

Final report

BIPV Quality Cities

ForskVE project j. nr. 2013-12059

Demonstration of BIPV systems with Focus on a high Quality in connection to large PV-systems investment plans in Danish Cities and Regions focusing on 3,85 MWp PV implementation



1.1 Project details

Project title	BIPV Quality Cities
Project identification (program abbrev. and file)	Energinet.dk project no. 2013-1-12059
Name of the programme which has funded the project	ForskVE
Project managing company/institution (name and address)	Gate21 Vognporten 2 2620 Albertslund
Project partners	Cenergia (project leader), Eniig, Solar City Denmark, FBBB, Teknologisk Institut, AAU, Solarvent
CVR (central business register)	32112846
Date for submission	1. November 2017

1.2 Short description of project objective and results

By November 2017, it can be concluded, that it has been possible to document a total PV implementation in the BIPV Quality Cities project of 4.355 kWp, which is considerably higher than aimed at in the contract, where 3.850 kWp was the goal.

It has however been a challenge to adapt the workplan in relation to the new PV legislation, which in Denmark led to a new situation for PV in municipalities after the BIPV Quality Cities project started in 2013.

The result was that the partners decided to have an extra focus on PV and BIPV quality control in the form of SolarWatch activities and at the same time as the best solution on how to proceed with a reasonable policy for PV implementation in cities was suggested to be the Active House Specifications, which rates Energy, Comfort and Sustainability, but which also includes a policy to support use of renewable energy and energy balance, e.g. by having CO₂ neutral building as a way to score high. This also gives prospects on how to deliver the zero energy building standard of the future, which is already the vision of the EU Building Directive.

Something, which was also presented in the presentation: "Towards 2025" of the international Active House Symposium in September 2017 at Bornholm.

Based on this it was decided to work on BIPV promotion in connection to the Active House specifications incl. CO₂ neutral building in the BIPV Quality Cities project, something, which was also promoted together with FBBB and Gate21, and actual cooperation were made with several cities on both Solar Watch follow-up in practice and plans for BIPV as part of CO₂ neutral Active House building.

At present there is ongoing activities to promote the use of BIPV in connection to Active House labelling with focus on CO₂ neutral building levels as a proposed standard towards year 2025.

1.3 Executive summary

Overall the BIPV Quality Cities ForskVE project had the ambition to support the booming interest in solar PV solutions in Danish cities. And based on the good results from the PV Boost ForskVE project realised in a cooperation between Cenergia and Gate21 from 2011, there was real optimistic hopes for the outcome of the project during the first year after it started. This was e.g. very clear at the launch conference held at Gate21's premises in Albertslund in August 2013, where Skive municipality gave their experience to the audience, based on the

ForskVE project Photo-Skive, where all municipal buildings had been equipped with PV systems, and where also the municipality of Gladsaxe had the opportunity to present their wishes for the PV area especially linked to local cooperation with housing associations, who wanted to realise PV projects.

By November 2017, it can be concluded, that it has been possible to document a total PV implementation in the BIPV Quality Cities project of 4.355 kWp, which is considerably higher than aimed at in the contract, where 3.850 kWp was the goal.

Overall, a lot of dissemination activities in cooperation with cities have taken place, and as a way of demonstrating good BIPV solutions towards cities, both so-called SolarWatch activities and an initiative to establish a BIPV demo site at the Technological Institute have also been realised by the involved stakeholders. This has as stated in the contract been seen as a tool to support future BIPV oriented activities in Danish cities.

It has however been a challenge to adapt the workplan in relation to the new PV legislation, which in Denmark led to a new situation for PV in municipalities after the BIPV Quality Cities project started in 2013.

Based on the demand in the electricity production legislation, that cities, which produce electricity, needs to establish a company with a board and official economic revision, several cities became uncertain on how to work with PV implementation in practice. At the same time several cities also made their bid, to be involved in the 20 MWp implementation scheme, launched in April 2015. The result was that the partners decided to have an extra focus on PV and BIPV quality control in the form of SolarWatch activities and at the same time as the best solution on how to proceed with a reasonable policy for PV implementation in cities was suggested to be the Active House Specifications, which rates Energy, Comfort and Sustainability, but which also includes a policy to support use of renewable energy and energy balance, e.g. by having CO₂ neutral building as a way to score high. This also gives prospects on how to deliver the zero energy building standard of the future, which is already the vision of the EU Building Directive.

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At present there is ongoing activities to promote the use of BIPV in connection to Active House labelling with focus on CO₂ neutral building levels as a proposed standard towards year 2025.

1.4 Project objectives

1.4.1 Description of the project objectives

Overall the BIPV Quality Cities ForskVE project, which started on the 1. July 2013, had the ambition to support the booming interest in solar PV solutions in Danish cities. And based on the good results from the PV Boost ForskVE project realised in a cooperation between Cenergia and Gate21 from 2011, there was real optimistic hopes for the outcome of the project during the first year after it started. This was e.g. very clear at the launch conference held at Gate21's premises in Albertslund in August 2013, where Skive municipality gave their experience to the audience, based on the ForskVE project Photo-Skive, where all municipal buildings had been equipped with PV systems, and where also the municipality of Gladsaxe had the opportunity to present their wishes for the PV area especially linked to local cooperation with housing associations, who wanted to realise PV projects.

By November 2017, it can be concluded, that it has been possible to document a total PV implementation in the BIPV Quality Cities project of 4.355 kWp, which is considerably higher than aimed at in the contract, where 3.850 kWp was the goal.

And concerning the city of Hørsholm it can at the same time be concluded, that only 250 kWp PV on an existing building will be part of their implementation in the project, while another 400 kWp PV, which is installed on a new ice hockey facility, would only be installed after the project was finalised.

Overall, a lot of dissemination activities in cooperation with cities have taken place, and as a way of demonstrating good BIPV solutions towards cities, both socalled SolarWatch activities and an initiative to establish a BIPV demosite at the Technological Institute have also been realised by the involved stakeholders. This has as stated in the contract been seen as a tool to support future BIPV oriented activities in Danish cities.

1.4.1.1 Describe the risks associated with the project.

It has been a challenge to adapt the workplan in relation to the new PV legislation, which in Denmark led to a new situation for PV in municipalities after the BIPV Quality Cities project started in 2013.

Based on the demand in the electricity production legislation, that cities, which produce electricity, needs to establish a company with a board and official economic revision, several cities became uncertain on how to work with PV implementation in practice. At the same time several cities also made their bid, to be involved in the 20 MWp implementation scheme, launched in April 2015. The result was that the partners decided to have an extra focus on PV and BIPV quality control in the form of SolarWatch activities.

Besides the best solution on how to proceed with a reasonable policy for PV implementation in cities has been suggested to be the Active House Specifications, which rates Energy, Comfort and Sustainability, but which also includes a policy to support use of renewable energy and energy balance, e.g. by having CO₂ neutral building as a way to score high.

And the fact that a Danish organisation, Active House Denmark, was established by January 2015 supported this quite strongly. See also enclosed presentation: "Towards 2025" of the international Active House Symposium in September 2017 at Bornholm.

Based on this it was decided to work on BIPV promotion in connection to the Active House specifications incl. CO₂ neutral building in the BIPV Quality Cities project, something, which was also promoted together with FBBB and Gate21, and actual cooperation were made with several cities on both Solar Watch follow-up in practice and plans for BIPV as part of CO₂ neutral Active House building.

1.4.1.2 Did the project implementation develop as foreseen and according to milestones agreed upon?

Until 2016, the aim was that a large part of the PV implementation would be secured by 1.500 kWp PV installations at sports park facilities in Hørsholm municipality.

But as mentioned in the status report from 2016-1, there was identified barriers in connection to the mounting of PV modules on some of the existing Sports Park roofs, which were being renovated.

In Marts 2017 it was confirmed, that only one of the existing buildings, the swimming centre, would be possible to equip with PV modules (250 kWp). And the installation were at the same time still waiting for an approval from Energinet.dk, according to the Electricity Supply regulation § 4.

This will be combined with PV for the new training skating facility, which will utilise another 400 kWp.

Work here however only started by 1. May 2017, so a total of 650 kWp PV will be reached on the Hørsholm Sport Park facilities.

In the enclosed article from the FBBB magazine, "Quality Cities", there is an article about the "Vision to develop a CO₂ neutral sports park with total budgets of 44 Mio. DKK, combined with 5,5 Mio. DKK for PV installations, while 30 Mio. DKK was used before to update all the technical installations.

Because of the above mentioned, only the 250 kWp PV at the existing swimming hall is still part of the Hørsholm PV capacity in the BIPV Quality Cities project.

The here mentioned aspects has meant, that the project team has identified other PV capacities, which could be included in the project.

E.g. in a former status report was mentioned an agreement with the city of Copenhagen to include PV capacity here, mainly in relation to new building, where it was aimed to reach a 2020 low energy standard, in all 294,4 kWp.

And in the revised implementation list there is included another 783,5 kWp in the municipality of Egedal, which is also part of the SolarWatch monitoring programme.

All the agreed implementation added together reach 4.355 kWp in total, which can be compared with the aim in the contract to reach 3.850 kWp, and in fact, 5.154 kWp are reached if all the capacity in Sønderborg is included.

From this can be seen, that the outcome of the Sports Park PV projects in Hørsholm is not so important, when we look at the aim to reach the full aimed at PV implementation. But it must still be considered as a very interesting project concerning use of BIPV in a whole city area perspective, also with reference to the aim of combining the needs for updating buildings with implementation of PV capacity. This was also emphasised in the presentation at the ForskVE – BIPV conference in September 2017 at “Nationalmuseet” in Copenhagen by Morten Slotved, the mayor of Hørsholm municipality

Implementation list for the BIPV Quality Cities project by end of 2016

		kWp	Part of IQ-Energy SolarWatch
1.	<u>Frontrunner PV anlæg</u>		
(indmeldte 2014 rapporter)			
1.1	Albertslund Rådhus	91,8	X
1.2	Hørsholm plejecenter	10	X
1.3	Kejd, Lavuk	3	
		<u>104,8</u>	
(1/7-2013 til 1/8-2014, Kejd, København)			
1.4	Multiverset	3,7	
1.5	Tove Ditlevsens Skole	2,8	
1.6	Solbakken Institution	2	
1.7	Dyveke Skolen	25	
1.8	Burlunden	18	
1.9	Ved Glyptoteket	6	
1.10	Forfatterhuset	12,5	
1.11	Sundby Idrætspark	27,5	
1.12	Børnehuset Bavneshøj	3,5	
1.13	Børnehaven Rørsangeren	2	
1.14	Daginstitution Nokken	12,7	
1.15	Hillerødsgade Bad og Hal	45	
1.16	Vibenhus Skole	15	
1.17	Bellahøj Svømmestadion	45	
1.18	Vigerslev Allé Skole	13,7	
1.19	Hal C	12	
1.20	Korsager Skole	48	
		<u>294,4</u>	
1.21	Hørsholm, Kommunes Sportcenter	250	
	I alt 1.	<u>649,2</u>	
2.	<u>Group of municipalities</u>	kWp	
(indmeldte 2014 rapporter)			
2.1	Gladsaxe Skole	120	
2.2	Rødvore Tekniske Forvaltning	59	X
2.3	Skovbrynet Skole, Gladsaxe	127	X
2.4	Grønmose Skole Gladsaxe	132	X
2.5	Marienlyst Skole, Gladsaxe	39	X
2.6	Materielgården, Gladsaxe	34	X
2.7	Kildeskovhallen, Gentofte	350	
2.8	Ordrup Multihal, Gentofte	48	
2.9	Gentofte Stadion, Gentofte	100	
2.10	Trørød Skole, Rudersdal	149	X
2.11	Skovly Skolen, Rudersdal	50	X
2.12	Materielgården, Rudersdal	82	X
2.13	Østergården, Frederikssund	82	
2.14	Marbærskolen, Frederikssund	164	
2.15	Skolen ved Kæret, Frederikssund	15	
2.16	Frederikssunds Hallen, Frederikssund	50	
2.17	Sogneskolen, Frederikssund	38	
2.18	City of Sønderborg	273	
	(samlet omfang: 1.300 kWp)	<u>1912</u>	

<u>Region Sjælland</u>				
(sommer 2013 til og med 2015)				
2.18	Nørre Alslev Skole, Guldborgsund Kommune	94		
2.19	Lindeskov Skole, Guldborgsund Kommune	100		
2.20	Stubbekøbing Skole, Guldborgsund Kommune	102		
2.21	Svømmecentret, Guldborgsund Kommune	54		
2.22	Køge Rådhus, Køge	76		
2.23	Sct. Jørgens Skole, Roskilde	130	X	
2.24	Vindige Skole, Roskilde	53	X	
2.25	Himmelev Hallen, Roskilde	47	X	
2.26	Tjørnegård Skolen, Roskilde	127	X	
		<u>783</u>		
Egedal Kommune				
2.27	Hampelandskolen (A-F)	258	X	
2.28	Balsmarksolen	105	X	
2.29	Brosagerskolen	95,5	X	
2.30	Søager Skole	105	X	
2.31	Stengårdskolen	220	X	
		<u>783,5</u>		
	I alt 2.	<u>3478,5</u>		
3. Group of housing associations				
Housing associations, budget:		I alt 3.	<u>227</u>	
(i samarbejde med City of Sønderborg)				
1. + 2. + 3.				
	I alt	<u>4354,7</u>		
	eller med hel Sønderborg andel	<u>5154,7</u>		
	Samlet mål: 3.800 kWp			

Concerning BIPV implementation can, as a special thing, be mentioned design of an Active House design for a one-family house in Jutland with KFS Boligbyg.

Besides several CO₂ neutral housing designs in the Copenhagen area has been developed, where both the Norwegian Ramstad Architects and Svendborg Architects has been active, while the Design company Designit and the Solarplan company also has been working on BIPV sketch designs.

The workpackages of the BIPV Quality Cities project includes:

Work packages of the project.

WP 1.1	Practical organisation of municipal and housing association oriented design workshops demonstration and documentation plan for best practice BIPV design solutions for Active Roofs
WP 1.2	Choice of 10 best practice BIPV solutions in connection to different types of roofs to be tested, documented and presented in connection to the BIPV Quality Cities programme.
WP 2	Sketch design and realisation of at least 10 different BIPV projects as basis of creating Best Practice BIPV recommendations
WP 3	Agreement on general BIPV Quality system in connection to large scale municipal and housing association based PV investments

WP 4	Introduction of advanced "Solar Watch" monitoring follow-up and maintenance package for BIPV systems to be documented for 60- 100 BIPV systems together with an overall improved BIPV quality and a combined focus on electricity savings.
WP 5	Introduction of quality control procedures for BIPV systems to be used in connection to BIPV Quality Cities programme.
WP 6	Sketch design work for at least 30 BIPV systems with focus on optimised BIPV solutions, use of Solar Watch System and a combined focus on electricity savings.
WP 7	City oriented BIPV implementation plans in 3 Danish regions in connection to realisation of at least 3,8 MWp out of 20 MWp PV installations.
WP 8	Documentation of use of optimised BIPV and "Solar Watch" system in practice to secure an improved basis of guaranteed solar results.
WP 9	City oriented BIPV implementation plans in 3 Danish regions in connection to realisation of at least 20 MWp PV installations.
WP 10	Dissemination of project results
WP 11	Project coordination

Below is seen a list of PV project Implementation in Copenhagen of which 294,4 kWp is part of the project.

Solceller på Københavns Kommunes bygninger					
Ejendom/kaldenavn	Adresse og postnummer	Dato for idrift	Afleveret År	Installeret effekt (kW)	Areal (m ²)
Valby Skole	Ved Ovnhallen 6, 2500 valby	01-01-2005	2005	37	356
Specialdaginstitutionen Hvalen	Artillerivej 75, 2300 Kbh S	2006	2006		40
Børnehuset Bryggen	Snorresgade 24, 2300	2009	2009	19	155
Prøvehallen	Porcelænstorvet 4, 2500 Valby	2009	2009	17	120
Lykkebo hallen	Vigerslevvej 141, 2500 Valby	2011	2011	3,8	26
Muldvarpen udflytterbørnehave	Ville Heise Park 49, 3450 Allerød	07-06-2011	2011	1,9	10
Slaraffenland	Fengersvej 22-28, 2500 Valby	16-11-2011	2011	6	43,4
Valby Vandkulturhus (Valby hallen)	Julius Andersens Vej 3, 2450 København SV	01-12-2011	2011	19,1	128
Hyttebjerghallen	Lønstrupvej 5, 2720 Vanløse	2012	2012		298
Ørestad City Skole og bibliotek	Arne Jacobsens Alle 21, 2300 Kbh. S	2012	2012	33,3	241
Det røde hjørne	Sundholmsvej 10, 2300 Kbh. S	01-01-2012	2012	13,1	75
Kløvermarkens Idrætsanlæg	Kløvermarksvej 50, 2300 Kbh. S	01-01-2012	2012	120	890
Kalvebod Miljøcenter	Sellinevej	02-01-2012	2012	49,9	340
Damperen	Eskildsgade 7-11, 1657 Kb. V	03-01-2012	2012	6	59,7
Vanløse Skole/Krokodillen	Ålekestevæj 121, 2720 Vanløse	16-04-2012	2012	4,8	30
Det Lille Univers	Nordre Digevej 2, 2300	12-05-2012	2012	6,3	46
Havaje	Støberigade 3, 2450 københavn SV	13-06-2012	2012	6	43,7
Solstrålen. Tagensvej 186H	Tagensvej 186H, 2400 Kbh. NV	21-10-2012	2012	9,1	62
IBOS	Ryrmarksvej 1, 2900 Hellerup	01-12-2012	2012	28	250
Valby Kulturhus	Valgårdsvæj 4-8, 2500 Valby	19-04-2013	2013	8,6	56
Charlottegården	Frederikssundsvæj 77-79, 2400 Kb NV	03-05-2013	2013	13,6	90
Hal C	Arsenalvej 6, 1436 Kb K	01-07-2013	2013	12	80
Korsager Skole	Tersløsevej 35/Gislingevej 14, 2700 Brønshøj	01-08-2013	2013	48	320
Lavuk	Borgerøenget 19, 2100 Kb Ø	12-09-2013	2013	3	16
Multiverset	Amagerfælledvej 203, 2300 Kbh	10-10-2013	2013	3,7	16
Tove Ditlevsens Skole	Matthæusgade 37, 1670 Kb V	02-12-2013	2013	2,8	33,8
Institutionen Solbakken - ny afdeling	Gl. Carlsbergvej 21-23, 2500 Valby	16-12-2013	2013	2	14
Dyvekeskolen	Remisevej 16 / Urmagerstien, 2300 Kb S	31-01-2014	2014	25	165
Burlunden	Rosenlundsvæj 1, 2791 Dragør	14-02-2014	2014	18	133
Ved Glyptoteket	Ved Glyptoteket 2-4, 1575 København V	03-03-2014	2014	6	39,2
Forfatterhuset	Edith Rodes Vej 2A, 2200 Kb N	27-03-2014	2014	12,5	75
Sundby Idrætspark	Englandsvæj 61, 2300 kbh S	01-04-2014	2014	27,5	189
Børnehuset Bænhøj	Tranehavevej 15, 2450 Kb. SV	07-04-2014	2014	3,5	30
Børnehaven Rørsangeren	Rørsangervej 78, 2400 KBH NV	12-05-2014	2014	2	16,2
Daginstitution Nokken	Rundholtsvej 89, 2300 KBH S	14-05-2014	2014	12,7	80,8
Hillerødsgade Bad og Hal	Sandbjergsgade 35, 2200 København	28-05-2014	2014	45	314
Vibenshus Skole	Kertemindegade 10, 2100 København	01-06-2014	2014	15	99
Bellahøj Svømmestadion	Bellahøjvej 1-3, 2700	30-06-2014	2014	45	314
Vigerslev Allé Skole	Vigerslev Allé 108, 2500 Valby	01-08-2014	2014	13,7	87,3
Kirkebjerg Skole	Vanløsehej 4, 2720 Vanløse	18-09-2014	2014	40	273,3
Amager Strandpark	Øresundsstien 5, 2300 Kbh S	01-02-2015	2015	3,9	19,4
Netverket	Thomas Koppels Allé 13, 2450 KBH SV	28-02-2015	2015	8	60
Sydhavnskolen	Støberigade 1, 2450 københavn SV	01-04-2015	2015	25	191,1
Brønshøj Skole	Klintholmvej 5, 2700 Brønshøj	01-01-2016	2016	30	240
Kirsebækhavens Skole			2017	18	
Club Danmark Hallen			2017		
Grøndalsvængets Skole			2017	25	
Skolen på Strandboulevarden			2017		
Kalvebodfælled Skole			2017/2018		

1.4.1.3 Did the project experience problems not expected?

As mentioned under section 1.4.2.1, rules and regulations was in the beginning estimated only to have a minor negative effect on the project objectives. However, after one year from start was experienced a range of changes to the regulations, that have had a more significant effect on use of PV in cities than expected when the project was developed.

Both in 2014 and 2016 new regulation effectively stopped the development of new PV projects in the sector (See graph below from AAU report).

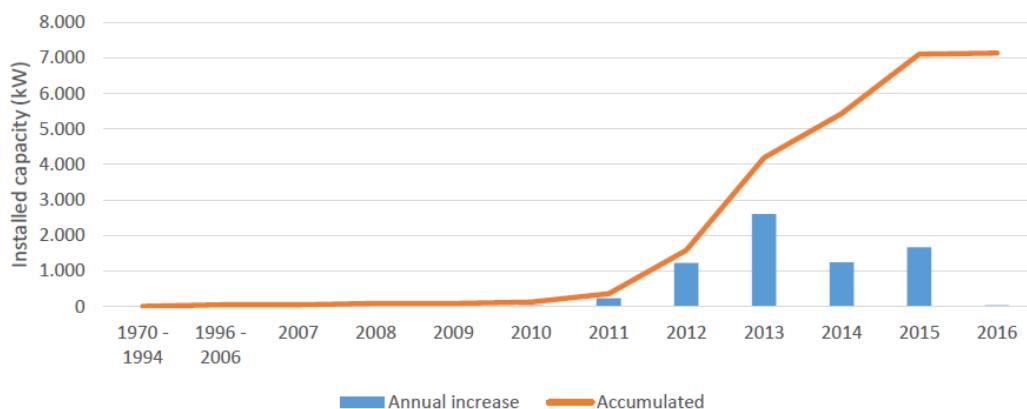


Figure 46: The annual development of the installed capacity of PV installations owned by public housing associations (columns) and the accumulated capacity. The development from 1970 to 1994 and 1996 to 2006 are summed as the development are insignificant. It should be noted that the data for 2016 only includes the first half of the year. The figure is based on data from Energinet.dk extracted medio 2016.

This generally made it difficult to recruit new front runner projects and sketch design projects.

1.5 Project results and dissemination of results

Description of main activities and technical results in the project, as well as description of commercial results and expectations of the project.

1.5.1 Did the project succeed in realising its objectives? If not, why?

In the following, the results of each work package will be presented. Afterward a conclusion on how the overall objectives of the project was met will be summarized.

WP 1

A large number of municipal oriented BIPV design workshops has been realized incl. presentation of BIPV best practice design catalogue

WP 2

BIPV documentation prepared with SCD and ongoing programme for BIPV sketch design work.

WP 3

Ongoing work on promotion of BIPV and Active House labelling in city areas. Finalised by proposed "prosumer levels" as part of Active House labelling by summer 2017.

WP 4 and WP 8

SolarWatch documentation programme realized with a large number of Danish cities, which based on individual agreements has utilized the PV implementation funding, to obtain this in practice. Main result is IQ- Energy SolarWatch platform, but also link to Evishine BIPV survey and local city based PV survey.

WP 5

Ongoing effort by Technological Institute on BIPV quality control and monitoring work, also involving EnergiMidt (Enig)

WP 6

Large number of BIPV sketch design work. E.g. in Sønderborg housing associations it had an important effect as shown at the BIPV QC study tour in September 2016.

Also sketch design package work e.g. by RRA architects from Norway and Svendborg Architects on Living in Light Box and GI. Jernbanevej urban renewal with BIPV.

WP 7 and WP 9

BIPV implementation reaching more than 4 MWp in practice.

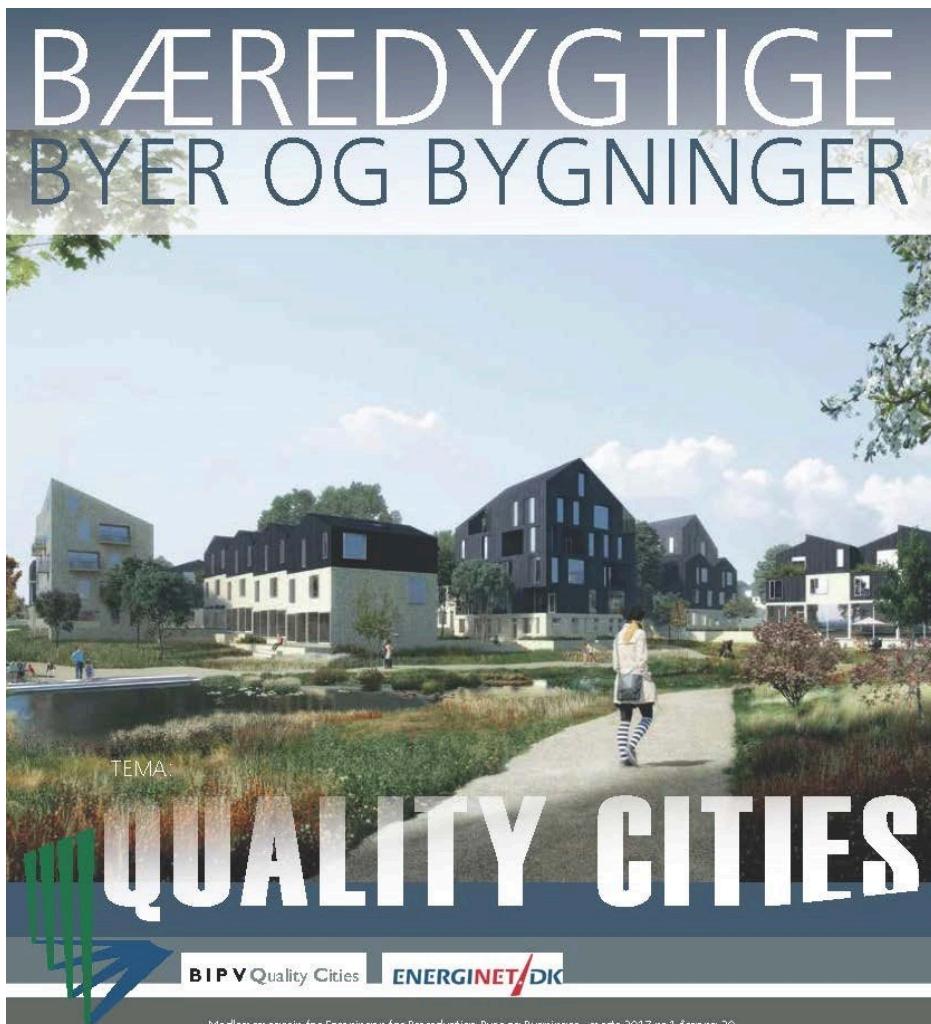
WP 10

Introduction of BIPV results into FBBB relaunched national database:

www.bæredygtigbygninger.dk and 2 FBBB thematic magazines on BIPV, see also dissemination list.

Dissemination activities	Place and date	Focus
BIPV QC presentation	FBBB and Almennet Social Housing conference, Sept. 2013	Presentation on BIPV project objectives
Factsheet towards cities	Gate21 and Cenergia, Oct. 2014	Promotion of SolarWatch system towards cities
Factsheet towards cities	Gate21 and Cenergia, Oct. 2014	BIPV support scheme for cities launched
Building Green 2015	Active House Denmark,	Promotion of Active House labelling in combination with BIPV
FBBB yearly member conference 2015	The Climate Shield of the Future, March 2015	Conference " Climate Shield of the Future" and thematic magazine from FBBB " Climate Shield of the Future"
FBBB yearly member conference 2016	Aarhus, March 2016 "Livable Cities"	Conference and thematic magazine from FBBB "Quality Cities"
Solceller i Sønderborg – temamøde + ekskursion	Solar City Denmark, October 5 2016, Sønderborg	BIPV study tour and presentation of best practice projects and promotion of the possibility to conduct sketch projects with 60% grants from the project. BIPV Q-CITIES
VE – messe Midtjylland 2016	Bjerringbro, June 2016	Panel discussion on renewable energy
AAU Energy conference	4 th generation district heating, 26. – 29. Sept. 2016	BIPV and "Smart Active House Building"
Seminar on certification of building areas	FBBB and conference. City of Aalborg, Aug. 2016	BIPV and Active House labelling
Temamøde: Solceller by-planlægning	Solar City Denmark, June 2017	Conference at Copenhagen International School - with the largest BIPV system in Europe - by Solar City Denmark on the possibility to conduct sketch projects with 60% grants from the project.

"Active House 2017 Symposium"	Green Solution House Bornholm 27. – 28. Sept. 2017	Presentation of paper: "Towards 2025" on Active House labelling and BIPV.
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A thematic magazine from the Danish association of Sustainable Cities and Buildings FBBB named "Quality Cities", was launched in March 2017 with BIPV articles concerning Sønderborg and Hørsholm (see also annex on this). Before that another thematic magazine on "The Climate Shield of the Future" was printed before the summer 2016.

Besides the BIPV Quality Cities project met its project objectives as follows:

- 1) Investigation of the potentials of BIPV technology in cities via front runner projects, sketch design projects and the installation of 4,3 MWp PV in cooperation with the sector:

In the project there has been a strong focus on implementing the Solar Watch activities for a large number of the involved BIPV projects. Below is shown the link to the Eniscope survey system which was established by IQ Energy in cooperation with Solarplan.

By help of the following link it is possible to access Eniscope Analytics by help of the following URL:

<http://analytics.eniscope.com>

mail: EniscopeBIPV@gate21.dk

Password: Eniscope123

Here there is at present accesss to 33 different PV systems which are involved in the Forsk VE project. Soon this will also include solar data and guarantied solar results information.

Besides there has in cooperation with the Evishine company been implemented a survey solution of one of six housing blocks with PV at the Hornemannsvænge housing estate in Valby in Copenhagen. Where you can both see the PV production and compare to the solar heat production, the district heating use and the electricity use for ventilation.

Link concerning this :

<https://evishine.dk/login/auth>

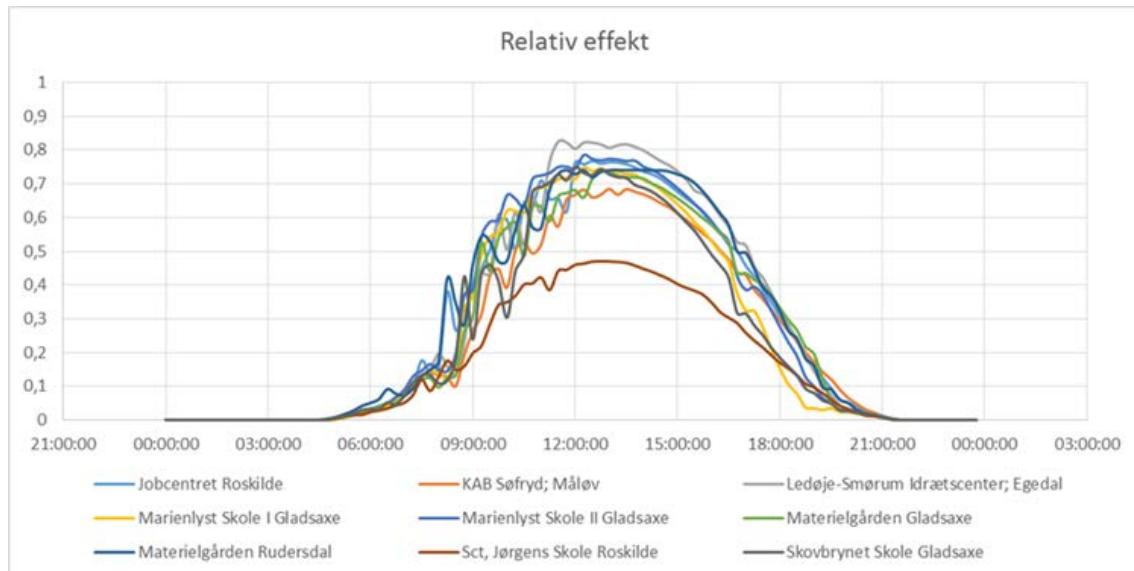
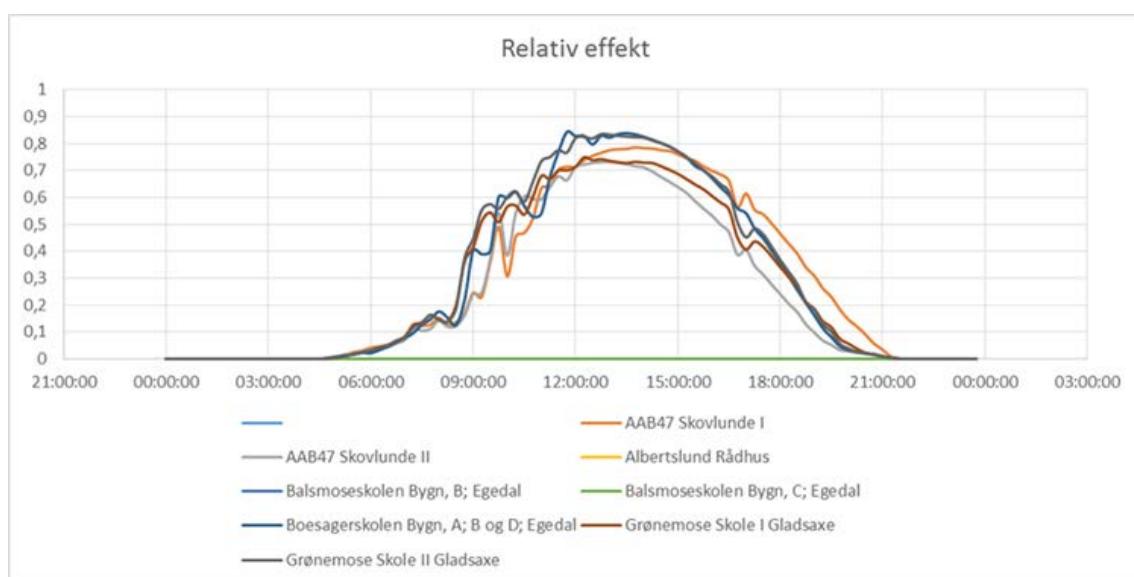
and here you shall use :

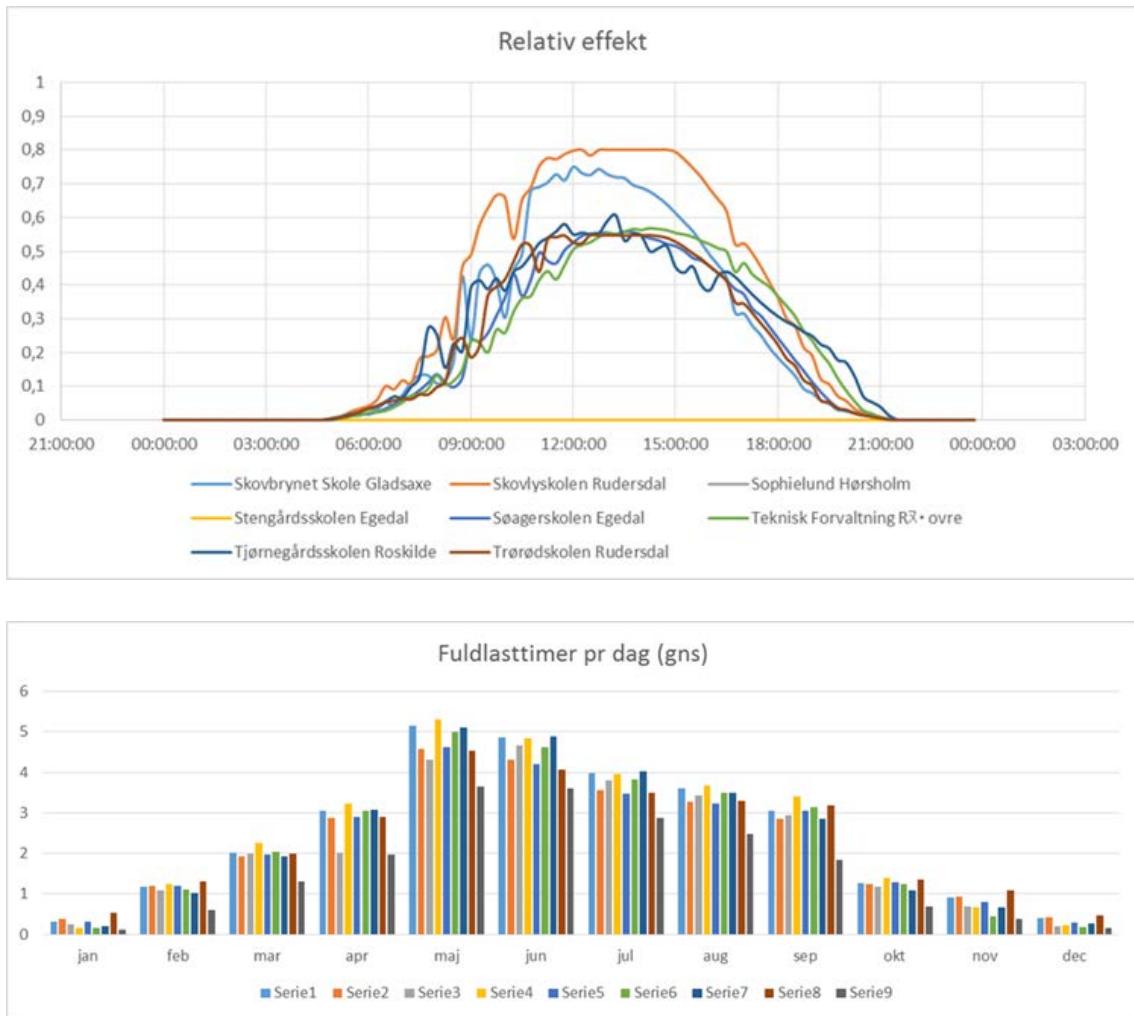
Username: cenergia

Password: cenergia1234

Besides this, cities like Sønderborg and Frederikssund also use Evishine survey, while cities like Copenhagen has their own survey system.

Below comparison of solar production data for SolarWatch PV systems:





- 2) Dissemination of project results to the involved cities and the housing association sector and other relevant stakeholders: (see also dissemination list) FBBB has included an article on the BIPV sketch design programme with Solar City Denmark in one of its member magazines, and there is still a reasonable interest to utilise this. A special activity here has been the focus on developing two BIPV test buildings in Copenhagen in connection to "Living in Light" activities, that Kuben Management has organised. Here it has been possible to involve the Norwegian architect Reiulf Ramstad with a very interesting design, which both includes use of several BIPV solutions together with optimised daylight for the building and also Svendborg Architects.. FBBB and Gate21 has made information and newsletters with focus on the project and in October 2015 both Solar City Denmark and Cenergia was involved in BIPV promotion at Building Green in Forum. Besides Cenergia has promoted project results towards partners in the international Active House Alliance and the Danish AktivHus Danmark association

- 3) Development of a common vision on how large scale PV and BIPV projects can be realised as part of an Active House labelling of city areas and energy efficient building. (See examples of this in the annex)

As mentioned it has, due to changes in PV rules of Denmark, been challenging to realise the project exactly as proposed, but it has however been possible to realise a continuous cooperation with Danish cities on BIPV, which has been important in the situation with continuous reduced global PV costs.

Even though there is not an impressive support for PV and use of BIPV in Denmark, projects like BIPV Quality Cities has maintained a focus on this important area with a main focus on dissemination work. Together with 2 other BIPV projects in the ForskVE programme, the BIPV Quality Cities project has secured a continuous effort on BIPV implementation with leading

Danish stake holders at very reasonable costs, so ongoing workshops, study tours and seminars has been conducted also with the involvement of the building industry.

1.6 Utilization of project results

At present there is ongoing activities to promote the use of BIPV in connection to Active House labelling with focus on CO₂ neutral building levels as a proposed standard towards year 2025.

1.7 Project conclusion and perspective

The time schedule of the project was increased with one year, mainly to make it possible to establish BIPV solutions in Hørsholm at Sport Park buildings here. Even though the outcome of this initiative will be more limited than originally anticipated, it was no problem to have included the originally PV implementation capacity in the project in cooperation with the large number of involved city partners, of which most cities at Zealand is actually at the same time members of Gate21.

From the implementation list and the enclosed SolarWatch installation list, made in cooperation with IQ-Energy and Solarplan can be seen that in all 2.315 kWp PV installations are included in the SolarWatch platform, with 33 PV installations in all.

To this can be added that Evishine survey systems have been used for all installations in Sønderborg and Frederikssund, while Copenhagen City Properties have their own survey system.

In connection to the analysis work by AAU it has been important with good hourly survey data, and work was prepared by the partners to make analysis of performance results where a large number of PV systems could be compared in practice.

In the annex is enclosed an example of a weekly BIPV Quality Cities report from IQ-Energy, which has been distributed to key partners of the project since the end of 2014.

It has been agreed with the city partners including the city of Copenhagen, to work on practical BIPV demonstration examples, which are not dependent on the rules concerning use of PV in cities. In connection to this, a special effort has been made to prepare and develop a small CO₂ neutral Active House test house with BIPV, which should be exhibited towards builders and architects. And with supplemental funding, it was possible to exhibit the result of this development in connection to a Nordic conference on the 23. June 2017.

Kuben Management has also been a very active partner in this context. This also includes work on the Hørsholm Sports Park as a support on the constructions in relation to general renovation of the sports buildings and besides this, there has been important work on BIPV implementation at the Landsdommergården housing estate in Copenhagen, where an architectural competition has been realised with focus on BIPV.

The result has been that Henning Larsen architects won the competition in cooperation with the Gaia Solar BIPV provider, here with an innovative BIPV solution for red tile roofs.

Since then the tenants have agreed to realise the whole roof towards the court yard with the proposed BIPV solution and there has also been a dialogue with the chief architect's office in Copenhagen.

The continuous work on BIPV dissemination with stake holders like Solar City Denmark, FBBB, Eniig, Solarplan, Cenergia and Kuben Management, has been one of the most important results of the project, also involving BIPV technology companies together with cities, builders and investors in this very interesting area for the future.

Annex

Relevant links

- <http://www.energyplan.eu/pv/>
- www.baeredygtigebygninger.dk
- <https://www.gate21.dk/project/bygningsintegrerede-solceller/>
- <http://www.solarcity.dk/Tilskud/Skitseprojekter>