

Smart Solar Charging

A unique solution for accelerating the transition to renewable energy

Time to change, time to grasp the opportunities



Quick read

!!! The transition from fossil energy to renewable energy is essential and is happening fast all over the world. The Netherlands is not (yet) a leader as regards the amount of sustainably generated energy (p 3).

!!! In the transition to 100% renewable energy, storage is a major factor and simultaneously a global challenge. Utrecht has a solution: Smart Solar Charging.(p 4)

!!! The Netherlands is a leader in the adoption of electric transportation. In Utrecht, existing technologies are being integrated in a smart manner through the development of smart services that link the generation and use of renewable energy. The Utrecht solution enables the Netherlands to respond to the global storage challenge (p 7).

!!! Smart Solar Charging brings benefits for citizens such as cleaner air, cheaper transportation and clean, renewable energy. It also creates employment and attracts international companies to the Netherlands. What's more, it helps to avoid investments in grid reinforcement. (p 8)

!!! If Smart Solar Charging is to achieve its potential, investments by businesses and local government must be backed up by smart legislation created by the state in consultation with operators. Smart Solar Charging needs regulatory authorities to provide space for experimentation. (p 10)

!!! The Utrecht region has major ambitions and is doing what's needed to achieve renewable energy. And it is already achieving success. Now it's time to scale up these successes. Good for Utrecht, good for the Netherlands and good for you! (p 11)

!!! This is how the Netherlands can provide smart services to facilitate the ongoing energy transition and adoption of electric transportation. It's a solution with a global market that will attract investment to the region and restore the Netherlands to a leading position. Global Challenges, Dutch Solutions. (p 14)

Transition from fossil energy to renewable energy in full swing

Ever more cities, regional authorities and countries are setting ambitious targets for reducing emissions of greenhouse gases. At the same time, in many parts of the world renewable energy is now competing with fossil energy without the benefit of subsidies. And so investments in renewable energy, especially in the form of solar and wind power, are seeing huge increases all over the world.

Ever more countries are setting course for a 100% sustainable energy supply. China has taken over the leading position from Germany with regard to investments in renewable energy, followed by Japan in terms of solar panels. Since China has been able to create a large domestic market the country has established a strong global market position in solar panels. Indeed, China was even able to [increase](#) its 2015 goal for newly created solar energy by 20%, upping it to 17.8 GW with the aim of further expanding the market for solar energy and accompanying applications. By way of comparison: in the space of just one year China will be installing half of the total amount of solar panels currently in Germany. And here's another impressive figure: this year, 700,000 solar panels are being installed every day worldwide. Last year the amount was 500,000 – and next year this will probably rise to 1,000,000. That's a capacity equal to a very large nuclear or coal power station every four days.



These rapid developments mean that economies already aiming for a sustainable economy are raising their sights even further. Just two months ago Governor Brown of California announced the most far-reaching reductions in CO₂ emissions in the USA: by 2030 emissions must be 40% below the level for 1990. Here too the authorities are already aiming for a 100% clean energy mix, with the emphasis firmly on solar power.

In Europe, Germany and Denmark are the front runners in the drive to a 100% renewable energy mix. Our neighbours to the east already get more than a quarter of all electricity from sun, wind and biomass. Indeed, during daylight hours on sunny days this is



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sometimes enough to provide 50% of Germany's electricity requirements. And on windy days in Denmark the country generates more energy than it uses. The *New York Times* recently hailed Germany as [the first green superpower](#), since the country already regularly has to manage an energy surplus.

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Energy storage is the key to 100% sustainable energy supply

If a 100% sustainable energy supply is to be achieved, energy storage is vital. This is because wind and solar energy are not constant sources. Moreover, this storage must be cheaper than the coal and gas power stations currently used as back-up systems. Many forms of storage are required, and are also under development. Until recently storage in batteries was an expensive method, but thanks to recent developments the battery is making rapid progress and is already competing with back-up power stations. This is due to the rapid growth of electric cars.

The rise of electric cars

The electric car sector is growing fast. Tesla has turned the automotive market on its head: although a newcomer, it has produced the best car ever (according to the Consumers' Union in America). And so Tesla has set the bar very high. Currently, Nissan-Renault is the global market leader in electric cars, producing half of all such electric vehicles. For years now Nissan has been investing billions in electric cars with just one goal: to become and remain the market leader. In the German automotive industry BMW is the leader: under the co-leadership of Stefan Quandt, 'the German Elon Musk', the company seems to be getting ready for 100% electric mobility. Volkswagen, Audi and Daimler-Benz are now following suit.

All over the world the number of electric passenger cars is rapidly increasing. In terms of figures, China is leading the field here too with major ambitions; BMW expects that China will be [the biggest market for electric cars by 2019](#). The Chinese car market is already huge and China is quickly expanding its network of charging stations.



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[The rumours that Apple](#) will be making electric cars as well are now pressuring the automotive industry even more to put a major effort into electric transportation. For some time there have been speculations that Apple will enter this market and although of course no official statements have been forthcoming from Apple itself, it is regarded as certain that the company is making corresponding preparations. And when the moment comes that Apple, a company with hundreds of billions of dollars at its disposal, does indeed make the move, all (car) companies that have neglected this market will find themselves sidelined. A salient detail here: Apple recently became the world's biggest corporate investor in renewable energy – the company is creating its own huge solar and wind farms in both the USA and China.

The (car) battery as local storage option

Thanks to the rapid rise of electric cars, the development of cheap, energy-efficient and lightweight batteries has accelerated. After all, the company with the best battery can deliver the best electric cars. Currently the battery capacity in cheap electric cars is still limited, but the capacity will at least double for electric cars in the near future. By the end of 2016 several large car brands will be presenting electric cars that can drive at least 300 km on a single battery charge. By way of comparison, that's enough energy storage to provide an average Dutch household with electricity for more than a week.



Tesla [recently launched the Powerwall home battery](#), enabling solar power to be used in the home both during the day and at night. This can either replace the traditional power grid supply or function as a back-up system. In order to make all these batteries Tesla is currently building the biggest production plant in North America: a battery factory in Nevada that has a production capacity equal to all existing battery factories worldwide. This factory is named Product 1.0, leading one to think that it will be followed by others of the same kind. And here too the competitors in Asia and Europe are not standing idly by. LG Chemical already has five mega-scale battery deals with major car manufacturers. And on 10 June the German equivalent company, [Solarwatt, run by Stefan Quandt](#) (a major BMW shareholder), is launching its home battery for the European market, just ahead of Tesla. These batteries for domestic use in the USA and Germany have already proved themselves profitable.

Where the home battery will have a capacity of approximately 7 kWh, by 2017 the battery in an average electric car looks set to be ten times as big. Access to this battery will be the killer app for enabling countries to shift to a 100% sustainable energy system. Providing smart access to a car battery to store (renewable) electricity when it's available and then retrieving it when production is lower opens up access to the fastest growing existing storage method in the world, which moreover becomes available 'free' to users wherever they are: at home, at work, in residential areas, in industrial estates, etc.

The Smart Solar Charging solution from Utrecht: a smart combination of developments in the field of electric cars along with the promise of home batteries

Energy storage and smart grids that enable stored energy to be fed back into the grid are two elements that form a major part of the solution for the transition to renewable energy. This is precisely the area that Tesla's Powerwall and the German Solarwatt address with their home batteries.

A European first from Utrecht: Vehicle2Grid

In March of this year the Utrecht region presented a European first that combines developments in the area of electric car batteries and domestic use of stored energy. This first was part of a project titled *Smart Grid: rendement voor iedereen* (English: 'Smart Grid: returns for all'; an element of the 'Peaks in the Delta' subsidies programme, March 2015), and involved Europe's first Vehicle2Grid (V2G) energy storage system. This storage system, a smart charging station for solar energy produced by Nissan, can both charge and discharge electric cars and thus enable car batteries to supply homes with power. Among the basic considerations that explain why car batteries are so suitable for the task are: cars have bigger batteries than is currently the case in homes and the capacity of these batteries will increase in the coming years, and cars often remain parked in front of homes for long periods, so there is plenty of opportunity.



A world first, now!

General Electric, Vidyn, LomboXnet, LastMile Solutions and Stedin have formed a Dutch consortium to develop the world's first solar-controlled, bi-directional, compact charging station for electric cars. The Smart Solar Charging consortium is now going a step further and presenting a world first on 9 June. This green world premiere has been developed in



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Utrecht under the slogan 'Global Challenge, Dutch Solution' and forms part of the Smart Solar Charging testbed.

This public-private partnership testbed combines the input of General Electric, Nissan Europa, Vidyn, Stedin, the SMEs LomboXnet, LastMile Solutions, the Municipality of Utrecht and the Economic Board Utrecht to develop and upscale smart local energy systems of the future.

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Charging standards, cheaper charging stations, suitable dimensioning

This new solution is unique in several ways:

- To begin with, it will apply a global charging standard (AC), in principle making this smart charging station suitable for *all* electric cars. This means that both Smart Solar Charging and V2G can be upscaled globally.
- What's more, this smart charging station is 80-90% cheaper than the current international standard. This savings is achieved through a more compact design, optimisation of the technology and large-scale, Dutch production.
- In addition, the dimensioning makes this charging station suitable for installation in both public spaces and in any garage or drive, so that every electric car can soon both charge and discharge on a smart basis.

Major potential for Smart Solar Charging

The smart charging stations, developed in Lombok, are an essential element in the new, local and sustainable energy systems worldwide. Thanks to open standards it can be applied to all cars, everywhere.

Smart Solar Charging thus contributes to:

- Required storage to enable the transition to renewables
- Smart clean mobility
- Higher returns on solar power
- Reduction of electricity peaks in the grid
- Healthy air, also in heavily urban areas
- By upscaling Smart Solar Charging from the Netherlands outwards, unique expertise is built up that can give us a leading position relative to the rest of the world
- Encouraging electric driving: the affordability of electric driving is increased because the energy that is fed back results in savings or even earnings (consumption of own energy and the consumer as producer)
- The new solar-controlled, bi-directional compact charging station will deliver at least 10% cost savings through more efficient use of existing grids



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- Employment is an attraction factor for global players (see below for more details)

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Employment: from one to three jobs per 20 cars

The smart energy infrastructure is creating new types of work. Moreover, an increase in the number of jobs can be expected because the entire chain of smart charging requires manpower. Research by the Netherlands Enterprise Agency indicates that one job will be created for every 20 electric cars. This will mean 10,000 jobs by 2020, and 50,000 jobs by 2030. Moreover, the Smart Solar Charging consortium expects that innovation and the combination with smart grids will treble this number of jobs. So from one to three jobs per 20 cars, thanks to the combination with solar panels and the inclusion of this infrastructure in the Smart Grid (the product presented on June 9th).



Attracting global companies

Thanks to these economic forces, global companies such as General Electric and Nissan are now also settling in the Utrecht region. And so the Utrecht region is putting itself on the international map and will continue its efforts to become the global testbed for Smart



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Solar Charging. It's no longer just about charging stations but also about the management of energy systems for cities. GE sees an important growth market for its organisation in this field. Prompted by the project in Utrecht, the company recently decided to retain its charging infrastructure division in the Netherlands (retention of 16 FTEs). In the coming period GE will be actively investing in the market for local energy systems (estimated additional FTEs: 400).

Avoiding investments in grid reinforcements

The possibility of storing energy also helps to avoid unnecessary major investments in grid reinforcement. This is particularly the case with the advent of smart grids in which supply and demand can be aligned more closely and where consumers can also act as energy producers and supply energy to others.

If countries in the EU continue to focus on the current grids of distribution network operators, then major investments will be required in electricity grids. The estimated costs for grid reinforcement in the Netherlands are around 30 billion euros (source: Ecofys). This cost savings will lead to additional investments being made in the green economy (electric cars, solar panels, smart cities) instead of in copper.

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What's needed to utilise all the opportunities?

A number of things are needed before all the opportunities can be utilised. Distribution network operators have to move beyond traditional models and grids and instead think in terms of smart grids and sell the associated new services (and no longer per kWh). This requires different, smart management. Accordingly, distribution network operators are being called on to be open-minded and to contribute to solutions, as Stedin in Utrecht is already doing.

Car manufacturers need to permit the batteries of their electric cars to be discharged, too. With this charging station, GE is setting an international standard that will challenge car makers to enable V2G through the global AC charging standard. Drivers of electric cars will ask for this standard.

Need for a new revenue model and legislative leeway

If real steps are to be made in the Netherlands and beyond, regulatory authorities need to provide space for experimentation. Currently one citizen's energy surplus cannot be legally sold directly to another citizen. The surplus has to be returned to the grid at low prices and energy then has to be purchased from the same grid at much higher costs.



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Unsurprisingly, this option meets with little interest. This means that a genuinely new revenue model with variable prices is not yet possible, although this is a prerequisite for the large-scale introduction of Smart Solar Charging in the Netherlands.

If the legislation provides corresponding leeway, then successful revenue models can arise here as they already have in the USA and Germany. Initially this will involve:

1. Enabling divergent/variable electricity and grid tariffs
2. Enabling divergent/variable energy tax rates

Among other things, this will enable closer alignment of energy supply and demand through smart management, allowing consumers to supply to each other as energy producers and thus achieving a 100% own use of solar power.

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Rapid change in the Netherlands, led by the Utrecht region

Although the amount of generated energy in the Netherlands is relatively small, the country has a strong focus on renewable energy. This is clearly reflected in the wind turbines and solar panels that are increasingly appearing all over the Netherlands.

In the Utrecht region notable successes have been achieved in the field of renewable energy. This is now visible in the electric shared cars in the Lombok district of Utrecht, energy-active residents in the Nieuwland district in Amersfoort, solar power stations operated by LomboXnet and large-scale joint development projects like *Smart Grid: Rendement voor iedereen*, in which government, businesses and science institutes are together developing innovative services.

The government, and certainly also residents of many residential districts, wish for attractive and healthy neighbourhoods – which equates to strong and vigorous neighbourhoods. And so the Municipality of Utrecht is investing heavily in solar panels on roofs, in electric mobility and in clean air.

Enabler for Solar City and e-mobility

It is important for the city and its residents that Smart Solar Charging is put into practice as much as possible. The municipality sees smart grids as an enabler for more solar power and more electric cars. Hence the development of smart grids forms a contribution to achieving a Solar City and a city with e-mobility – two issues of major importance to the Municipality of Utrecht and its population. This is why Utrecht is applying hard work (=



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jobs) and common sense to achieve a healthy living environment, and of course healthy people. Utrecht aims to grow and, ideally, also to be regarded as a leader in making cities both healthier and more sustainable.

One of the goals of the Municipality of Utrecht is that within five years 10.000 electric cars will drive around in the city. The Municipality of Utrecht will deliver 5% to the national aims of 200.000 electric cars in 2020.



The population of the city of Utrecht is expected to grow to 400,000 by around 2030. And in 2030, too, Utrecht residents must be able to enjoy a pleasant and healthy living environment. Moreover, there must be sufficient jobs for the population. So the fact that these smart developments will also create employment in the region is another important factor. No less important is the know-how and further expertise development required in Utrecht to enable green growth. In this way Utrecht can establish its long-term attractiveness for both residents and business.

The development of smart grids / Smart Solar Charging will thus contribute to the competitiveness and living quality of cities. As a leader in the field, Utrecht sees the opportunity to collaborate with the state in a City Deal, forming part of the Dutch Urban Agenda. In this way companies, the Utrecht region and the state can join forces in a 'living lab' to research the conditions under which efficient and effective upscaling of smart grids can be achieved, in turn benefiting citizens, companies and authorities.

The benefits will therefore certainly not be confined to Utrecht's own region. Indeed, it is precisely the global opportunities that make this development so interesting. In the regional testbed, the alliance will investigate how participation by residents can best be achieved so that further developments can truly take place in partnership with citizens.



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The testbed also provides the chance to find out how smart legislation can promote green growth. This research takes place in a living lab, however, instead of being modelled at a desk.



Government's role is to create future-proof conditions in which businesses and residents can achieve green growth together. Once these conditions have been thoroughly examined in real-life situations in the Lombok testbed, the acquired knowledge will be nationally upscaled and anchored in new, smart legislation. And thus the lessons learned, the products and the services can be used by other alliances in other cities in the Netherlands and Europe. In this way this Utrecht-based development not only stimulates technical solutions themselves but also the accompanying processes, e-mobility and the use of solar panels far beyond the boundaries of Utrecht.

Upscaling Utrecht's successes

A wide variety of local initiatives are appearing in the Utrecht region aimed at clean renewable energy, reduced CO₂ emissions and smarter use of the grid. The regional *Smart Grid – Rendement voor Iedereen* project has developed smart new services that are already creating business and jobs and avoiding unnecessary investments in grids. The further development of these smart products and services is just right for the Utrecht region, thanks to the rapid growth of solar energy, electric transportation and the innovative potential of its strong service sector and highly skilled population.

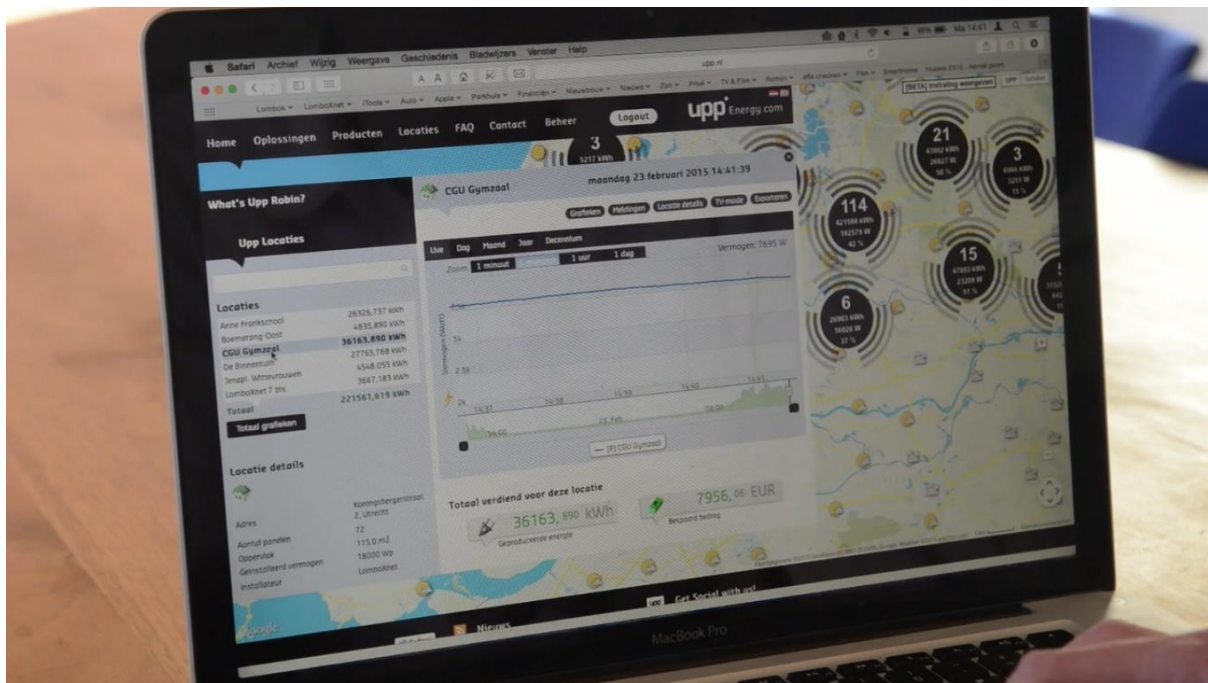


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The time is now!

With Smart Solar Charging, the Dutch consortium has developed a product for which there will be huge global demand. A product that creates space for a wide variety of new services. This public-private partnership gives the Netherlands a solution that contributes to major societal issues such as global warming and the provision of a healthy living environment in cities.

This fine-tuning of electricity at the local level is a 'rising star' in international terms, a market worth billions currently in the making. Reason enough why Nissan, General Electric, Tesla, BYD and other parties are showing exceptional interest in the Utrecht solution.

The next steps involve the creation of an internal market and upscaling within the Netherlands to transform this innovation into a concrete and viable product. It would be a huge pity if this first were to be handed over to interested foreign parties. As said, in order to create this market a new revenue model is required – and this can only come about if the day and night electricity tariffs are ended and variable tariffs can be applied instead.



Then the Netherlands can continue to play a major role and even become global leader in the field of Smart Solar Charging.

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