ICEPT response to Joint Environmental Audit Committee and Energy and Climate Change Committee Call for Evidence on PV Feed-in Tariff, 2011.

Icept consultation response
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Dr Robert Gross (Robert.gross@imperial.ac.uk)
Dr Chiara Candelise c.candelise05@imperial.ac.uk)
**Introduction**

ICEPT is an interdisciplinary research centre focused upon the interaction of technology and policy. From its base at Imperial College, the centre is uniquely placed to gather insights into technological and scientific developments relevant to contemporary debates in energy policy. The centre also has policy analysis expertise, drawing upon a wide range of system modelling, scenario and technology assessment techniques. ICEPT runs the Technology and Policy Assessment function of the UK Energy Research Centre. The reports it produces have been widely cited by both select committees and in policy documents. Imperial College has considerable strengths in many aspects of the science of photovoltaics (PV), co-ordinated through the PV network of the Imperial Energy Futures Lab (http://www3.imperial.ac.uk/solar).

ICEPT is also leading the techno-economic work-package of the UK’s leading scientific consortium on inorganic photovoltaic devices, PV21 (http://www.pv21.org/). Dr Candelise is a leading specialist in the economics of PV, and she and Dr Gross have published extensively on solar technology and policy. Dr Gross has undertaken extensive research in a wide range of energy policy areas, specialising in innovation policy, and is a Co-Director of the UK Energy Research Centre (www.ukerc.ac.uk). Dr Gross acted as Specialist Advisor to the ECC Committee during the spring of 2011. He has interacted extensively with the Environmental Audit Committee. He was Specialist Advisor to the House of Lords European Union Select Committee in 2008.

This submission is based upon their combined knowledge of the global PV sector, insights into policy developments internationally and perception of the emerging UK market. It is structured in accordance with the list of topics put forward by both committees in the evidence call.

**a. Impact to date of Solar PV Feed-in Tariffs and the state of the solar energy market**

**Main points**

- Globally, the use of FITs has been hugely important for the solar PV industry and market growth. This in turn has driven cost reductions.
- There is still a huge potential for further innovation and cost reductions both at module and PV system level – this requires both investment in RD&D and crucially market stimulation.

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Analysts of the PV sector describe global support as ‘buying down’ the cost of PV.

The argument that this is better done in sunnier regions is misplaced. Given the position the UK wishes to take in the climate arena, a robust market support environment for PV in the UK is both appropriate and desirable.

UK companies are also active in many aspects of the supply chain for PV.

Internationally, feed in tariffs (FITs) have been hugely important to the development of the solar PV industry, and to cost reductions. Since mid-2000 an increasing body of literature and evidence have supported the contention that FITs are the most cost effective policy mechanism for renewables deployment. Implementation of FIT schemes in key countries has driven an exponential PV market growth in the past decade, with worldwide annual installed capacity increasing from 280MW in 2000 to over 16.5GW in 2010. Market growth and development has been central to the cost reductions that have been delivered in PV modules. In turn, the existence of a range of market support measures has been essential to market growth (see figure 1).

PV is a highly innovative technology and the effects of ‘learning by doing’ have had a huge impact on overall cost reductions. Examples include the development of a dedicated silicon feedstock supply; innovations in manufacturing processes; economies of scale in module and inverter manufacture and the supply of other balance of system components; falling installation costs. In common with other devices using semiconducting materials, not least flat screen displays and the consumer electronics sector, PV is subject to innovation right through the so called ‘innovation chain’ – improvements come from fundamental science and new materials, in manufacture and processing, and in applications and marketing.

Figure 1. Historical PV module price decline against market expansion as driven by FIT implementation in key countries

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Moreover, the existence of a thriving market for PV modules acts as a spur to device development and innovation, manifested most dramatically in the emergence of low cost thin film devices a few years ago (see figure 2). In our view it is impossible to separate the role of market growth from that of support for PV R&D in the overall picture of PV development. Both are essential.

In addition, PV systems should be seen as compound learning system, where module costs reduce along with the cost of Balance of System (BOS) – which includes other system components as well as system design and installation. Although installed costs generally differ among countries as a result of a wide variety of factors (including differences in technical standards for grid connection, installation labour costs, exchange rates and the degree to which components are manufactured locally) evidence from other countries suggests that more developed national PV markets reach lower PV system cost level thanks to steeper BOS learning⁵. Indeed, more mature PV markets can offer greater competition between players; reduced margins; a more experienced network of installers, developers and retailers; reduced installation labour costs; increased purchasing power of national players in the global market of modules and system components. All these elements contribute to cost savings along the whole supply chain and lower PV system prices.

Figure 2. Experience curve for crystalline silicon (c-Si) and Thin Film PV modules

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Despite the tremendous progress made in PV in recent years the scope for innovation is still large. PV is a well proven and reliable technology, yet it is in many respects still an ‘infant’ option. The scope for ongoing innovation is extremely large with much to gain from R&D and learning by doing. Examples include, at the module level, novel materials for photon capture, new techniques for encapsulation and deposition, efficiency improvement, reduced materials utilisation and, at system level, new module types for PV system diversification and easier/cheaper building integration (flexible cells, windows, etc), improvements in power electronics and system performance. This means that continued support for the PV market and ongoing research efforts are very likely to continue to drive PV along a declining cost curve, with system prices (module plus BOS) expected to decline of 36-51% over the next 10 years, depending on the market segment (see Figure 3). Some analysts suggest that PV could reach grid parity (the point where the levelised cost of PV electricity equals the cost of an equivalent amount of grid power) by 2015 in Southern Europe and by 2017-2018 in Northern Europe.

Many analysts of the PV sector describe global market support as ‘buying down’ the cost of PV. We believe this to be an appropriate and useful conceptualisation. It has been suggested by the Committee on Climate Change among others that solar should not be a priority in the UK since we can wait for investments elsewhere to deliver cost reductions. This is an argument for free riding,

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which appears inconsistent with the leadership position the UK wishes to take in the climate arena. UK companies are also active in many aspects of the supply chain for PV.

We would like to submit an addendum on the UK supply chain.

Some commentators also suggest that the UK is not a sensible place to deploy PV, because PV offers electricity at lower cost where insolation is higher. PV works in many latitudes and climates, but it is of course correct that output is a function of incident sunlight, so PV deployment in desert, equatorial and warm temperate regions in principle offer the best economic proposition for solar technologies. However the highest insolation countries are often not the best placed to provide incentives for PV, given financial constraints, infrastructure issues and competing policy priorities. As yet there is no mechanism to allow wealthy but less sunny countries to support the deployment of PV in poorer, but sunnier locations. Viewed in terms of global learning curves solar resource is in any case largely irrelevant. Module, system and installation costs come down with deployment, irrespective of insolation levels. Recent market growth in Germany, with a similar climate to Britain, has played a substantial role in driving PV along the learning curve. At least for now, we believe that countries like the UK and Germany have an important role to play in buying down the price of PV.

With all these factors in mind, we believe that a robust market support environment for PV in the UK is both appropriate and desirable.

*Figure 3. Potential of PV system price decrease in Europe, across different PV market segments*

![Figure 3](image_url)

Note: Estimates presented in this figure are consistent with those provided by other studies and contributions, including EU PV Technology Platform estimates and IEA PV Roadmap scenarios.

b. The balance between affordability and delivering the objectives of the Solar PV Feed-in Tariffs, including factors to consider when setting the rate of
small-scale Feed-in Tariffs including jobs created, emissions reductions and energy-saving behavioural change

Main Points

- The argument over the affordability of PV is completely at odds with the impact of the PV FiT on bills – currently less than £4 per customer per year.

- PV FiTs are intended to help move PV down the global learning curve and encourage consumers to engage with their energy use. It is difficult to disaggregate the UK contribution to learning, but the contribution is real and should not be neglected. There is evidence of behaviour change, though this needs more research.

- Both factors need more effective measurement, but representing PV FiTs in terms of £/ton carbon saved is inappropriate and unhelpful.

- Recent UK PV sector growth driven by the FiT has resulted in a significant amount of employment in the UK, and many SMEs have come into the sector.

The arguments around affordability appear to us to be at odds with the overall impact of the FiT on bills. Whilst costs are expected to decline, there is no doubt that PV is currently an expensive way to make electricity on a pence per unit (p/kWh) basis. However the total contribution of PV (measured in GWhs per year delivered) in the next few years will remain extremely small. This means that it is most unlikely that the high unit costs will translate into a large overall burden on consumers. Indeed, we estimate that support specific to PV is currently costing between less than £4 per customer per year. This compares to around £50 per year for the Renewables Obligation. In absolute terms therefore the burden of the FiT is, and is likely to remain, very small. The key questions then become how to weigh the benefits of the FiT against the benefits it delivers in terms of UK jobs and capabilities, engagement, and a UK contribution to global cost reduction trends. Recent UK PV sector growth driven by the FiT has resulted in a significant amount of new companies and employment in the UK with over 2,400 installers accredited to date. If we use the EPIA estimate of 30 jobs per MW installed this implies 2,500 new jobs created in 2010.

The debate over value for money often appears to centre around a representation of the FiT payments that is expressed in terms of £/tonne carbon. This is an inappropriate metric for evaluation because carbon saving it is not the sole, and arguably not the main, goal of the FiT. There is an urgent need for DECC to devise a more effective and robust measure of value for money for a scheme explicitly intended to promote engagement and innovation/learning. Our view is that the main problem is not that the tariff for PV is too high (though we accept that it needs to be reduced in a timely fashion, see below) but that the overall fiscal cap the Treasury has imposed on the money flowing through the FiT is incompatible with the enthusiasm with which the public has embraced PV.

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10 Our estimate using the DECC Sept 2011 data on installed capacity - 200 MW in the sub-4kW tariff bracket, approximately 30 MW stand alone and 10 MW each in intermediate tariff bands. We assume UK average of 900 kWh/kWp per year in each case. We assume 20 million households. On this approximate basis the cost per household is £3.80 per year.


12 http://www.policyexchange.org.uk/publications/publication.cgi?id=197
The difficulties that DECC now faces are largely created by the existence of a cap that now appears profoundly un-ambitious relative to the growth the PV market has experienced. It may also fail to account properly for the benefits the FIT can provide. Benefits linked to engagement are difficult to quantify because they are non-monetary. There is evidence that households with PV systems use energy more efficiently, but more research is needed on this\textsuperscript{13}. The UK contribution to global cost reduction is difficult to disaggregate from developments internationally. We believe that a thoroughgoing review of the evaluation metrics utilised for technologies that are further from mainstream cost competitiveness would be extremely valuable and could greatly enrich the debate around the FIT.

c. The way in which the Government has managed the Solar PV Feed-in Tariff, the impact this has had to date, including the management of the Consultation;

Main points

- The FiT was created just two years ago with cross party support with the explicit goal of creating a stable climate for investors and bringing a UK micro-generation sector into being.

- The way the consultation is being handled is highly inappropriate, particularly the timeline for change.

- Rushing through change so quickly and in such a damaging way runs completely counter to the increased long term investor confidence that is being sought through electricity market reform.

- The FiT has encouraged a raft of UK based SMEs into the sector and these will be the hardest hit by the change, least able to cope with the speed with which the tariff cut is planned to come into effect.

- The level of degression being suggested goes beyond current price reductions and leaves little room for social providers to share the benefit of the FiT with the least well off.

- It appears that preoccupation with the notional fiscal cap that the Treasury has imposed has been allowed to over ride all normal expectations of policy in terms of timeliness of change and proportionality of response.

In our view the way the current consultation is being handled is entirely inappropriate and extremely regrettable. The consultation proposes a level of tariff reduction that is not commensurate with cost reductions. It proposes to make changes on a timescale that is so rapid and unexpected consumers and industry cannot fail to be caught out. We deal with the latter point first.

The timeline for change

DECC will in effect impose a cut off date that is just 6 weeks after the changes were proposed and is in advance of the consultation closing. Whilst not strictly speaking a retroactive change this gives the

\textsuperscript{13} Keirsted, 2007, Behavioural Responses to photovoltaics systems in the UK domestic sector http://www.sciencedirect.com/science/article/pii/S0301421507000651
industry scant notice, and will almost inevitably lead to the cancellation of projects that are already under development. This will lead to losses on the part of suppliers, for example through excess inventories. As a result DECC is effectively punishing a nascent industry for success, penalising customers who have taken an interest in PV in recent months and comes very close to undermining the government’s commitment to grandfathering.

A long established and widely acknowledged principle of policy is that policymakers should make every effort to provide industry with advance notice of proposed changes and avoid stranding investment. The DECC consultation document has a preoccupation with the Treasury cap that is so overarching it appears to completely neglect the impact that the changes, particularly their timing, will have on the industry and on investors. DECC’s determination to avoid a ‘rush’ of applications has in our view led them into territory that is extremely bad for investor perceptions of the UK market for renewable energy. This runs completely counter to the increased long term investor confidence that is being sought through electricity market reform.

We completely accept the need for flexibility and for policy to be as cost reflective as possible, hence a rate of degression that is accelerated relative to the reductions originally scheduled for 2013/14. Flexibility in the face of cost reduction has been discussed in other contexts14. Achieving a balance between flexibility and certainty is not easy. Striking the right balance requires that lead times for policy changes are reasonable and fair. The instability of the UK regulatory regime is reducing the attractiveness of the UK market to investors, which is likely to increase the overall cost of finance for solar PV above levels that would have existed under a stable FIT regime.

We are also concerned that the timing of the tariff change may be particularly difficult for smaller, UK based system developers/installers and newer entrants. The small players are unlikely to have enough time (or volume of sales) to adjust to rapid global module price reductions, may not be able to renegotiate contracts with component suppliers and may not yet be able to match current ‘best practice’ PV system prices (which allow profitable returns under reduced tariffs). They may well be carrying stock that they will end up having to install at a loss. If many of the new players go out of business and the UK market becomes less competitive the rate of cost reduction could decline in the long run and the UK could revert to its ‘pre-FIT’ status as a relatively expensive place to install PV. Moreover, larger PV system developers from well established overseas markets might find themselves in better position than relatively young UK players. This might result in a missed opportunity for the UK to successfully develop a healthy and sustainable PV sector of its own.

For all these reasons we urge the committees to do all they can to encourage DECC to reconsider the timeline for tariff reduction.

Tariff levels

With regards to the level of tariff proposed by DECC it is notable that the consultation intends that returns available on the smallest scale installations reduce from the 5 – 8% range highlighted in the original proposals to 4.5%. This is justified in part on the basis that alternative investment options have become less attractive in the period since 2008. DECC provide very little further justification. We have reviewed the argumentation provided by Cambridge Econometric Research Associates in

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14 Deutsche Bank, 2009, Paying for Renewable Energy, TLC at the right price
http://www.dbcca.com/dbcca/EN/_media/Paying_for_Renewable_Energy_TLC_at_the_Right_Price.pdf
the supporting analysis cited in the consultation. This suggests that returns of around 4% will be attractive primarily to wealthy, possibly altruistic householders – those with spare cash who are relatively unconcerned about the zero liquidity associated with an investment in PV (unlike most other investments the PV investment cannot be recovered unless the house is sold and its sale value fully reflects that of the PV). A return of 4 or 5% certainly precludes debt finance by most people. As we discuss below, cutting tariff levels makes the potential for social finance provision less feasible, hence reduces the opportunities for the fuel poor to benefit from the FiT.

We are cautious about the appropriateness of continuously adjusting the hurdle rate applied to policy. As a general principle it is probably more appropriate to define a level of return that is appropriate and stick to it.

DECC also note a 30% reduction in capital costs. This is broadly consistent with our own view, based upon soundings taken with industry\(^\text{15}\). However the government is not proposing to cut tariffs in line with the capex reductions the industry is delivering, it is instead proposing cuts of around 45%, because DECC is acting in anticipation of both continued reductions in the cost of PV and a further 7% rise in domestic electricity prices. The upshot is to take the returns to the limit of what is likely to be acceptable to some (not all) consumers and to push prices below the level needed by many installers, at least at first. On the whole it is regrettable that a slightly more measured and gradual trajectory could not have been followed, which would not be inconsistent with arriving at the same end point. Again, the main priority appears to be the Treasury’s notional tax take rather than the best deal for consumers or fairness to the sector.

Overall, tariff cuts are far from cautious. We believe that the timing for the changes are wholly inappropriate, and represent bad practice. We would stress overall that the implications of change should be kept proportionate. In the case of PV the absolute impact on consumers almost negligible. It is very hard to avoid the perception that DECC are more concerned about rules set by the Treasury for an imputed tax than either good practice or the implications for an industry that government policies brought into being less than two years ago with cross party support.

d. Affordability of Solar Photovoltaic energy versus other renewable energy (given the overall levy-funded cap for energy bills) and the impact of Feed-in Tariffs on energy bills

Main points

- As set out above the PV FiT costs less than £4 per household at present. It is by no means the main contributor in terms of the various policies that contribute to increased electricity prices at present.

- The media have made a play of the FiT as a ‘reverse Robin Hood’ policy. Yet much of the installed capacity to date has been on social housing, with occupiers benefitting from lower

power bills, or has been commercial ‘rent a roof’ offerings, which also benefit people unable to afford the upfront cost of PV.

- Research undertaken at ICEPT indicates that innovative social finance provision can allow the least well off to share in the benefits of FiTs. We believe greater attention to realising this would have been a more helpful response to the potentially regressive nature of the FiT scheme than the cuts DECC has proposed.

- The FiT is the least impactful place to start addressing consumer bills. The least effective of the various policies currently in place is the carbon price floor. This, not the FiT, would be where we would advise the government to seek cuts.

Our basic proposition on affordability was set out in response to question b above. Whilst the per-unit cost of PV is high the overall burden is extremely small, far smaller than that of the Renewables Obligation or EU Emissions Trading Scheme. DECC’s own numbers in the consultation show that PV installations have reached just 255 MW, which of course accounts for the very modest overall impact on bills.

A great deal of media attention has focused upon the supposed ‘reverse Robin Hood’ nature of the FiT. Yet many of the installations to date are by social housing providers, offering free electricity to their occupants or are ‘rent a roof’ schemes offered by commercial outfits. The notion of a tax on the poor that benefits only the rich is not borne out by the facts.

Research at ICEPT, published in Energy Policy and available on the ICEPT website\textsuperscript{16}, indicates that innovative social finance solutions can be used to allow FiT revenue to reach the fuel poor, including those in hard to heat homes. This can go beyond ‘rent a roof’ and offer a share of the FiT income to the occupier. However maximising the potential for doing so requires enough return to allow a share out between the social financier and the household that does more than merely provide ‘free’ electricity. The changes to the FiT proposed by DECC reduce the scope for this and as noted above are most likely to restrict investment to the altruistic and wealthy.

We contend that innovative solutions for reaching the least well off could be found. We suggest that this (along with a raft of social and energy efficiency measures beyond the scope of this submission) would do far more to benefit the least well off than cutting the FiT. To return to a theme, the FiT is the least burdensome of the various policies currently in the DECC panoply. The potential to impact the poor is commensurate with this.

We generally support the government’s efforts to make support for renewable energy cost reflective and have argued for reform of the RO to this end for several years. As an aside it appear to us that the measure that delivers least value in terms of new investment in low carbon is the carbon price support, which is largely superfluous given the existing RO and proposed contract for difference and will depress the carbon price outside the UK. The FiT appears to us to be the least impactful place to start cutting support levels.

e. Experience of similar incentive mechanisms for renewables in other countries.

We have not sought to address this question. The international experience has been extensively reviewed elsewhere, including both lessons from the flexible, volume based approach to degression used in Germany and the retroactive changes made by Spain. See the various Deutsche Bank reviews of FiT schemes for example 17

17 Deutsche Bank, 2009, Paying for Renewable Energy, TLC at the right price
http://www.dbcca.com/dbcca/EN/_media/Paying_for_Renewable_Energy_TLC_at_the_Right_Price.pdf