



## Development of the building integrated PV solar installation in Nieuw Sloten, Amsterdam

### The start of the project

This 250 kWp solar energy project was carried out in the period 1991 - 1996 in the newly built residential area of Nieuw Sloten in the southwestern part of Amsterdam. The roofs of 34 one family houses and the roofs and cladding of an apartment building with 37 apartments were covered with photovoltaic (PV) solar modules.

This document describes the development process and identifies lessons learnt and factors for success. For a more technical description of the PV systems installed see the accompanying Nieuw Sloten case study.

This was the first project ever realized on this scale in the built-up environment. The success of this project led on to later large scale PV solar energy projects in other urban areas. A number of technical issues had to be worked out for the first time. In addition the project involved many professionals with no previous experience with PV and very little knowledge of PV. These professionals were assisted by the manager of the PV project.

Previous 'nearby' pilot projects with a single PV solar house in Castricum and with ten solar houses in Heerhugowaard had been successfully finalized in 1991. The pilot projects were carried out within the framework of the Netherlands NOZ-PV subsidy and R&D program, and the next step foreseen in the development of solar energy solutions by this Dutch incentive program was a '100 solar houses project'. The energy company of Amsterdam was enthusiastic about solar energy and took the initiative to prepare and realize a project on this '100 houses' scale.

From the beginning until the completion of the project, the PV project was led by the policy department of the energy company. In 1991, a dedicated project manager was appointed, and the size of the desired system was calculated and fixed to be 250 kWp. This was the effective start of the '100 solar houses project'.

The first task of the project manager was to find a location in Amsterdam with a pending urban development plan where a building integrated PV solar system of this size could be implemented. An important prerequisite was that the buildings should not have been designed yet, so solar energy could be taken into account in the architectural design of the buildings.

In parallel to this, in 1990, the mayor and aldermen's office of Amsterdam had commissioned a project team for the development of the new residential area of Nieuw Sloten. The team consisted of representatives of the municipal offices: Town Planning Service (Dienst Ruimtelijke Ordening), Building and Housing Office (Bouw en woningdienst), Public Services (Dienst openbare werken), Environment Office (Milieudienst) and Municipal Land Development and Management Service (Grondbedrijf). The Nieuw Sloten area development was divided into five subprojects which were developed and built successively. The Project Initiation Document stated that the last subproject had to develop an environmentally friendly district, although the details regarding the environmental measures were not defined.

The project manager of the PV solar project saw the development in the Nieuw Sloten district as an ideal opportunity to realize the solar project of the energy company and she successfully took the initiative to join efforts with the team.



During their first meeting, the project managers of the PV project and of the Nieuw Sloten project respectively made an agreement in principle to try to unite their ambitions into a common project where a 250 kWp solar system would be fully integrated into the development of the new residential city district. In the meetings that followed, the planning of the joint project was worked out and agreements were made regarding the tasks and responsibilities of the parties involved. An important success factor turned out to be that this included the positioning of the PV project manager within the Nieuw Sloten area development project team.

The first concrete contribution of the solar project was the definition of the additional requirements regarding the spatial planning of the district. Subsequently, the energy company signed an agreement with the involved parties. At the time, the Amsterdam municipality was the owner of the energy company and also the main investor in this solar project. The energy company Amsterdam has since been privatized and is now a part of the Netherlands energy company NUON (2008).

In the period from 1991 to 1996 the Nieuw Sloten district went through the foreseen development phases: urban planning, building design, sale, construction of the houses and the completion and the delivery to tenants and owners on 6 June 1996.

The implementation of this project was based for a great deal on goodwill; most involved parties cooperated in the realization of the project without any financial benefit.

#### **Actions taken in the development process**

Throughout the project, the dedicated manager of the PV solar project worked out a number of documents and conducted a number of activities. Below is an overview of these activities:

- ◇ Submit a proposal for a feasibility study within the Dutch national program NOZ-PV
- ◇ Conduct the feasibility study for a 250 kWp fully integrated PV system in a newly built residential area (in cooperation with Ecofys)
- ◇ Work out the Guidelines for the PV systems (in cooperation with Novem and a group of architects and property developers). This document was used to inform the parties involved in the development and realization of the New Sloten project.
- ◇ Submit a project proposal within the Dutch national program NOZ PV for the realization of the project
- ◇ Submit a project proposal within the European Thermie program for the realization of the project (in cooperation with Ecofys, Miljøkontrollen from Copenhagen, Sermasa from Madrid, ICIE from Genoa and the University of Newcastle)
- ◇ Develop instructions for the architects regarding the design of PV houses
- ◇ Develop a check-list for the review of the architectural ideas for the PV district
- ◇ Review the global architectural plan and support the architect in working out the final architectural design
- ◇ Work out the requirements for the system supplier
- ◇ Request quotations from three system suppliers
- ◇ Organize consultations with the candidate system suppliers
- ◇ Organize three meetings with future tenants in order to create acceptance for this project
- ◇ Develop the requirements regarding the long-term ground lease contract
- ◇ Select the system suppliers and prepare the turn-key contract

- ◇ Request and coordinate the research and testing of the PV roofing construction at the Institute for roof research (Buro Dakadvies)
- ◇ Organize a workshop regarding the grid connection in cooperation with KEMA (technical testing and consultancy enterprise)
- ◇ Make agreements with the grid operator regarding the grid connection
- ◇ Support the system engineering according to the requirements of the public grid
- ◇ Work out the requirements to be implemented within the house purchase contracts
- ◇ Work out the monitoring program in cooperation with Ecofys
- ◇ Submit a project proposal within NOZ PV for the monitoring in cooperation with Ecofys
- ◇ Work out the communication plan
- ◇ Work out the project information brochure
- ◇ Coordinate the system installation and grid connection
- ◇ Work out the maintenance plan
- ◇ Request the research of the PV roofing due to the leakage problems at the Institute for roof research (Buro Dakadvies)
- ◇ Act as a contact person for the tenants with leakage problems
- ◇ Coordinate the reparation activities (due to roof leakages)
- ◇ Make agreements with the property developer and with the Housing guarantee Institute (GIW - Garantieinstituut Woningbouw) regarding the building guarantee for the PV-houses
- ◇ Publish five newsletters for the tenants of the PV houses
- ◇ Make reports for the Dutch and European subsidy programs
- ◇ Present the project and lessons learned at many national and international PV conferences between 1994 - 2000

### **Informal meetings**

At various stages in the development of the project there were issues, sometimes only minor details, in which the PV project formed a hurdle for the property developer, the architect or the spatial planner to develop their ideas in the 'usual way'. It was one of the success factors of the project that these kinds of problems were often discussed (and solved) during informal meetings between the project manager of the PV solar project and the 'owner of the problem'.

### **Social research**

During the project, social research was provided by IVAM (University of Amsterdam) on this project and some other building integrated PV projects in the Netherlands. This research concluded for the New Sloten project that the municipal project team, architect and property developer were suspicious about PV as a roofing material and as a technology for electricity generation. Also, they perceived the involvement of the energy company and the requirements of the PV project as disturbing and complicating. The final conclusion of IVAM was that the PV project probably would not have been realized if the energy company had not put such a big effort into it. Especially the communication by the dedicated project manager (frequent, direct, easy to reach contact person) with the candidate tenants during the project preparations and later with the real tenants during e.g. the leakage problems, was a crucial part of this effort. See further info No.2: "Kiem van maatschappelijke verandering", Barbara van Mierlo, ISBN 90-5260-082-1.

The IVAM research also learned that the tenants of PV houses did not primarily choose their houses because of PV. The size of the house, price and the financing possibilities were the most



important criteria. The quality of the house, distance to work, surroundings and services (schools, shops, recreation) were also very important issues. This is in line with expectations. The choice between the same house with or without a PV roof would come on the tenth place of the selection criteria.

### **Major impacts, lessons learnt and success (or fail) factors**

The major market impacts and lessons learnt for future PV projects and for the development of PV in the Netherlands by the Nieuw Sloten PV project were:

- on the one hand architectural and building integration did not require drastic solutions or adaptations in the building practice, but on the other hand had more 'collateral' consequences than expected. Despite all tests at relevant test laboratories on the water tightness and other characteristics of the PV roof, the PV panels turned out to be a much more troublesome roof than e.g. roof tiles, resulting in leakage problems later on. Several later urban PV projects like the Nieuwland 1 MegaWatt project learnt how to avoid problems with this issue from the project.
- this was the first large PV project to accept PV panels with sub-optimal orientations, due to other constraints in the built-up environment. East or west orientated PV solar panels had not been done before in a large PV project. The lower solar irradiation on east and west roofs was 'compensated' by lower sloping angles of the roofs, resulting in about 15% lower energy performance than in the optimum south-oriented situation. This was an eye-opener for many building integrated PV projects to come.
- the grid-connected inverters were sized to have a lower power rating than the peak power of the PV system. This was the first time this was done in a PV project. The under-dimensioning of the inverter led to both a better overall performance and economy of the PV project. The size of the inverter system was based on a computer simulation of the performance of the PV systems using one year of hourly meteo data.

The architect learnt that working with PV is not so difficult if detailed data of the solar building elements are available. But he/she also learnt that PV has to be taking into account from the very beginning, as the location of PV in the roof or façade of the building can conflict with other functions such as for ventilation, chimneys etc. as well as with future functions such as space for windows, dormers etc.

The urban planner learnt that orientation of streets (though a bit difficult) and height and sloping angles of roofs still can be optimized during the urban planning process, as long as PV is taken into account early enough. In fact in Nieuw Sloten the PV project development and the urban planning processes were integrated a bit late.

The landscape architect, who entered the project with suspicions regarding the visual effects of PV roofs, admitted that the PV district now has a nice visual appearance.

The real estate developer learnt that PV solar energy is certainly not the most important benefit people take into account when they buy a house, but is also not a barrier. In fact the houses with PV were still easy to sell, if the primary needs of buyers were met.



The PV company learnt that installing PV in a roof is completely different from realizing a PV system in a field. The skills for this were not developed in time. The PV company also learnt that they were not able to do a turn-key PV-roof delivery in the complicated market of real estate development and housing.

The municipality learnt that it was possible to fulfill energy & environment policy goals together with an energy company. From this project on, Amsterdam municipal project teams have included the energy company into the project teams for all large projects with energy and environmental ambitions.

The energy company learnt that (at that time) large-scale PV was feasible and attractive, and did not cause complications for the public electricity grid.

The PV project manager learnt that it is crucial that he/she is part of the overall urban development team with sufficient power. On the other hand it also became clear that all other stakeholders had to be sufficiently involved and committed to the PV project.

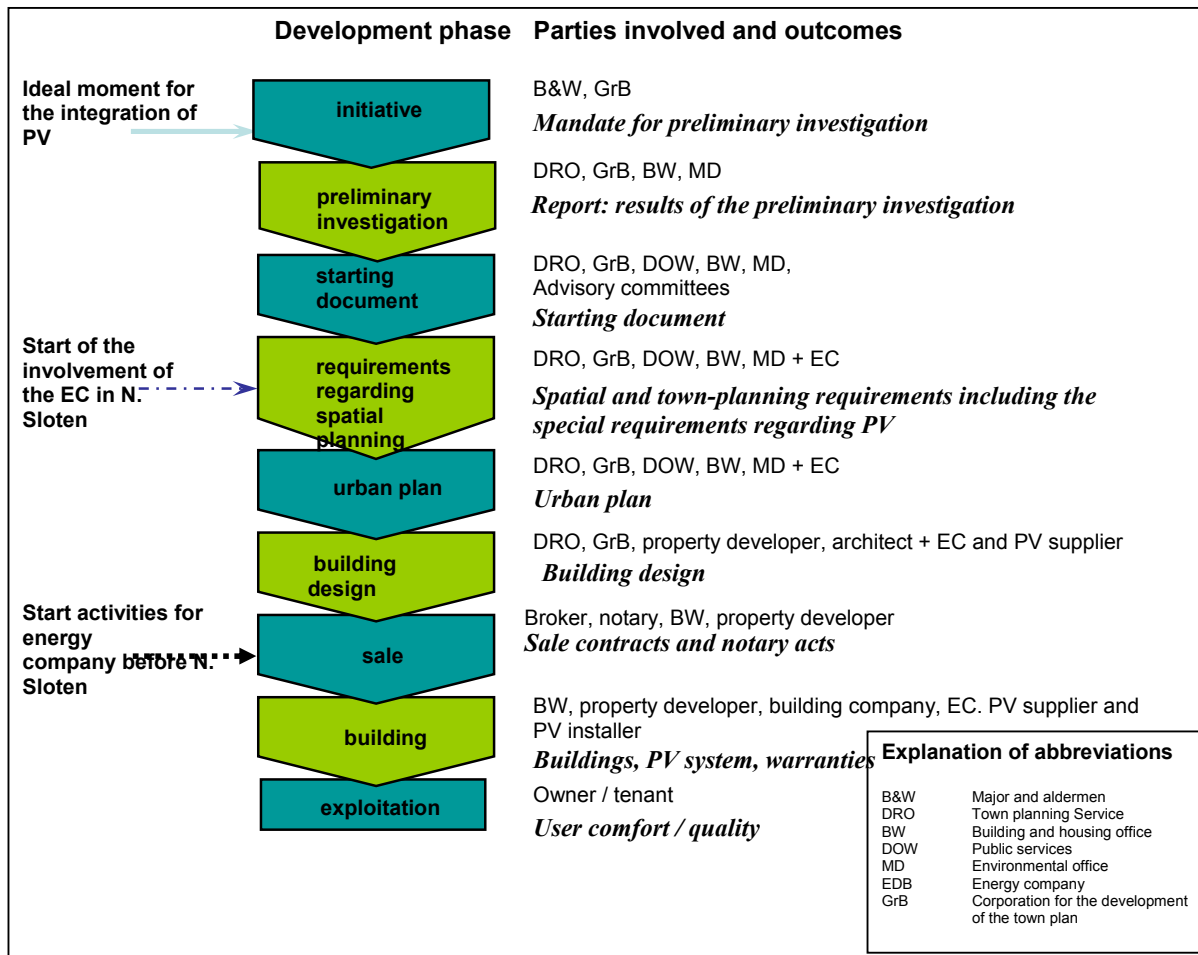


Figure 1: Phases and stakeholders of the Nieuw Sloten PV project.



**PV UPSCALE**

Urban Scale Photovoltaic Systems



The most important success factors for the PV project were:

- the continuity and persistence of the PV project manager
- the convincing and honest communication of the PV project manager to create support from all stakeholders
- finance from the different national and EU subsidy programs
- the persuasion and belief of the energy company of Amsterdam in this 100 solar houses project
- the convincing national PV incentive program with a focus on building integrated PV
- the opportunity given by the municipality
- the goodwill of the tenants of the PV houses

An important negative factor was the idea that the time was right for a turn-key delivery by the PV company, causing major trouble and delay's instead of preventing them; e.g. when there were serious leakage problems shortly after the completion of the houses.

### Sources of further information

1. "Monitoring PV system Nieuw Sloten", May 1999, report available only in Dutch.
2. "Kiem van maatschappelijke verandering", B.C. Van Mierlo, December 2002, Amsterdam.

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Web sites: <http://www.pvdatabase.org>  
<http://www.bipvtool.com/index.php?case=The%20Netherlands>  
[http://wikimapia.org/2636556/nl/Nieuw\\_Sloten\\_Zonnepaneel\\_Huizen](http://wikimapia.org/2636556/nl/Nieuw_Sloten_Zonnepaneel_Huizen)

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