands is large. If the entire market potential for solar panels in the Netherlands were utilised, solar could provide three quarters of the Netherlands electricity needs.

The Dutch government is actively trying to encourage the uptake of PV through a PV Covenant in collaboration with a number of market parties. A range of policy measures are in place with a budget of f34.3 million (Eur 15.6 million). However, the Ministry of Economic Affairs has a target to install just 1,450 MWp of PV by the year 2020. This will produce 1,160 GWh of electricity annually, giving PV a 1.5% share of the total amount of electricity consumed.

The Impasse

Despite a large number of policy initiatives aimed at promoting the uptake of PV the market for solar in the Netherlands has remained very small. This impasse is due to the fact that the price for solar electricity remains four to five times higher than the price of retail electricity from conventional sources. This has resulted in a small demand for solar energy and solar panels. This comes down to a classic chicken and egg problem: as long as demand is small, solar will remain small scale and expensive and as long as it is small scale and expensive, demand will remain low and the price high; catch 22.

Breaking the impasse

If a 500 MWp factory were to be built it would produce 5 km^2 of solar panels a year. This target could be met by installing PV on the 2% existing buildings in the Netherlands – equivalent to the annual rate of new building. Possible mechanisms include using the Building Decree or separate legislation.

The effect of building a 500 MWp factory in the Netherlands would be to bring the price of solar electricity down from f1.34 (Eur 0.61) to f0.35 (Eur 0.17) per kWh. This would be a huge step towards bringing solar PV into competition with retail electricity from conventional sources at fl 0.29 (Eur 0.13) per kWh.

Further price reductions can then be expected due to the continuing fall in the price of solar electricity and the increasing efficiency of panels.