

Solar PV cost update

Department of Energy &
Climate Change

January 2012

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Solar PV cost update

January 2012

Prepared for
Department of Energy & Climate Change

Prepared by
Parsons Brinckerhoff

www.pbworld.co.uk



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1 INTRODUCTION

The Department of Energy & Climate Change (DECC) appointed Parsons Brinckerhoff (PB) to update the costs of solar PV used in DECC's model for the UK Feed-In Tariff (FIT). These costs had been provided previously by PB in 2011 as part of the CEPA/PB project to update the FIT model and costs¹.

This report provides the updated cost data.

2 METHODOLOGY

PB was appointed to carry out this work on 10th January 2012, with a required reporting date of 13th January 2012. Given the short timescale available, our approach has been to gather up-to-date cost data using our existing project and market knowledge, informal discussions with industry contacts and a number of quotes from industry. A total of approximately 80 data points on current costs were obtained from a total of 13 different industry contacts and 7 other sources.

This data was reviewed to update the cost estimates provided in 2011, which were largely based on data gathered during the summer of 2011. A medium estimate was developed, representing what we consider to be a typical project cost based on an average of the range of data gathered within each capacity band. High and low cost estimates were also developed, representing our estimate of the range of reasonable costs based on what the market is currently offering.

Future cost projections were reviewed in light of market views on potential trends in both component and installation costs. The sources of this information are discussed in Section 4 below.

3 CURRENT COSTS

3.1 Capex

Appendix A of this report provides our updated capex data for UK PV installations. In summary, this shows significant reductions since the data provided in the 2011 report, ranging from 10-20% for domestic systems to 40-50% for larger installations (50 kW and above). Compared to 2011, there now appears to be a significant price drop once system size reaches 50 kW. Given the smaller number of data points available for larger systems, there is relatively less confidence in these costs than for smaller systems, although the data that were available were reasonably consistent, providing confidence that the reductions shown have taken place.

There was very limited new data available on capex for aggregators <4 kW. We have therefore maintained the ratio of 65% between aggregated and non-aggregated costs from our 2011 report. The data we did receive for the current report suggest this is a reasonable value. For aggregators >4 kW, no new data was available so the same ratio to non-aggregated costs has been applied.

The current capex data is based on a sample size of approximately 80 data points covering the range of system sizes. These individual data points are provided in Appendix B. With the exception of small number of data points from PB project experience in late 2011, these data are all from January 2012. While we consider the

¹ "Updates to the Feed-In Tariffs Model: documentation of changes for solar PV consultation", CEPA/PB, October 2011

data to provide a reasonable picture of current costs, they represent only a sample of current UK prices and so there may be systems available at prices outside the range shown.

To derive the updated costs provided in Appendix A, the individual cost data points were averaged for each system size. These were then grouped into the relevant FIT size bands and an average taken for the band to provide the medium case cost for that band. The highest and lowest data points for each system size were grouped in the same way to provide the high and low case costs for each band.

For the <4kW band, costs were split into a fixed cost per installation and a variable cost per kW, based on the proportions used in 2011 report and supported by anecdotal evidence received for this report.

DECC also requested an indicative capex breakdown for different project scales and this is shown in the table below:

<i>Item</i>	<i>% of capex</i>		
	Domestic installation	Commercial installation	Utility-scale installation
PV modules	35-50%	40-45%	45-55%
Inverters	10-15%	10-12%	8-12%
Other components	6-10%	10-15%	25-30%
Installation and other project costs	35-45%	30-40%	10-15%

Domestic = small system, typically on domestic roof, < 10kW

Commercial = medium size system on commercial or industrial premises, 10's or 100's of kW

Utility scale = large system design for electricity export, MW's in scale

3.2

Opex

Appendix A provides our updated operating cost data for UK PV installations. Periodic inverter replacement is included in our data as an operating cost. We have updated the opex data to reflect the 5 - 10% reduction in inverter costs since mid-2011, as reported in both our discussions with supply chain parties and the anecdotal evidence received.

Other elements of operating cost have not been changed since the 2011 data as there was no evidence that indicated that these have changed significantly.

3.3

Other assumptions

Other data provided in 2011 included load factors, equipment lifetime and export fractions. From our brief review, we have seen no evidence that these have changed significantly since our 2011 report. As noted in previous discussions with DECC, and in our 2011 report, data on actual export fractions remains limited and so these values remain subject to significant uncertainty.

3.4 Data sources

The data sources used to develop our current cost values have been:

- Direct verbal, email or web quotes from UK installers (11 in total);
- Informal discussions with two developers of larger scale UK projects on recent cost quotes they have received;
- PB experience of recent large scale projects (>50 kW) in the UK, both roof-mounted and stand-alone. In these projects we have been advising either developers or lenders and have had access to installation costs. We have also worked on a number of utility scale projects in Europe, Africa and the Middle East which, while not directly applicable to the UK market, have provided insight into global component prices;
- Informal discussions with supply chain parties including an independent supply chain expert and an inverter supplier; and
- Anecdotal evidence from DECC (sourced from installers, module suppliers and others) and other sources including industry news websites.

4 FUTURE COSTS

4.1 Capex

There are numerous factors influencing the future capital costs of PV systems. These include the global supply chain for PV modules (and the raw materials, in particular silicon, used to make them), the size and capability of the UK installer base, the level of demand in the UK and Europe as a result of feed-in tariffs and the level of demand in other countries where high solar resources are making PV increasingly competitive.

Both supply and demand factors are currently uncertain – falling prices have stimulated demand, but changes in tariffs may reduce demand, while increased supply capacity has increased competition and driven down prices but may result in capacity being reduced which could in turn affect prices. The uncertainty in supply and demand and how they will influence each other means that future costs are very difficult to predict.

Our approach to updating future costs has been to gather views from a range of industry participants. These have principally been a sub-set of the sources described in Section 3 above including:

- Developers and installers of UK systems;
- Supply chain parties; and
- Anecdotal evidence from DECC and other sources.

Note that our assessment of future costs has not included quantitative analysis of demand for PV in the UK or elsewhere, supply chain capacity or future technology

development. We have, however, used insights drawn from our evidence gathering on the possible trends in these factors to develop the future cost values.

The information gathered showed significant uncertainty about future costs, with a range of different views expressed and all sources highlighting the high level of uncertainty. The views expressed fell broadly into two categories: those that expect a stabilisation or slight fall in prices during 2012, followed by further falls in subsequent years, and those who expect more significant declines during 2012 and ongoing falls in 2013 and beyond. Some installers and supply chain sources expected some price fluctuations during 2012 in response to specific factors such as potential changes in tariff levels in different European countries.

For sources expecting some price stabilisation during 2012, key factors leading to this outcome were:

- Significant reductions in supply chain capacity (both global module supply and UK installer base) as firms exit the market as a result of low margins;
- Demand being maintained, albeit with variation between countries/regions.

Sources expecting significant price reductions in 2012 cited the following as key factors:

- Continuing over-capacity (both globally and in the UK) as suppliers and installers compete for market share;
- UK installers stay in the market and accept reduced margins;
- Demand in the UK and Europe reduces as available tariffs reduce.

Table B2 in Appendix B gives the data provided by the various sources on costs for 2012.

From the range of data gathered, we have developed three scenarios (large, medium and small cost reduction) for future capex costs. While we have made use of the available quantitative data, development of these scenarios has required the use of judgement as to the impact of the different factors influencing costs.

We have applied the three future cost scenarios to the current capex costs so as to show the full range of possible outcomes, i.e. the large reduction is applied to the low current cost scenario, the medium reduction to the medium current cost scenario and the small reduction to the high current cost scenario.

The resulting potential future cost data from this methodology is shown in the tables in Appendix A. The range of potential reductions in the capex cost is 10 - 30% by the end of 2012, with further falls of 5 - 25% per year in 2013/2014 and smaller ongoing reductions in 2015 and beyond. This is based on our judgement that the combination of factors (as described in the table below) will result in some cost reductions by the end of the 2012. For 2013 and beyond, the values cover a range from supply-demand stabilisation (leading to smaller incremental cost reductions) to a continuing over-supply (leading to larger reductions on 2013/14).

The key factors assumed to apply for each scenario are shown in the table below:

Period	Small cost reduction	Medium cost reduction	Large cost reduction
2012	Significant reductions in global PV module capacity as plants close	Some reductions in global module capacity, but over-supply persists	Global module capacity maintained as suppliers stay in the market
	Significant numbers of UK installers leave the market, allowing remaining players to stabilise margins	Some UK installers leave market but sufficient capacity remains to continue pressure on margins	UK installers stay in the market and accept very low margins
	Global demand continues to grow as emerging markets make up for reducing demand elsewhere	Demand maintained overall but at lower growth rates than recent years	Global demand weakens, emerging markets do not make up for reductions in established countries
	Tariff reductions across Europe less than expected, maintaining demand	Tariff reductions in European markets reduce demand growth	Tariff reductions across Europe lead to significant reduction in demand
	Competitive market continues, but tighter supply chain capacity reduces scope for price falls	Highly competitive market continues, component prices and installer margins continue to fall allowing prices overall to fall	Very high levels of competition, installers accept very low margins, fight for market share and focus on lowest possible cost components
2013/2014	Continued demand growth but at a slower pace due to stabilised prices, supply chain capacity maintained/re-started and some price reductions result	Some degree of overcapacity persists despite demand growth, maintaining downward pressure on prices	Previous price falls encourage demand to grow, increasing volumes and allowing capacity and competition to be maintained, pushing prices down further
2015 & beyond	Maturing supply chain allows incremental improvements and price reductions	<i>As low, plus:</i> Some technology breakthroughs occur, resulting in price reductions	<i>As low & medium, plus:</i> Significant technology breakthroughs allow ongoing price reductions

DECC requested a view of where capital costs are likely to be in July 2012. The available data on this is provided in Table B2 and shows a range of views. A supply chain source commented that mid-year tariff reductions in Germany may cause a short term increase in demand in the April-June period, causing mid 2012 costs to be similar to today. This would then be followed by a sharp drop in prices as demand reduces, which may affect prices in July. Other anecdotal data and developer data indicated reductions expected throughout 2012, resulting in lower prices in July 2012 than today. A further supply chain source expected costs to remain flat throughout 2012 and that July prices would therefore be similar to today. Overall, prices in July 2012 may be of the order of 10 - 20% lower than today, but this is expected to be dependent on the nature and timing of tariff decisions in a number of European countries.

4.2 Opex

On operating costs, we have assumed that there will be ongoing downward pressure on inverter prices as a result of the wider cost reduction pressures described above, maintaining the historical trend of slowly falling prices. This has been taken into account in the future operating costs shown in Appendix A.

4.3 Comments

Note that the scenarios for future costs are based a small sample size, a high degree of variability within the data gathered and the need to use judgement as to the impact of the above factors on costs. This therefore means there is a high level of uncertainty associated with the data. As an illustration of this, a number of the contacts we discussed future prices with did not feel able to give an opinion, given the uncertainties in both supply and demand.

It should also be borne in mind that the data was gathered over a short period in mid January 2012 and therefore represents a “snapshot” of industry views at that time. Given the uncertainties in the market we acknowledge that market sentiment may have shifted since the data was gathered, and is likely to continue to do so in the future.



APPENDIX A - UPDATED PV COSTS

Capex – low cost estimate

Table A1: Fixed cost (£/installation)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£734	£661	£595	£565	£548	£545	£543	£540	£537	£535	£532	£529	£527	£524	£521	£519	£516	£514	£511	£508
Retrofit domestic (2kW)	£734	£661	£595	£565	£548	£545	£543	£540	£537	£535	£532	£529	£527	£524	£521	£519	£516	£514	£511	£508
New build 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 250–5000kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 250–5000kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stand alone system	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators<4kW	£500	£450	£405	£385	£373	£371	£369	£368	£366	£364	£362	£360	£359	£357	£355	£353	£351	£350	£348	£346
Aggregators>4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: in this and subsequent tables, costs from 2013 onwards are for the end of the end of year stated

Table A2: Marginal cost (£/kW)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£1,716	£1,201	£901	£811	£730	£679	£631	£587	£546	£508	£487	£468	£449	£431	£414	£397	£382	£366	£352	£338
Retrofit domestic (2kW)	£1,716	£1,201	£901	£811	£730	£679	£631	£587	£546	£508	£487	£468	£449	£431	£414	£397	£382	£366	£352	£338
New build 4–10kW	£1,700	£1,190	£893	£759	£645	£580	£522	£470	£423	£381	£362	£344	£326	£310	£295	£286	£277	£269	£261	£253
Retrofit 4–10kW	£1,700	£1,190	£893	£759	£645	£580	£522	£470	£423	£381	£362	£344	£326	£310	£295	£286	£277	£269	£261	£253
New build 10–50kW	£1,700	£1,190	£892	£758	£645	£580	£522	£470	£423	£381	£362	£344	£326	£310	£295	£286	£277	£269	£261	£253
Retrofit 10–50kW	£1,700	£1,190	£892	£758	£645	£580	£522	£470	£423	£381	£362	£344	£326	£310	£295	£286	£277	£269	£261	£253
New build 50–150kW	£1,400	£980	£735	£625	£531	£478	£430	£387	£348	£314	£298	£283	£269	£255	£243	£235	£228	£221	£215	£208
Retrofit 50–150kW	£1,400	£980	£735	£625	£531	£478	£430	£387	£348	£314	£298	£283	£269	£255	£243	£235	£228	£221	£215	£208
New build 150–250kW	£1,100	£770	£578	£491	£417	£376	£338	£304	£274	£246	£234	£222	£211	£201	£191	£185	£179	£174	£169	£164
Retrofit 150–250kW	£1,100	£770	£578	£491	£417	£376	£338	£304	£274	£246	£234	£222	£211	£201	£191	£185	£179	£174	£169	£164
New build 250–5000kW	£1,000	£700	£525	£446	£379	£341	£307	£277	£249	£224	£213	£202	£192	£182	£173	£168	£163	£158	£153	£149
Retrofit 250–5000kW	£1,000	£700	£525	£446	£379	£341	£307	£277	£249	£224	£213	£202	£192	£182	£173	£168	£163	£158	£153	£149
Stand alone system	£1,000	£700	£525	£446	£379	£341	£307	£277	£249	£224	£213	£202	£192	£182	£173	£168	£163	£158	£153	£149
Aggregators<4kW	£1,000	£500	£375	£338	£304	£279	£257	£237	£218	£200	£190	£181	£172	£163	£155	£147	£140	£133	£126	£120
Aggregators>4kW	£1,030	£515	£386	£348	£313	£288	£265	£244	£224	£206	£196	£186	£177	£168	£160	£152	£144	£137	£130	£123

Capex – medium cost estimate

Table A3: Fixed cost (£/installation)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£1,249	£1,187	£1,127	£1,071	£1,039	£1,008	£997	£987	£978	£968	£958	£949	£939	£930	£920	£911	£902	£893	£884	£875
Retrofit domestic (2kW)	£1,249	£1,187	£1,127	£1,071	£1,039	£1,008	£997	£987	£978	£968	£958	£949	£939	£930	£920	£911	£902	£893	£884	£875
New build 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stand alone system	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators<4kW	£900	£855	£812	£772	£748	£726	£719	£712	£704	£697	£690	£684	£677	£670	£663	£657	£650	£644	£637	£631
Aggregators>4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A4: Marginal cost (£/kW)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£2,542	£1,907	£1,621	£1,459	£1,356	£1,289	£1,224	£1,163	£1,105	£1,050	£1,018	£988	£958	£929	£901	£874	£848	£823	£798	£774
Retrofit domestic (2kW)	£2,542	£1,907	£1,621	£1,459	£1,356	£1,289	£1,224	£1,163	£1,105	£1,050	£1,018	£988	£958	£929	£901	£874	£848	£823	£798	£774
New build 4–10kW	£2,464	£1,848	£1,571	£1,414	£1,272	£1,171	£1,077	£991	£912	£839	£805	£773	£742	£712	£684	£663	£643	£624	£605	£587
Retrofit 4–10kW	£2,464	£1,848	£1,571	£1,414	£1,272	£1,171	£1,077	£991	£912	£839	£805	£773	£742	£712	£684	£663	£643	£624	£605	£587
New build 10–50kW	£2,260	£1,695	£1,441	£1,297	£1,167	£1,074	£988	£909	£836	£769	£738	£709	£680	£653	£627	£608	£590	£572	£555	£539
Retrofit 10–50kW	£2,260	£1,695	£1,441	£1,297	£1,167	£1,074	£988	£909	£836	£769	£738	£709	£680	£653	£627	£608	£590	£572	£555	£539
New build 50–150kW	£1,648	£1,236	£1,051	£946	£851	£783	£720	£663	£610	£561	£539	£517	£496	£476	£457	£444	£430	£417	£405	£393
Retrofit 50–150kW	£1,648	£1,236	£1,051	£946	£851	£783	£720	£663	£610	£561	£539	£517	£496	£476	£457	£444	£430	£417	£405	£393
New build 150–250kW	£1,300	£975	£829	£746	£671	£618	£568	£523	£481	£442	£425	£408	£391	£376	£361	£350	£339	£329	£319	£310
Retrofit 150–250kW	£1,300	£975	£829	£746	£671	£618	£568	£523	£481	£442	£425	£408	£391	£376	£361	£350	£339	£329	£319	£310
New build 250–500kW	£1,200	£900	£765	£689	£620	£570	£524	£483	£444	£408	£392	£376	£361	£347	£333	£323	£313	£304	£295	£286
Retrofit 250–500kW	£1,200	£900	£765	£689	£620	£570	£524	£483	£444	£408	£392	£376	£361	£347	£333	£323	£313	£304	£295	£286
Stand alone system	£1,200	£900	£765	£689	£620	£570	£524	£483	£444	£408	£392	£376	£361	£347	£333	£323	£313	£304	£295	£286
Aggregators<4kW	£1,610	£1,208	£1,026	£924	£859	£799	£743	£691	£643	£598	£574	£551	£529	£508	£487	£468	£449	£431	£414	£397
Aggregators>4kW	£1,650	£1,238	£1,052	£947	£880	£819	£761	£708	£659	£612	£588	£564	£542	£520	£499	£479	£460	£442	£424	£407

Capex – high cost estimate

Table A5: Fixed cost (£/installation)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£2,288	£2,231	£2,175	£2,121	£2,089	£2,058	£2,027	£1,997	£1,967	£1,937	£1,908	£1,880	£1,851	£1,824	£1,796	£1,769	£1,743	£1,717	£1,691	£1,665
Retrofit domestic (2kW)	£2,288	£2,231	£2,175	£2,121	£2,089	£2,058	£2,027	£1,997	£1,967	£1,937	£1,908	£1,880	£1,851	£1,824	£1,796	£1,769	£1,743	£1,717	£1,691	£1,665
New build 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stand alone system	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators<4kW	£1,500	£1,463	£1,426	£1,390	£1,369	£1,349	£1,329	£1,309	£1,289	£1,270	£1,251	£1,232	£1,213	£1,195	£1,177	£1,160	£1,142	£1,125	£1,108	£1,092
Aggregators>4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A6: Marginal cost (£/kW)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£3,606	£3,245	£2,921	£2,775	£2,636	£2,557	£2,480	£2,406	£2,334	£2,264	£2,196	£2,152	£2,109	£2,067	£2,025	£1,985	£1,945	£1,906	£1,868	£1,831
Retrofit domestic (2kW)	£3,606	£3,245	£2,921	£2,775	£2,636	£2,557	£2,480	£2,406	£2,334	£2,264	£2,196	£2,152	£2,109	£2,067	£2,025	£1,985	£1,945	£1,906	£1,868	£1,831
New build 4–10kW	£3,600	£3,240	£2,916	£2,770	£2,632	£2,526	£2,425	£2,328	£2,235	£2,146	£2,103	£2,061	£2,020	£1,979	£1,940	£1,901	£1,863	£1,826	£1,789	£1,753
Retrofit 4–10kW	£3,600	£3,240	£2,916	£2,770	£2,632	£2,526	£2,425	£2,328	£2,235	£2,146	£2,103	£2,061	£2,020	£1,979	£1,940	£1,901	£1,863	£1,826	£1,789	£1,753
New build 10–50kW	£3,200	£2,880	£2,592	£2,462	£2,339	£2,246	£2,156	£2,070	£1,987	£1,907	£1,869	£1,832	£1,795	£1,759	£1,724	£1,690	£1,656	£1,623	£1,590	£1,558
Retrofit 10–50kW	£3,200	£2,880	£2,592	£2,462	£2,339	£2,246	£2,156	£2,070	£1,987	£1,907	£1,869	£1,832	£1,795	£1,759	£1,724	£1,690	£1,656	£1,623	£1,590	£1,558
New build 50–150kW	£2,200	£1,980	£1,782	£1,693	£1,608	£1,544	£1,482	£1,423	£1,366	£1,311	£1,285	£1,259	£1,234	£1,210	£1,185	£1,162	£1,138	£1,116	£1,093	£1,071
Retrofit 50–150kW	£2,200	£1,980	£1,782	£1,693	£1,608	£1,544	£1,482	£1,423	£1,366	£1,311	£1,285	£1,259	£1,234	£1,210	£1,185	£1,162	£1,138	£1,116	£1,093	£1,071
New build 150–250kW	£2,100	£1,890	£1,701	£1,616	£1,535	£1,474	£1,415	£1,358	£1,304	£1,252	£1,227	£1,202	£1,178	£1,155	£1,131	£1,109	£1,087	£1,065	£1,044	£1,023
Retrofit 150–250kW	£2,100	£1,890	£1,701	£1,616	£1,535	£1,474	£1,415	£1,358	£1,304	£1,252	£1,227	£1,202	£1,178	£1,155	£1,131	£1,109	£1,087	£1,065	£1,044	£1,023
New build 250–500kW	£2,000	£1,800	£1,620	£1,539	£1,462	£1,404	£1,347	£1,294	£1,242	£1,192	£1,168	£1,145	£1,122	£1,100	£1,078	£1,056	£1,035	£1,014	£994	£974
Retrofit 250–500kW	£2,000	£1,800	£1,620	£1,539	£1,462	£1,404	£1,347	£1,294	£1,242	£1,192	£1,168	£1,145	£1,122	£1,100	£1,078	£1,056	£1,035	£1,014	£994	£974
Stand alone system	£2,000	£1,800	£1,620	£1,539	£1,462	£1,404	£1,347	£1,294	£1,242	£1,192	£1,168	£1,145	£1,122	£1,100	£1,078	£1,056	£1,035	£1,014	£994	£974
Aggregators<4kW	£2,810	£2,529	£2,276	£2,162	£2,054	£1,972	£1,893	£1,817	£1,745	£1,675	£1,641	£1,609	£1,576	£1,545	£1,514	£1,484	£1,454	£1,425	£1,396	£1,369
Aggregators>4kW	£2,700	£2,430	£2,187	£2,078	£1,974	£1,895	£1,819	£1,746	£1,676	£1,609	£1,577	£1,546	£1,515	£1,484	£1,455	£1,426	£1,397	£1,369	£1,342	£1,315

Opex – low cost estimate

Table A7: Fixed costs (£/installation per year)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£45	£43	£42	£41	£41	£40	£40	£40	£40	£40	£39	£39	£39	£39	£39	£38	£38	£38	£38	£38
Retrofit domestic (2kW)	£45	£43	£42	£41	£41	£40	£40	£40	£40	£40	£39	£39	£39	£39	£39	£38	£38	£38	£38	£38
New build 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stand alone system	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators<4kW	£40	£38	£38	£37	£36	£36	£36	£36	£35	£35	£35	£35	£35	£35	£34	£34	£34	£34	£34	£34
Aggregators>4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A8: Marginal costs (£/kW per year)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit domestic (2kW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 4–10kW	£17	£16	£16	£16	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14
Retrofit 4–10kW	£17	£16	£16	£16	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14
New build 10–50kW	£17	£16	£16	£16	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14
Retrofit 10–50kW	£17	£16	£16	£16	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14
New build 50–150kW	£16	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£14	£14	£14	£14	£14	£14	£14	£13	£13
Retrofit 50–150kW	£16	£16	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£13	£13	£13	£13	£13
New build 150–250kW	£16	£16	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£13	£13	£13	£13	£13
Retrofit 150–250kW	£16	£16	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£13	£13	£13	£13	£13
New build 250–500kW	£16	£16	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£13	£13	£13	£13	£13
Retrofit 250–500kW	£16	£16	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£13	£13	£13	£13	£13
Stand alone system	£16	£16	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£13	£13	£13	£13	£13
Aggregators<4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators>4kW	£16	£16	£15	£15	£15	£15	£15	£15	£14	£14	£14	£14	£14	£14	£14	£13	£13	£13	£13	£13

Opex – medium cost estimate

Table A9: Fixed costs (£/installation per year)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£65	£63	£63	£62	£61	£61	£61	£61	£61	£61	£61	£61	£61	£60	£60	£60	£60	£60	£60	£60
Retrofit domestic (2kW)	£65	£63	£63	£62	£61	£61	£61	£61	£61	£61	£61	£61	£61	£60	£60	£60	£60	£60	£60	£60
New build 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stand alone system	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators<4kW	£90	£88	£87	£86	£85	£85	£85	£85	£84	£84	£84	£84	£84	£84	£83	£83	£83	£83	£83	£83
Aggregators>4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A10: Marginal costs (£/kW per year)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit domestic (2kW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 4–10kW	£23	£22	£22	£22	£22	£22	£22	£22	£21	£21	£21	£21	£21	£21	£21	£21	£21	£21	£21	£21
Retrofit 4–10kW	£23	£22	£22	£22	£22	£22	£22	£22	£21	£21	£21	£21	£21	£21	£21	£21	£21	£21	£21	£21
New build 10–50kW	£22	£21	£21	£21	£21	£21	£21	£21	£21	£21	£20	£20	£20	£20	£20	£20	£20	£20	£20	£20
Retrofit 10–50kW	£22	£21	£21	£21	£21	£21	£21	£21	£21	£21	£20	£20	£20	£20	£20	£20	£20	£20	£20	£20
New build 50–150kW	£22	£22	£21	£21	£21	£21	£21	£21	£21	£20	£20	£20	£20	£20	£20	£19	£19	£19	£19	£19
Retrofit 50–150kW	£22	£22	£21	£21	£21	£21	£21	£21	£21	£20	£20	£20	£20	£20	£20	£19	£19	£19	£19	£19
New build 150–250kW	£20	£20	£20	£19	£19	£19	£19	£19	£19	£19	£18	£18	£18	£18	£18	£18	£18	£17	£17	£17
Retrofit 150–250kW	£20	£20	£20	£19	£19	£19	£19	£19	£19	£19	£18	£18	£18	£18	£18	£18	£18	£17	£17	£17
New build 250–500kW	£20	£20	£20	£19	£19	£19	£19	£19	£19	£19	£18	£18	£18	£18	£18	£18	£18	£17	£17	£17
Retrofit 250–500kW	£20	£20	£20	£19	£19	£19	£19	£19	£19	£19	£18	£18	£18	£18	£18	£18	£18	£17	£17	£17
Stand alone system	£20	£20	£20	£19	£19	£19	£19	£19	£19	£19	£18	£18	£18	£18	£18	£18	£18	£17	£17	£17
Aggregators<4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators>4kW	£25	£25	£24	£24	£24	£24	£24	£23	£23	£23	£23	£23	£23	£22	£22	£22	£22	£22	£22	£21

Opex – high cost estimate

Table A11: Fixed costs (£/installation per year)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110
Retrofit domestic (2kW)	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110	£110
New build 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 4–10kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 10–50kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 50–150kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 150–250kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit 250–500kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stand alone system	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators<4kW	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140	£140
Aggregators>4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Table A12: Marginal costs (£/kW per year)

Size	Jan-12	End 2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
New build domestic (2kW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Retrofit domestic (2kW)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
New build 4–10kW	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33
Retrofit 4–10kW	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33	£33
New build 10–50kW	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32
Retrofit 10–50kW	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32	£32
New build 50–150kW	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30
Retrofit 50–150kW	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30	£30
New build 150–250kW	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28
Retrofit 150–250kW	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28
New build 250–500kW	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28
Retrofit 250–500kW	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28
Stand alone system	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28	£28
Aggregators<4kW	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aggregators>4kW	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35	£35

APPENDIX B – SOURCED COST DATA

Table B1: current capex data and sources

Size (kW)	Installer quotes											Anecdotal						Developer		PB project experience	AVERAGE £ installed	AVERAGE £/kW											
	1	2	3	4a	4b	4c	5a	5b	6	7	8	9	10	11	1	2	3 (DECC)	4 (DECC)	5 (DECC)				6	1	2								
1.1														£4,800																	£4,800	£4,211	
1.5														£6,370																	£6,370	£4,191	
1.9												£6,224		£7,640																	£6,932	£3,648	
2.0	£7,300	£8,000	£5,300	£4,995	£5,750	£6,995	£7,750	£9,500		£4,750	£5,500																				£6,584	£3,292	
2.3														£8,590																		£8,590	£3,768
2.4										£6,500																						£6,500	£2,664
2.7														£9,292																		£9,292	£3,493
2.9														£9,833																		£9,833	£3,450
2.9										£7,000																						£7,000	£2,431
3.0	£7,995	£9,500	£6,600	£6,495	£7,250	£8,750	£8,800	£10,900		£6,950	£6,250																					£7,949	£2,650
3.0														£10,449																		£10,449	£3,437
3.4										£7,500																						£7,500	£2,232
3.4														£11,001																		£11,001	£3,217
3.5							£9,600	£12,150		£7,975																						£9,908	£2,831
3.8														£12,566																		£12,566	£3,307
3.8										£8,500							£10,000															£9,250	£2,409
3.9													£9,777																			£9,777	£2,494
3.99														£13,064																		£13,064	£3,274
4.0	£8,995	£12,000	£8,500	£7,995	£8,495	£10,495	£10,400	£13,400		£8,995	£9,500			£14,400			£7,200	£11,000	£11,000													£10,170	£2,542
4.5				£8,750	£9,250	£11,495		£14,800																								£11,074	£2,461
5.4													£14,001																			£14,001	£2,598
9.0													£20,306																			£20,306	£2,256
10				£16,995	£17,995	£23,495							£22,500			£32,000																£22,597	£2,260

(continued on next page)

Table B1 contd.

Size (kW)	Installers											Anecdotal						Developer		PB project experience	AVERAGE	AVERAGE £/kW							
	1	2	3	4a	4b	4c	5a	5b	6	7	8	9	10	11	1	2	3 (DECC)	4 (DECC)	5 (DECC)				6	1	2				
50													£95,000		£90,000	£81,000	£70,000									£92,799	£92,300	£1,846	
75																											£105,000	£105,000	£1,400
200																											£260,000	£260,000	£1,300
1000																	£1,200,000										£1,200,000	£1,200,000	£1,200
5000																					£6,200,000						£6,200,000	£1,240	
10000																							£12,000,000				£12,000,000	£1,200	
Aggregated 4.0													£7,600				£5,600										£6,600	£1,650	

Notes:

1. All data is for January 2012, except PB project experience which is from data gathered during November 2011 to January 2012.
2. Source types:
 - a. Installer = direct quote from a UK installer;
 - b. Anecdotal = informal data from industry contacts, industry news reports etc, some of which was provided by DECC;
 - c. Developer = data from developers of large scale UK projects;
 - d. PB project experience = cost data from recent UK projects that PB has had involvement with.
3. Installer 1, 2, 3 etc.; Anecdotal 1, 2, 3 etc refers to different sources within each source type;
4. Installer 4a, 4b, 4c etc. indicates data from the same source but for different systems.

To derive the updated costs provided in Appendix A, the individual cost data points were averaged for each system size, as shown in Table B1 above. These were then grouped into the relevant FIT size bands and an average taken for the band to provide the medium case cost for that band. The highest and lowest data points for each system size were grouped in the same way to provide the high and low case costs for each band.

For the <4kW band, costs were split into a fixed cost per installation and a variable cost per kW. The medium case fixed cost of £1,249 is equivalent to around 20% of the total cost of a 2 kW system, based on the evidence gathered for our 2011 report and supported by anecdotal evidence received for this report.

Table B2: future cost data and sources

% cost reduction vs. Jan 2012	<i>Anecdotal</i>			<i>Developer</i>		<i>Supply chain</i>	
	<i>1</i>	<i>2 (DECC)</i>	<i>3</i>	<i>1</i>	<i>2</i>	<i>1</i>	<i>2</i>
<i>By mid 2012</i>	-	17%	10%	-	small reduction	0%	flat
<i>By end 2012</i>	17%	20%	-	flat	small reduction	30-50%	flat

Note: a number of other installer and developer sources were asked about future prices but stated that there was too much uncertainty to provide meaningful comments.