

Solar PV

Analysis of recent changes in PV arrays size diversity in Germany

Diversity in solar PV installations sizes is an advantage and the German case has been already analyzed [1], [2], using detailed data provided by the Bundesnetzagentur (BNetzA)[3]. Changes in PV feed-in tariffs discussed and passed in the first half of 2012 have resulted in a fast increase in new PV installations opening discussions on the changes in array sizes, types of systems developers and owners and cost for electricity consumers [4]. In this guest article, French expert Bernard Chabot analyzes and comments the potential impacts on PV arrays size diversity of the PV installations in Germany from 2009 to the end of June 2012.

According to reference [5], PV installations in Germany delivered 19 TWh in 2011, from a cumulative installed power starting at 17.32 GW in January 1st and increasing to 24.82 GW at the end of December. Full data from BNetzA released in August 2nd for the complete first half of 2012 indicates that a total of 4.373 GW were registered from January to June, leading to a total of 29.193 GW of installed and registered PV systems at the end of June 2012. The total PV power registered and made public by BNetzA since the beginning of 2009 is 23.038 GW from 745,344 systems. So the registered PV power is 79 % of the total installed PV power in Germany, and thus the following analysis on all registered PV systems is well representative of all installed PV arrays in Germany.

Table 1 summarizes the distribution in MW and in number of systems of all registered PV installations classified under 10 power classes (no registered systems were higher than 100 MW). Around 1/3 of registered power is from systems larger than 300 kW, which constitute only 0.8 % of the number of systems, around 1/3 from systems larger than 30 kW and up to 300 kW (13.4 % of systems) and slightly more than 1/3 from systems up to 30 kW (85.7 % of systems). The maximum contribution (25.1 %) is from the 10 to 30 kW class (39.1 % of systems), followed by the 30 to 100 kW class (20.6 % of power from 11.3 % of systems). The combination of those two classes in a “10 to 100 kW” class leads to 45.7 % of power from 50.4 % of systems, representing what could be described as the “core characteristic of distributed PV production in Germany.”

Registered solar PV systems in Germany from 2009 to the end of June 1012. Source of data: BNetzA						
Classes of power	Total Power	Mean Power	% Total Power		N	% of N
	MW	kW/system			Units	% of systems
> 100 MW	0,0	0	0,0%		0	0%
> 30 to 100 MW	51,0	50 990	0.3%		1	0.0001%
> 10 to 30 MW	1021.707795	15 719	3.2%		65	0.0087%
> 3 to 10 MW	2791.8	5 076	11.4%	32.7%	550	0.074%
> 1 to 3 MW	2103.9	1 684	8.4%		1 249	0.17%
> 300 to 1 000 kW	2 354,0	529	9.5%		4 452	0.6%
> 100 to 300 kW	2705.1	166,28	11.3%		16 268	2.18%
> 30 to 100 kW	4457.2	53,09	20.6%	31.9%	83 949	11.26%
> 10 to 30 kW	5334.6	18,30	25.1		291 517	39.11%
> 3 to 10 kW	2174.3	6,63	10,1%	35.4%	327 723	43.97%
≤ 3 kW	44.2	2,26	0,2%		19 570	2.63%
TOTAL	23 038	30.9	100%	100%	745 344	100%

Table 1: Categories of the 745,344 PV systems registered form 2009 to mid-2012

Figure 1 summarizes this distribution in MW and in % of registered power.

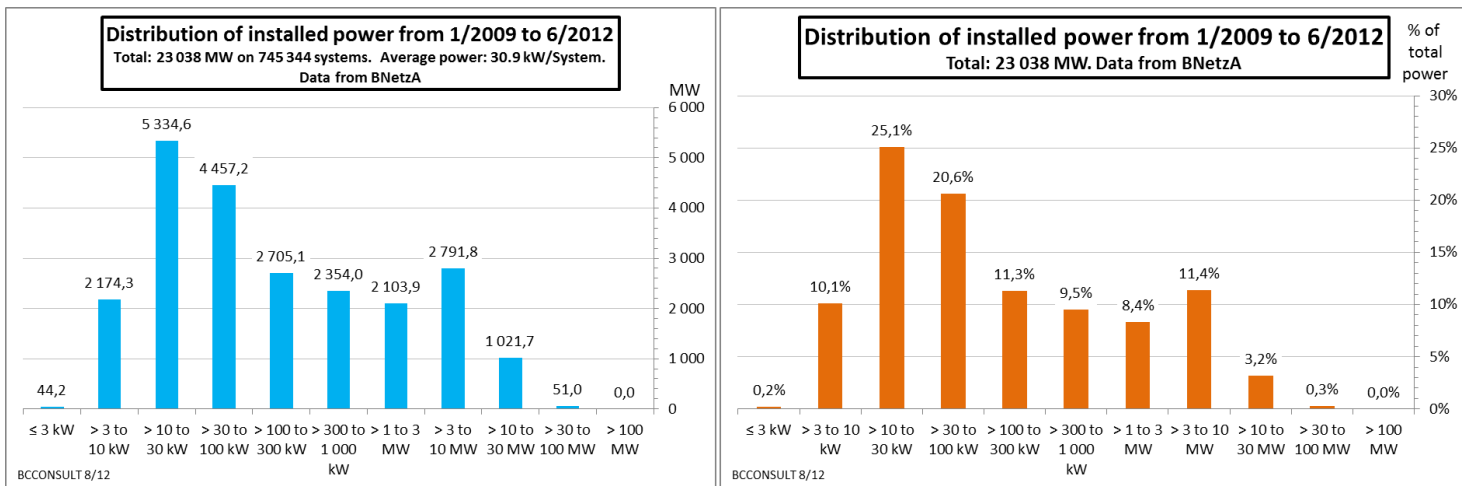


Figure 1: Distribution in MW and in % of power of all registered PV systems at the end of June 2012

In addition to the larger contribution from 10 to 100 kW classes, one can note also the third contribution from systems of the 3 to 10 MW class, probably constituted mainly of ground mounted systems. Typical medium size commercial PV roofs (100 to 300 kW) gives quite the same contribution. Domestic PV roofs (up to 10 kW) contribute only 10.3 % of installed power, with a negligible part from smallest ones under 3 kW.

Table 2 gives details of the distribution of the 2012 monthly installations, along with those from 2009-2011 and the total registered up to the end of June. One can see that the larger contribution to installed power in June and from January to June 2012 was from the 3 to 10 MW class, leading to a decreasing contribution from other power classes, particularly the ones up to 100 kW.

Classes of Power Data from BNetzA	2009 to 2011	2012						January to June 2012	1/2009 to 6/2012
		January	February	March	April	May	June		
> 100 MW	0%	0%	0%	0%	0%	0%	0%	0%	0%
> 30 to 100 MW	0.27%	0%	0%	0%	0%	0%	0%	0%	0%
> 10 to 30 MW	3.16%	6.4%	0%	0%	6.2%	15.4%	18.8%	9.9%	3.2%
> 3 to 10 MW	11.4%	19,0%	5.5%	9.9%	3.3%	6.3%	22.5%	15.2%	11.4%
> 1 to 3 MW	8.4%	10.3%	12.1%	5.3%	6.6%	8.1%	19.8%	12.5%	8.4%
> 300 to 1 000 kW	9.5%	11.1%	12.2%	14.2%	14,0%	8.0%	14.0%	13.3%	9.5%
> 100 to 300 kW	11.3%	13.9%	15,0%	16.7%	16.2%	13.2%	10.6%	13.5%	11.3%
> 30 to 100 kW	20.6%	16.8%	20.2%	19.8%	18.7%	15.5%	7.2%	14.0%	20.6%
> 10 to 30 kW	25.1%	16.2%	23.8%	23.8%	24.3%	21.8%	4.6%	15.0%	25.1%
> 3 to 10 kW	10.1%	6.25%	11.0%	10.1%	10.6%	11.5%	2.3%	6.63%	10.1%
≤ 3 kW	0.21%	0.16%	0.26%	0.18%	0.2%	0.21%	0.05%	0.13%	0.21%
TOTAL	100%	0%	0%	0%	0%	0%	0%	100%	0%
TOTAL MW	18 664	517	230	1 223	359	254	1 791	4 373	23 038

Table 2: Detailed distribution of 2012, total 2009-2011 and 2009 to end of June 2012 installations

This tendency appears also in Figure 2, where January to June 2012 distribution is compared to the preceding one from 2009 to the end of 2011. There was also a surge in the last 6 months of ground-mounted large PV plants larger from 10 to 30 MW; they represented around 10 % of installed power from January to June 2012, three times more compared to the 3.2 % contribution from 2009 to 2011.

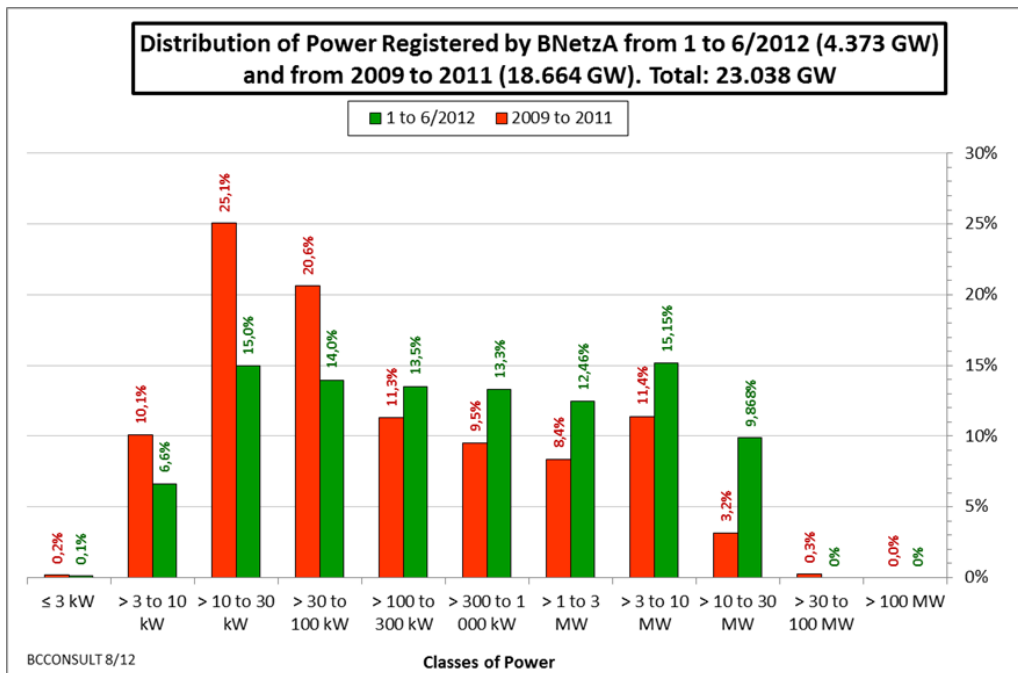


Figure 3: January to June 2012 power distribution compared to the 2009-2011 one

Figure 4 gives the MW registered by power classes during the January to June 2012 period. During those 6 months, around 1.1 GW of PV plants larger than 3 MW were registered.

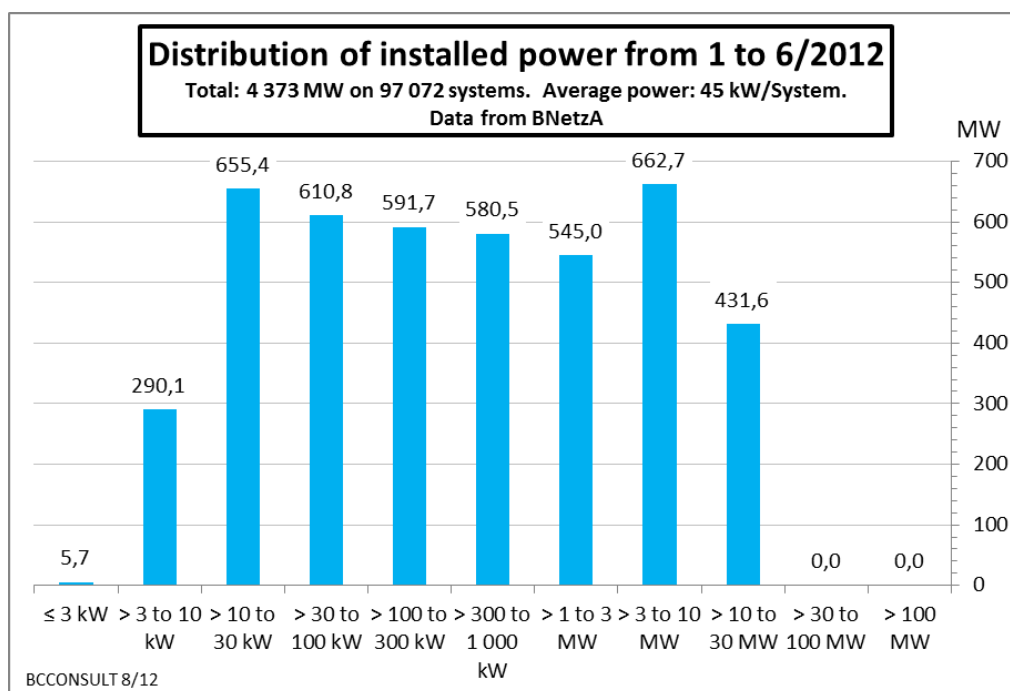


Figure 4: MW registered from January to June 2012

A focus on June 2012 and its 1,790 MW registered is shown in Figure 5. During this month, the larger part of 2012 large power plants were registered, obviously in anticipation of future regulatory and feed-in tariffs changes for those types of PV plants. The June 2012 power distribution is completely different from the historic ones in Figures 1 and 3. Contribution of systems larger than 1 MW was around 1.1 GW and represented more than 51 % of the total MW registered on this month only.

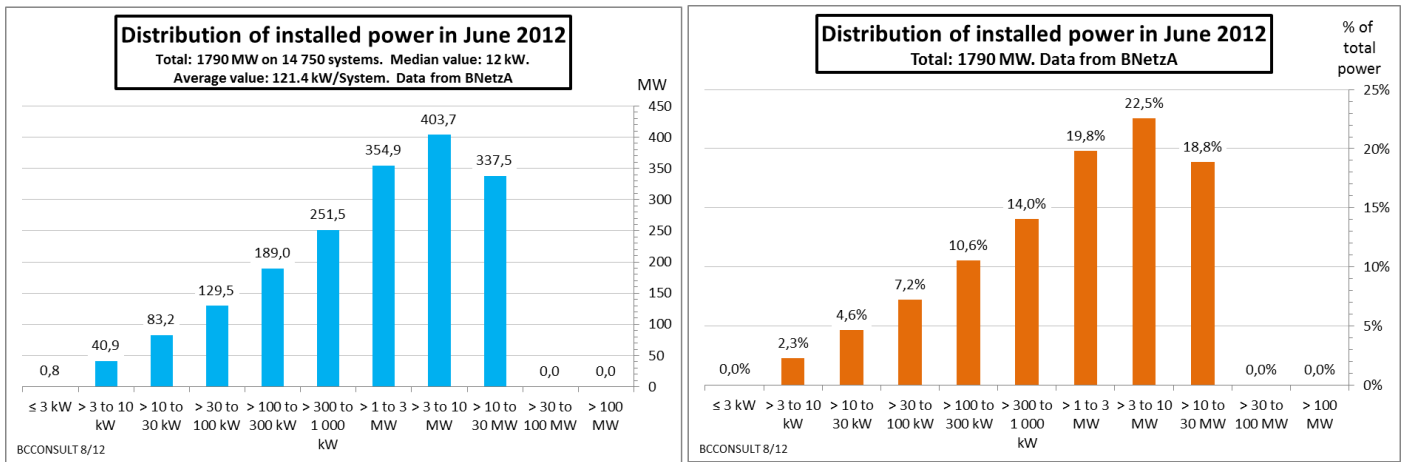


Figure 5: June 2012 registered power distribution

Figure 6 and 7 represents the cumulative percentage of registered power in June 2012 versus the cumulative percentage of the number of registered systems. Those two “fractal curves” are representative of power distribution shifting to large power plants: only 5 % of systems represented 75 % of registered power and 50 % of registered power was from only 1.15 % of systems

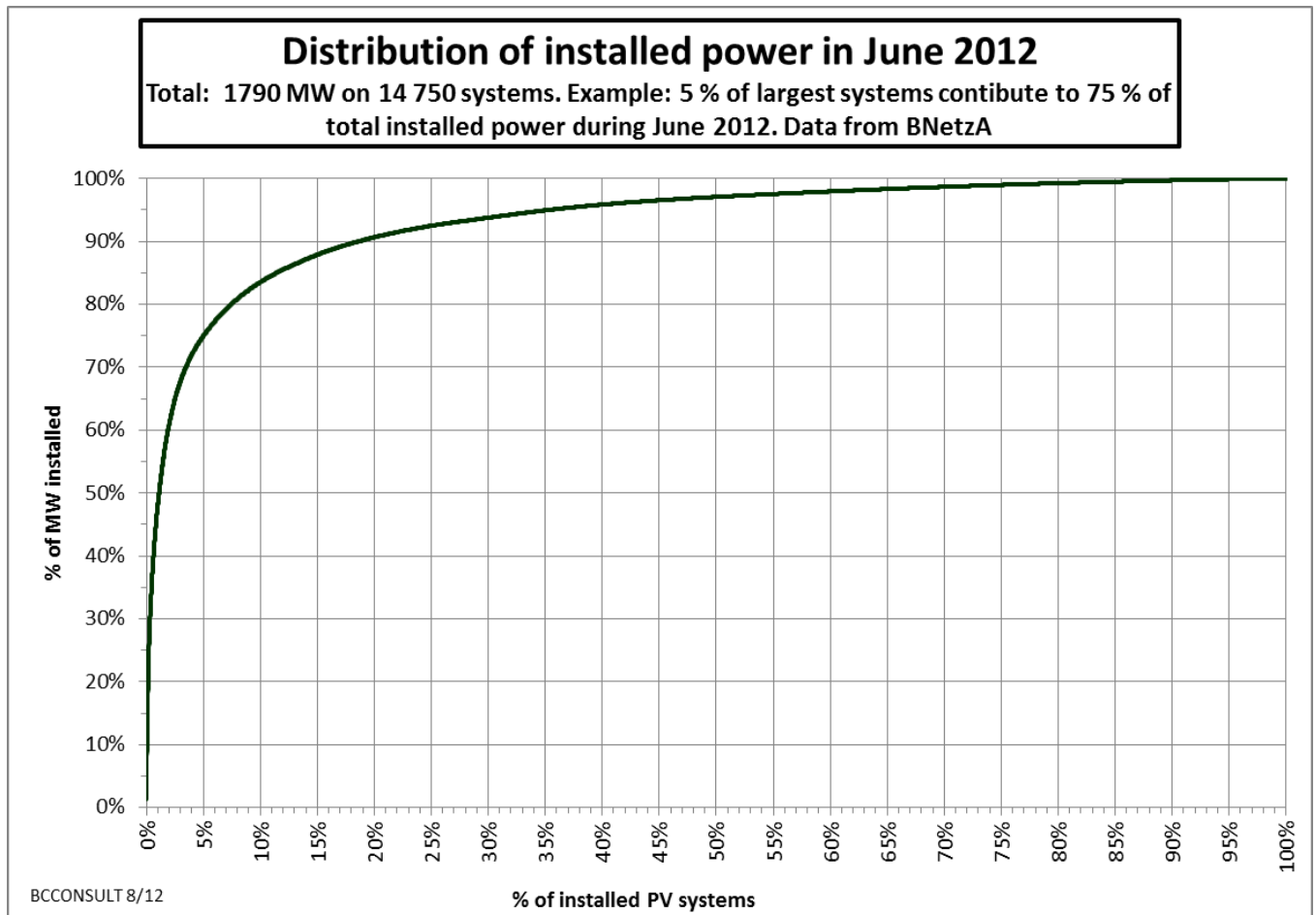


Figure 6: Cumulative % of power in June 2012 versus the cumulative % of the number of PV systems

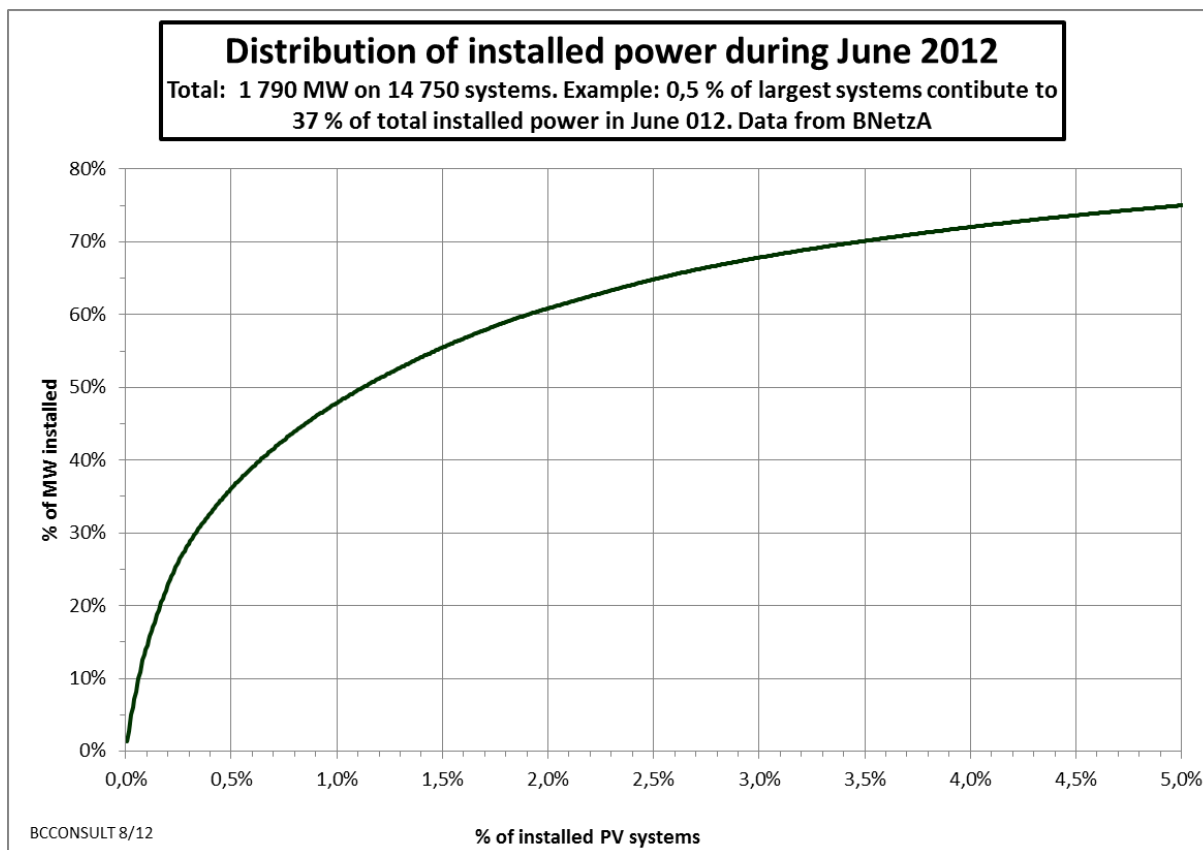


Figure 7: Zoom on cumulative % of power in 6/2012 versus the cumulative % of the number of PV systems

As Germany has a large installed PV base (more than 29.1 GW at the end of June 2012), those recent changes in power classes distribution has not fundamentally altered the historic distribution of the total operating PV base in the country. Thus, the related advantages created from the diversity in array sizes, types of systems, status of PV developers and owners (families, farmers, cooperatives, communities, entrepreneurs, small and medium size companies and independent power producers) are still present. But for the remaining 24 GW to be installed before 2020 for the 52 GW target in the German National RE Action for the April 2009 European Directive on renewables, attention should be put in maintaining this diversity and it related advantages.

Other countries should also take into account this German PV experience to define their PV market development policies: changes in regulation and pricing policies may lead to rapid and important changes in monthly and yearly installation rates with related impacts on PV industry and developers activities. Thus those changes and their consequences must be carefully assessed. And this assessment must be based on detailed monitoring and analysis of precise monthly statistics of PV registrations and installations in a short delay, completed by detailed analysis of production from all renewable technologies, including decentralized small PV systems.

Bernard Chabot

REFERENCES:

[1] "Diversity in Array Size is Advantageous", Renewables International, online May 31st, 2012 at: <http://www.renewablesinternational.net/diversity-in-array-size-is-advantageous/150/510/38662/>

[2] "PV Systems Size Still Diverse in Germany", Renewables International, online June 25th, 2012 at: , <http://www.renewablesinternational.net/pv-system-size-still-diverse-in-germany/150/510/39133/>

[3] Bundesnetzagentur web page for registered PV statistics:

http://www.bundesnetzagentur.de/cln_1912/DE/Sachgebiete/ElektrizitaetGas/ErneuerbareEnergienGesetz/Verguetungssaetze/PVAnlagen/VerguetungssaetzePhotovoltaik_node.html

[4] "German Solar Power Production Surges", Renewables International, online July 5th, 2012 at;

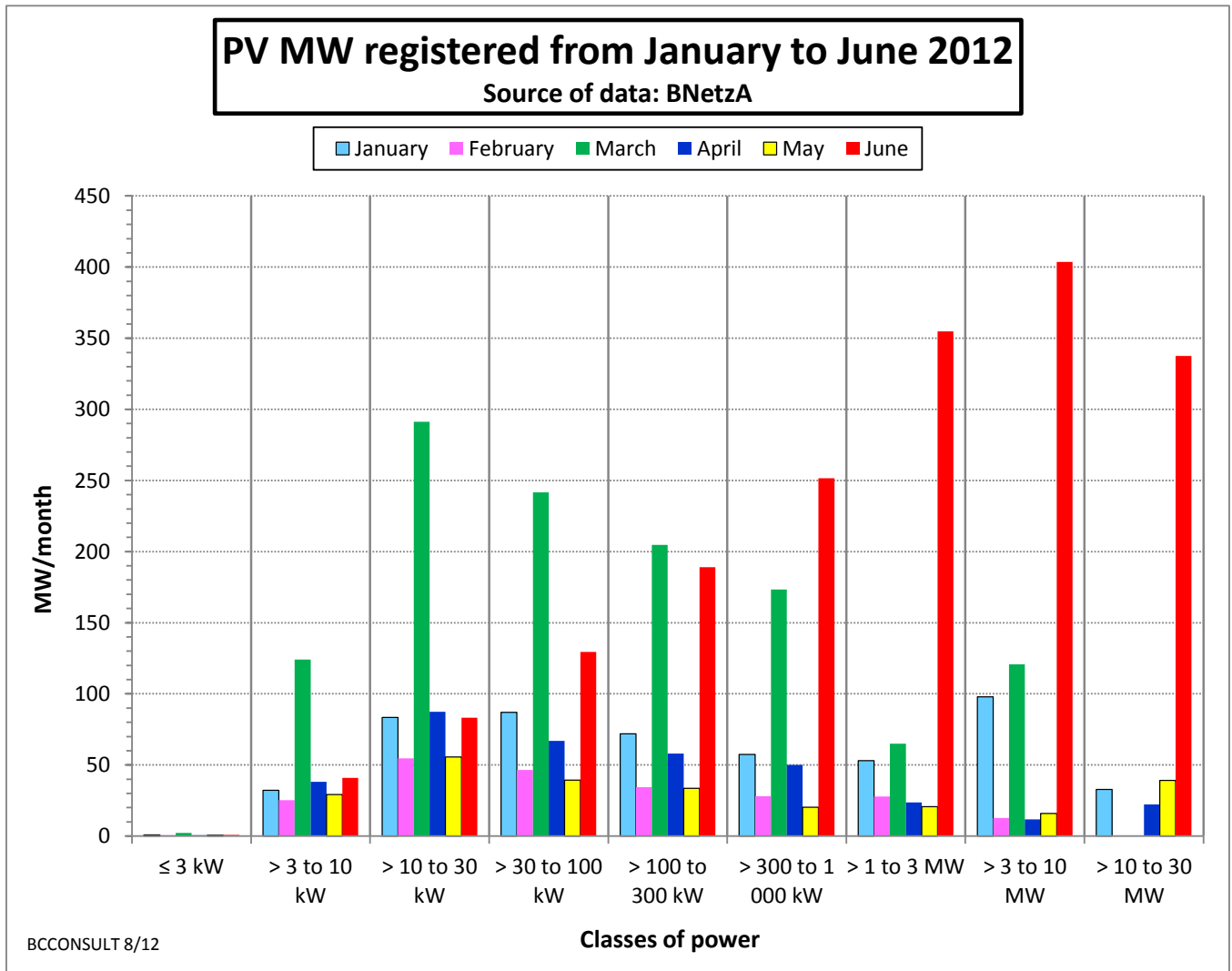
<http://www.renewablesinternational.net/german-solar-power-production-surges/150/510/39327/>

[5] « Entwicklung der erneuerbaren Energien in Deutschland im Jahr 2011, März 2012, unter Verwendung aktueller Daten der Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat), BMU, 2012, downloadable at:

http://www.bmu.de/files/pdfs/allgemein/application/pdf/ee_in_deutschland_graf_tab.pdf

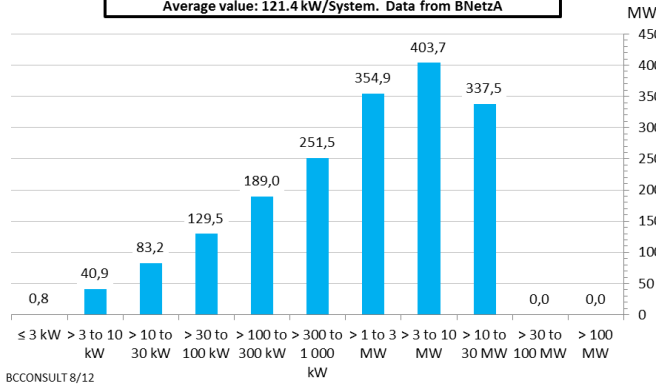
ANNEX:

Aggregated and separated graphs of monthly PV installations distributions from January to June 2012



Distribution of installed power in June 2012

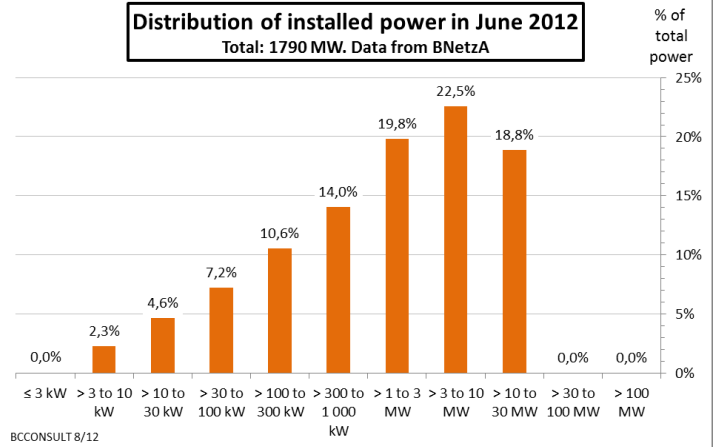
Total: 1790 MW on 14 750 systems. Median value: 12 kW.
Average value: 121.4 kW/System. Data from BNetzA



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Distribution of installed power in June 2012

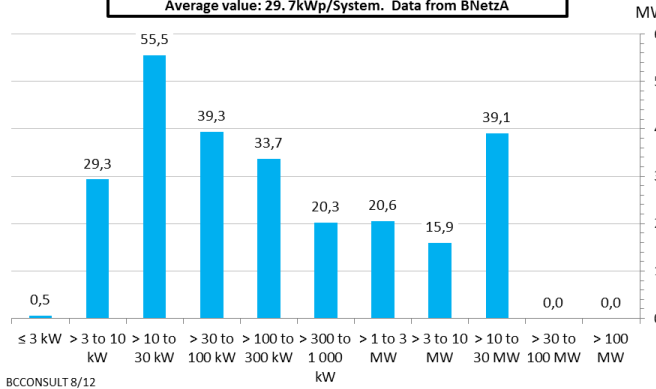
Total: 1790 MW. Data from BNetzA



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Distribution of installed power in May 2012

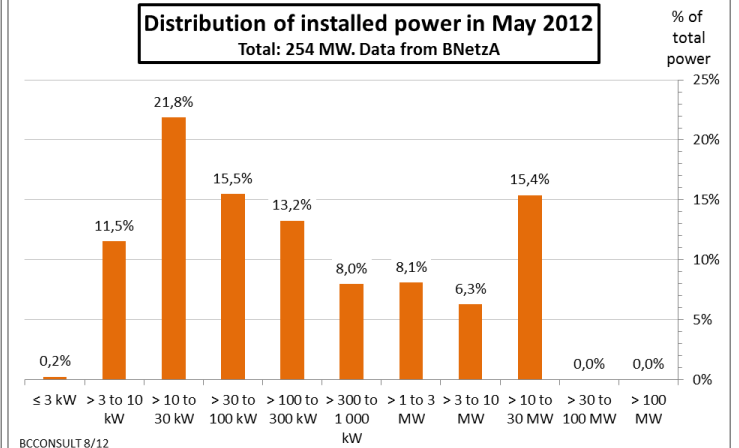
Total: 254 MW on 8566 systems. Median value: 9.79 kW.
Average value: 29.7 kW/System. Data from BNetzA



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Distribution of installed power in May 2012

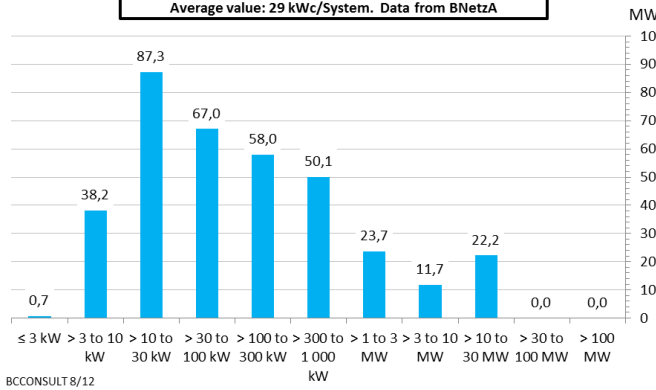
Total: 254 MW. Data from BNetzA



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Distribution of installed power in 4/2012

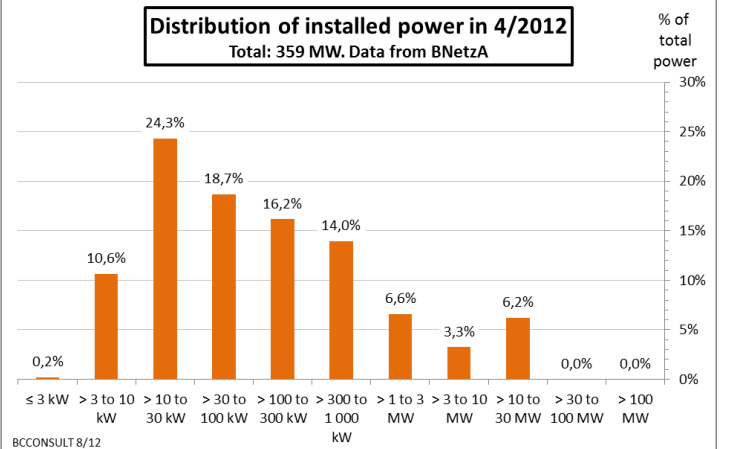
Total: 359 MW on 12 380 systems. Median value: 10.29 kW.
Average value: 29 kWc/System. Data from BNetzA



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Distribution of installed power in 4/2012

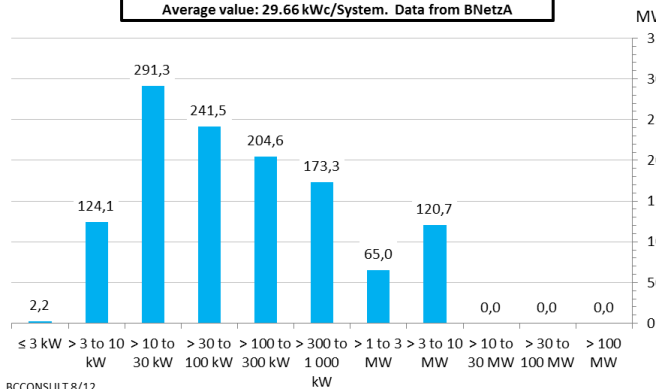
Total: 359 MW. Data from BNetzA



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Distribution of installed power in 3/2012

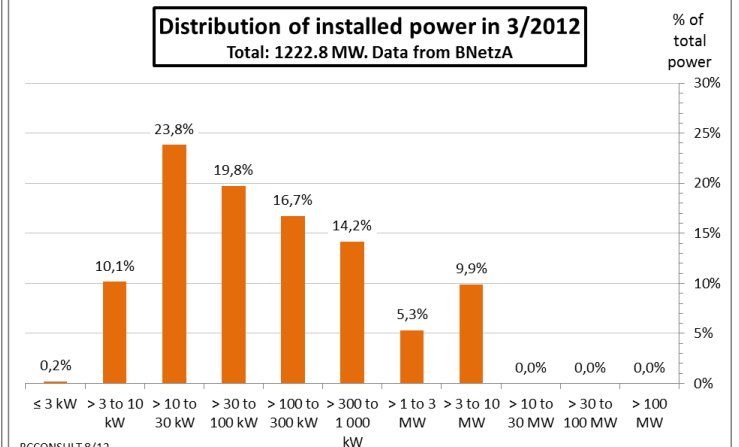
Total: 1222.8 MW on 41 238 systems. Median value: 10.53 kW.
Average value: 29.66 kWc/System. Data from BNetzA



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Distribution of installed power in 3/2012

Total: 1222.8 MW. Data from BNetzA



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