

Seasonal Performance Factors

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Seasonal Performance Factors



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- What are they?
 - Why are they important?
 - Where can I buy one?

Why are SPF's important?



- Provides performance of a system over a season
- System performance, together with electricity cost and heat demand establishes Opex – important for buyers
- Referred to in policies, including the RES Directive
- Trumps COP (which is a mere “snapshot”):
 - Poorly performing heat pump with low COP can have high SPF in good application
 - High performing heat pump with high COP can have poor SPF in poor application

Where can't you get an SPF?



- In a laboratory test
- Heat pump manufacturer's literature
- By ~~COP~~ and writing SPF instead
- B&Q
- The Energy Minister
- An uninformed heat pump salesman

How do you establish SPF?



- RES can use either:
 - Field Trial (measured), or
 - Simulation (predictive)
- For Simulation
 - Work to a replicable standard eg. BS EN 14825
 - Based on laboratory testing – eg. COP's
 - Make assumptions

How do you get a COP?



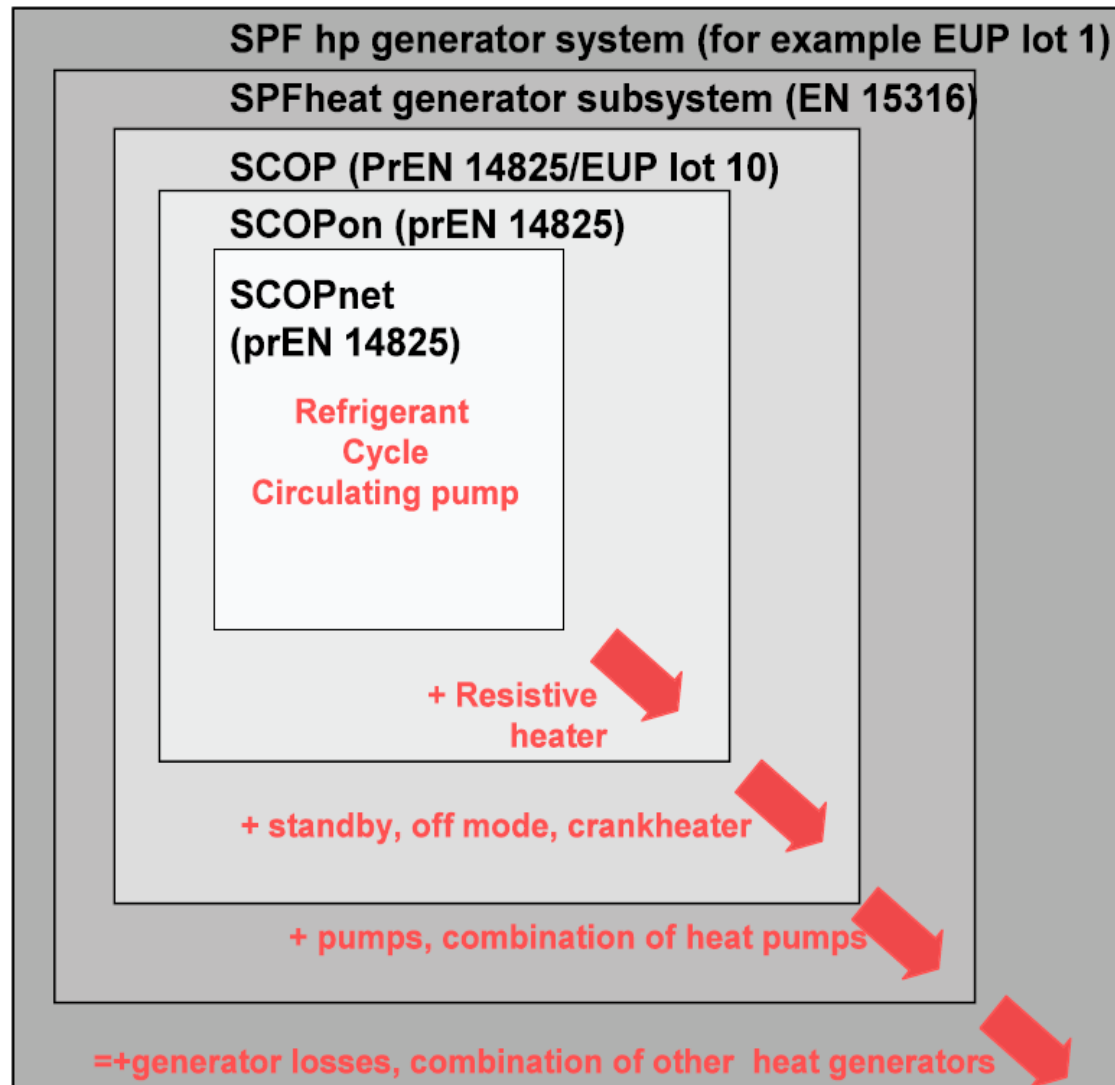
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- Conduct laboratory testing
 - Usually to EN14511
 - Ideally UKAS accredited lab
 - Range of source and sink temperatures

Some of the assumptions



- Performance of the ground array
- Climate data
- Climate data also used for source for ASHP's
- Weather compensation enabled, and, if so, its efficacy
- Load side temperatures – ie. Emitter efficiencies
- % of annual space heating demand
- Size/temperatures of domestic hot water demand
- System boundary – load side pumps, controls etc

Possible system boundaries



Renewable Sources Directive



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- Proposals now on the table
 - Need ratification by Member States
 - EHPA representing EU HP industry
 - Common sense

Renewable Sources Directive



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- BS EN 14825 will be used (not BS EN15316)
 - The Heat Pump Emitter Guide uses BS EN 14825
 - Only interested in Renewable Heat element
 - System boundary – just compressor and ground pump

SPF Calculation



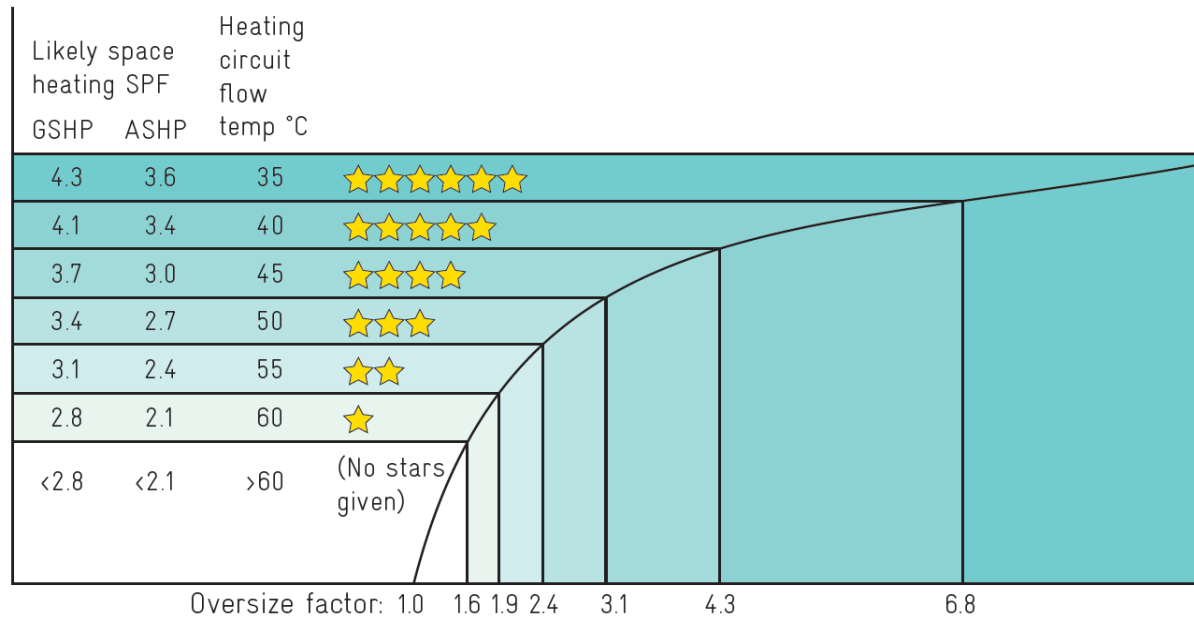
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- Choose a bin size – say every 5 deg C
 - Take the COP at (minimum) four laboratory test points
 - Must have different source and load temperatures
 - Feed in all the assumptions
 - Software model calculates results to BS EN 14825

Weaknesses in SPF Calculations



- The Assumptions
- But, Assumptions are OK as long as they are evidence-based, verifiable and replicable
- Race Tuning of heat pumps sent for testing

Heat Pump Emitter Guide



- Designed for Consumers/Heat Pump Salesmen
- Similar results to SAP Q
- Based on MCS minimum COP's
- Does not include DHW

RES uses the Turmes Formula



- $ERES = Qusable * (1 - 1/SPF)$
- *Qusable* = the estimated total usable heat delivered by heat pumps fulfilling the criteria referred to in Article 5(4), implemented as follows:
- Only heat pumps for which $SPF > 1,15 * 1/\eta$ shall be taken into account, where:-
- *SPF* = the estimated average seasonal performance factor for those heat pumps
- η is the ratio between total gross production of electricity and the primary energy consumption for electricity production and shall be calculated as an EU average based on Eurostat data.

Eurostat Data



EU 27	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Gross Electricity generation incl. Pumping (GWh)	2,586,280	2,631,421	2,614,760	2,616,347	2,657,844	2,733,982	2,834,777	2,847,122	2,911,346	2,941,947	3,025,238	3,106,669	3,131,668	3,219,921	3,288,069	3,310,643	3,354,764	3,367,476	3,371,287	3,209,053	3,345,618
Electricity generation from pumping - Main producers (GWh)	18,463	19,768	21,371	18,891	17,753	20,735	23,155	21,361	24,502	27,203	28,561	28,979	32,255	31,982	33,410	35,712	35,524	33,702	31,384	31,207	31,490
Electricity generation from pumping - Autoproducers (GWh)	25	110	103	143	174	186	221	174	196	229	0	0	0	0	0	0	0	0	0	0	0
Gross Electricity Generation excl. pumping (ktoe)	220,780	224,542	222,972	223,318	226,981	233,270	241,725	242,945	248,195	250,591	257,656	264,621	266,489	274,100	279,837	281,580	285,390	286,639	287,166	273,233	284,950
Transformation Input Conventional Thermal Power Stations ((ktoe)	389,572	389,877	378,762	365,082	365,892	372,115	381,489	372,265	375,759	375,543	382,964	391,251	398,945	419,986	427,343	427,868	437,208	443,590	430,308	399,883	415,091
Calculation of fuel input to for heat in CHP plants																					
Transformation input to main producers CHP plants (ktoe)	113,916	111,193	100,750	99,452	99,570	101,004	108,082	101,563	90,898	88,939	97,521	100,570	101,865	118,240	120,353	121,352	127,549	122,274	121,821	118,264	128,103
Transformation input to autoproducers CHP plants (ktoe)	24,751	24,727	28,175	28,664	27,423	23,381	23,852	24,947	25,667	28,396	22,121	22,597	24,072	33,215	38,819	40,087	40,741	37,265	36,697	32,710	35,684
Transformation input to CHP plants (ktoe)	138,667	135,920	128,925	128,116	126,994	124,385	131,934	126,510	116,565	117,335	119,642	123,167	125,936	151,456	159,172	161,439	168,291	159,538	158,518	150,974	163,787
Transformation output of electricity of main producers CHP plants (ktoe)	28,697	29,207	26,393	26,086	27,044	27,553	29,481	27,904	24,338	23,709	29,417	31,073	31,894	35,544	38,918	40,105	42,667	40,986	40,330	39,046	41,606
Transformation output of electricity of autoproducers CHP plants (ktoe)	7,058	7,224	7,955	8,282	8,832	9,343	10,136	11,703	12,500	13,525	10,645	10,587	11,248	13,803	15,022	15,554	15,770	15,918	16,274	15,443	16,537
Total CHP electricity production (ktoe)	35,755	36,431	34,349	34,368	35,876	36,897	39,617	39,607	36,837	37,234	40,063	41,660	43,142	49,347	53,940	55,660	58,437	56,904	56,603	54,489	58,143
Transformation output of heat of main producers CHP plants (ktoe)	32,064	31,892	31,332	31,023	30,744	33,243	35,068	34,088	33,501	32,068	31,020	32,337	31,513	34,034	36,372	35,817	35,790	34,463	34,933	35,552	38,878
Transformation output of heat of autoproducers CHP plants (ktoe)	9,144	7,720	9,697	9,462	7,725	4,447	4,604	3,554	3,294	3,542	4,998	5,354	5,750	13,083	15,542	15,966	15,763	8,648	7,870	6,842	6,836
Total CHP heat production (ktoe)	41,208	39,611	41,029	40,485	38,469	37,689	39,672	37,642	36,795	35,610	36,018	37,691	37,263	47,117	51,914	51,783	51,554	43,111	42,802	42,394	45,715
Calculated fuel input for heat in CHP, ktoe	74,246	70,802	70,176	69,293	65,712	62,853	66,013	61,646	58,249	57,360	56,641	58,504	58,364	73,977	78,063	77,807	78,880	68,768	68,255	66,063	72,094
of which: input for heat in CHP plants (ktoe)	74,246	70,802	70,176	69,293	65,712	62,853	66,013	61,646	58,249	57,360	56,641	58,504	58,364	73,977	78,063	77,807	78,880	68,768	68,255	66,063	72,094
Transformation input Nuclear Power Stations (ktoe)	205,205	211,540	213,494	222,483	221,591	227,301	238,954	241,966	240,716	243,431	243,841	252,665	255,556	257,017	260,286	257,516	255,499	241,410	241,909	230,767	236,563
Primary energy from Hydro (electricity, ktoe)	24,609	25,470	26,693	27,279	28,151	28,045	27,876	28,531	29,529	29,292	30,312	32,031	27,088	26,292	27,791	26,273	26,594	26,652	28,145	28,218	31,492
Primary energy from Wind (electricity, ktoe)	67	94	134	202	300	350	419	633	969	1,221	1,913	2,296	3,123	3,814	5,067	6,057	7,077	8,972	10,273	11,439	12,817
Primary energy from tide, wave, ocean (electricity, ktoe)	49	50	50	48	48	49	47	49	51	50	49	47	46	46	45	46	45	45	44	43	45
Primary energy from Photovoltaics (electricity, ktoe)	1	1	2	2	3	3	4	5	7	7	10	16	24	40	62	125	214	324	639	1,205	1,923
Efficiency of the electrical system* (i.e. efficiency for electricity generation)	40.5%	40.4%	40.6%	40.9%	41.2%	41.3%	41.5%	41.8%	42.2%	42.3%	42.8%	42.7%	42.5%	43.3%	43.6%	44.0%	44.1%	43.9%	44.7%	45.1%	45.5%
N.B.1																					
Figures in red: extracted from Eurostat's production database on 27Mar2012																					
Figures in black: calculated from figures in red																					
N.B.2																					
All annual data have been extracted on 27Mar2012 and reflect the stand of revisions provided by Member States till that date																					

- Efficiency generally improving
- Data revisions have been made some years later

SPF's in the RES



SPF Calculation					
Year	2006	2007	2008	2009	2010
Generation Efficiency	44.10	43.90	44.70	45.10	45.50
SPF	2.61	2.62	2.57	2.55	2.53

SPF Projections					
Year	2011	2012	2013	2014	2015
Generation Efficiency	45.80	46.00	46.30	46.50	46.80
SPF	2.51	2.50	2.48	2.47	2.46

- Averages around 2.5

SPF's – What have we learnt?



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- They aren't generally dangerous
 - This talk on SPF's is marginally more enjoyable than an in-growing toenail?
 - The highest possible economically achievable SPF is the most important output when applying a heat pump

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