DISRUPTIVE INNOVATORS IN THE ENERGY SECTOR

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10 YEARS - HET CONSULTANCYHUIS (HCH)

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Ten years ago, we started Het ConsultancyHuis (Dutch for *"The Consultancy House"*, we'll use *"HCH"* from here onwards) with a number of experienced Business Consultants and IT experts. Our focus was to help our customers in Energy and Utilities to deliver on their IT projects, on time and with quality results.

I know it's a cliché but I'm going to say it anyway: Even though it has only been 10 years, it really was a different world back then: Energy providers did not have to worry about charging electric cars, smart grids were still in its infancy, and to many people *"renewable energy"* was a niche market. Also, StartUp companies in the industry were not very common and they were definitely not on the radar for most of the larger energy providers.

Fast forward to the present day and we now see something completely different: these days we help our clients to increase the rate in which they can deliver value to their customers, as the expectations about response time are much higher. We also see that the larger companies pay much more attention to the (potentially) disrupting StartUps and even make acquisitions. The newest development in the last few years is the development of (partly) shielded internal startups.

At HCH we believe that this rate of rapid innovation and constant pressure from new disruptors in the field will keep increasing, and that's why we decided on creating this report: to help our clients to get insights from those disruptors that may not be on the radar yet. We hope you enjoy your read and get some new insights from it, we certainly did!

DISRUPTIVE INNOVATORS IN THE ENERGY SECTOR

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Let's be clear from the start: this is not another Innovation report that gives you quadrants filled with ranked companies that you are already familiar with. Most of the disruptive **European Innovators*** in this report you may never have heard of before, and we believe that you should keep an eye on them to stay informed and ahead in the energy market.

Most companies that we are familiar with are innovative in one way or another. That is, they will look for new opportunities to optimise their existing products and processes. Some call this linear innovation.

Disruptive Innovators are those rare companies that break the mould. They do not just work on linear innovation (gradual improvements), but try to come up with new ways to solve the needs of their customers (who may not recognise yet that they have these needs) in a different way.

For obvious reasons, it is very hard and even cannibalistic to be disruptive in an industry that your company relies on for most of the revenue. These are 3 examples of resistance to disruptive innovation from within that the authors of this paper have been involved in, both inside and outside the energy sector:

1. One of the major energy companies in the Netherlands has a number of internal startups that challenge the current way of going about business. Senior management has learned the hard way that those internal startups need a level of shielding from the rest of the organization to be able to maintain momentum. ***Result:*** One of the first internal Startups didn't make it because of fear of cannibalisation. A more recent try has been very successful and now has received outside funding and will become independent.

2. When one of the largest online retailers in the Netherlands started to introduce a marketplace for 2nd hand books there was definitely a concern that this would "eat" some of the revenues that were earned on the new books.

***Note:** Russia, Israel and Turkey were included along with 30 European Countries for this report.

Senior management had to be bold and push it through. ***Result:*** Second hand books became a platform for private book lovers and generated it's own significant income stream.

3. For many it seemed cannibalistic for Open Universities Australia (the nr 1 online education institute in Australia) to disrupt the online education market by introducing an online platform with free online courses. ***Result:*** Management maintained course and the platform became the fourth largest in the world generating leads to the main business model.

Besides overcoming the fear of revenue cannibalization, it also takes a specific perspective, mindset and execution drive to develop a disruptive idea. Most of all, it requires a lack of "red tape" or bureaucracy in an organization. This is why StartUps, especially those StartUps that receive significant funding, are crucial to monitor.

This report[1] is exactly that: it helps you to develop an insight in the field of smaller, but potentially very disruptive, players in the European Energy sector that have received significant funding. The sources of funding are very diverse, from huge Venture Capital funds to smaller private funds. Most of these funding rounds are public to attract as many investors as possible, and our research partner Traxcn keep track of these. Some of the funded companies are most likely not on your radar yet at this moment. [2]

In front of you is a summarized report. When you like to dive deeper in one or a few of the specific sections, we have a lot more information available that we would love to share with you in a meeting about Disruptive Innovators.

A taster of what you get out of this report

Let's get you started with an example of an interesting insight from this report:
The impact of Tesla on the car industry cannot be overstated, but the downstream effects of 0% emission electric vehicles (EVs) are also becoming very clear:

- Norway is leading the world when it comes to the adoption of Electric Vehicles, which creates it's own challenges as it now has 12 cars per charging point, the highest in Europe

- The number of charging ports in Europe are quickly growing (in the Netherlands from less than 5,000 in 2012 to 25,000 in 2016)

- From 2010 until 2015 an average of 60 completely new European

[1] We partnered with funding statistics company Traxcn on this report

[2] Note that our aim was to show trends and share some insights, and not to be 100% complete.

disruptors with external funding entered the field of battery and charging solutions for EVs every single year.

These conditions combined have lead to an increase of funding in the sector. The amount of external funding that was invested in EV-related solutions (like smart charging and charging points) jumped by almost 400% between 2015 and 2016 from 58M tot 229M

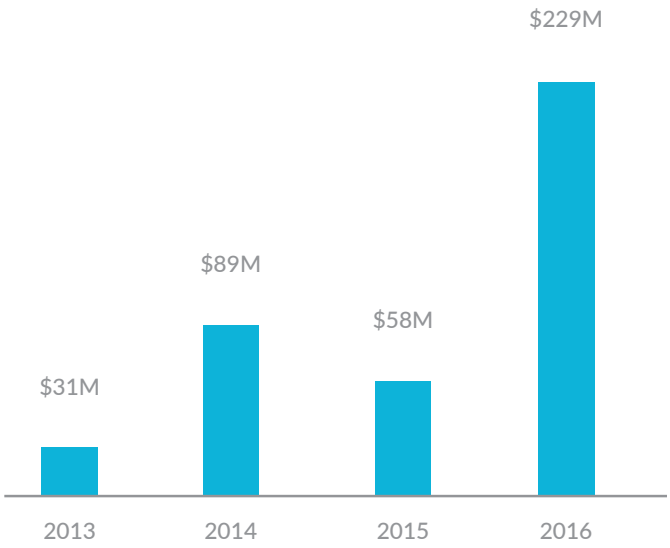

Figure 1 - European external funding of disruptors in the (downstream) Electric Vehicle market

One of those companies that is ready to disrupt the charging market is UK based InstaVolt, which was founded in 2016 with 11M in external funding and has a business model which allows you to earn money if you put a charger on your property for others to use.

Or have a look at the French company G2Mobility that received 3M investment to work out their concept of smart charging entire fleets of EVs. You can read about these investments and others in the EV section of this report.

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INTRODUCTION

We have analysed the external investments in potential disrupting companies across 5 Energy subsectors in Europe, up to 2016*:

- Renewable Energy
- Energy Storage
- Smart Grids
- Energy Efficiency
- Electric Vehicles

Across those sectors we have seen a total investment of almost 3 Billion Dollars in 2016. In Figure 1, it is clear that most of those investments were done in Renewables with Energy storage in second place.

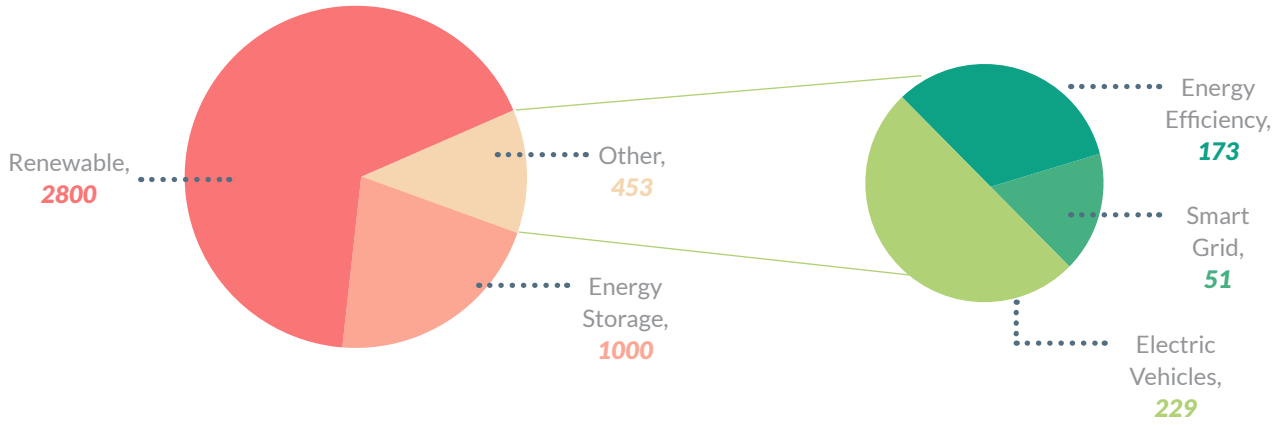

Figure 2 External investments in Million Dollars

We have broken these investments down and zoomed in on a few of the potential disruptors in each sector. Some of these companies you may never have heard about yet. For example, how much do you know about Werpo, the company that wants to generate energy from ocean waves and was recently acquired? Or what about Future Blends, the company that is aiming to disrupt the biomass industry? And then there is HeliaTek which has received 85M dollar funding last year and has succesfully created a thin flexible transparent solar panel which may at some point in the near future make us rethink the entire solar industry.

We have also looked at the acquisitions made in the sector and listed the ones that we counted among the most interesting. If you work for one of the Energy providers or grid companies in Europe, this may also give you some insights in what startups your major competitors are investing in.

Overall, this report has given us some great insights in the field of smaller and younger (often less than 10 years old) but potentially very disruptive, players in the European Energy sector that have received significant funding.

*Note: We intend to refresh this report next year.

1. DISRUPTING RENEWABLE ENERGY

1.1 Funding Trends

For Renewable Energy a few funding trends in Europe can be seen straight away:

1. Although the total amount of funding in this subsector grew with another 16% to 2.4 Billion, that growth was a far cry from the 60% growth from the year before.

2. In the mix of renewable energy Solar and Wind are unsurprisingly in the lead from the point of view of invested funds. Bio and Marine energy have both been in decline for the last few years (although there have been a few interesting investments in the latter category) and geothermal energy is not getting a lot of excitement from investors.

3. The number of companies in Renewable Energy that were founded in 2016 and received external funding saw a surprising decline from 112 companies in 2014 to only 12 in 2016. This may have to do with some European countries shifting their subsidies from Renewable to Energy storage, Smart Grid and other subsectors.

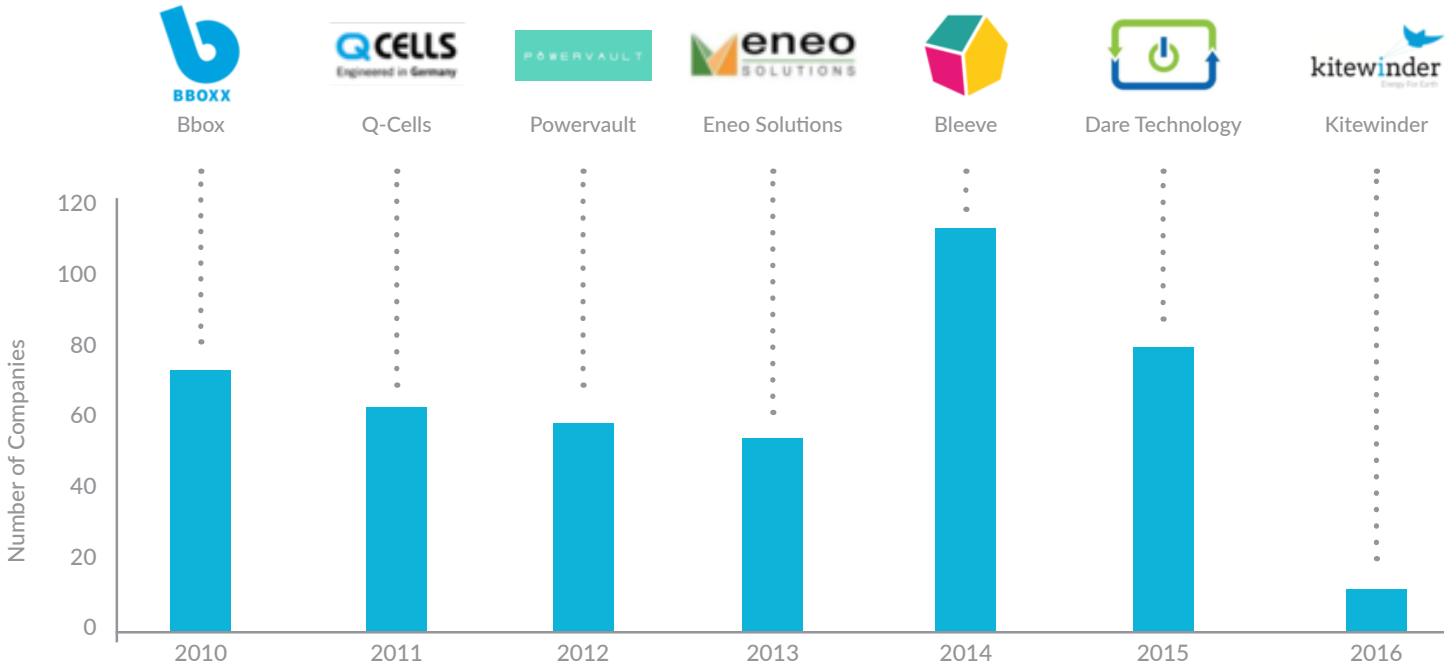

Figure 3 - Year on Year - Number of companies founded

4. The number of Innovation Disruptors per country in the Renewable subsector shows that most startups are founded in the UK and Germany, which may not be surprising considering the size and population of those countries. However, directly behind these two it seems a level playing field with the Netherlands, Israel and Denmark supplying a remarkable portion of the Disruptors.

Distribuition of Companies across Countries

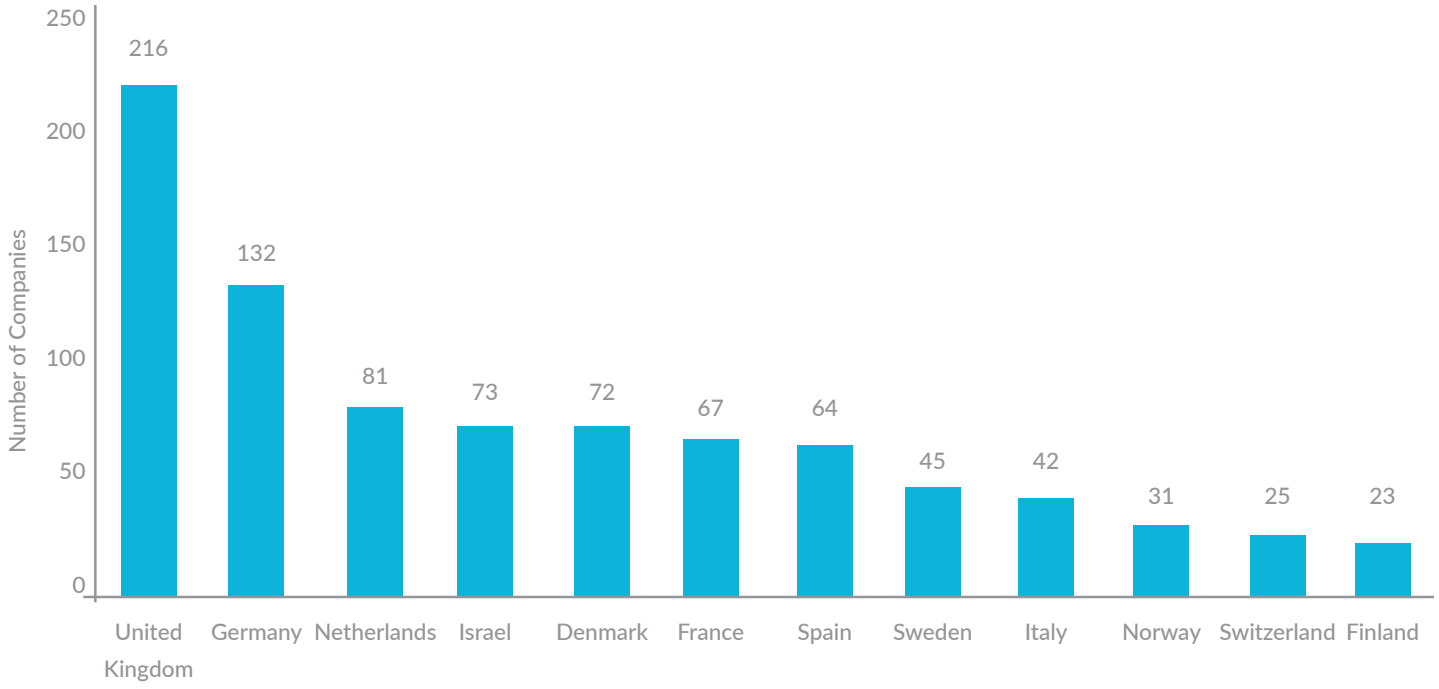

Figure 4 - Number of disruptive innovators with funding by country

1.2 Recently funded disruption

We have looked at StartUps that were founded less than 10 years ago, and have recently in the last 2 years received significant external funding. By using those parameter we have a clear idea of where investors see a definite chance that these companies are going to disrupt the renewable energy market. We've listed a few examples on the next pages.

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Het ConsultancyHuis (HCH) is quite different. We do not just advise our clients on Innovation from the sidelines. We are with them in the **mud**, and help to make things happen.

To get started we often organize Innovation trainings, games and workshops. For example, we can organize a **1-week Google Innovation Sprint** to help you decide on validated the best direction to take your product, and validate it with real customers.

In larger organisations we can use Innovation approaches such as **The Innovation Box** which allows each and every employee to become the entrepreneur behind new ideas.

And of course, we have the **Agile Scrum Masters** and project managers, **Automated Testers** and **Full Stack Developers** to help you make those new initiatives a reality.

Don't hesitate to contact

erik.van.eekelen@hetconsultancyhuis.nl or

info@hetconsultancyhuis.nl for more information.

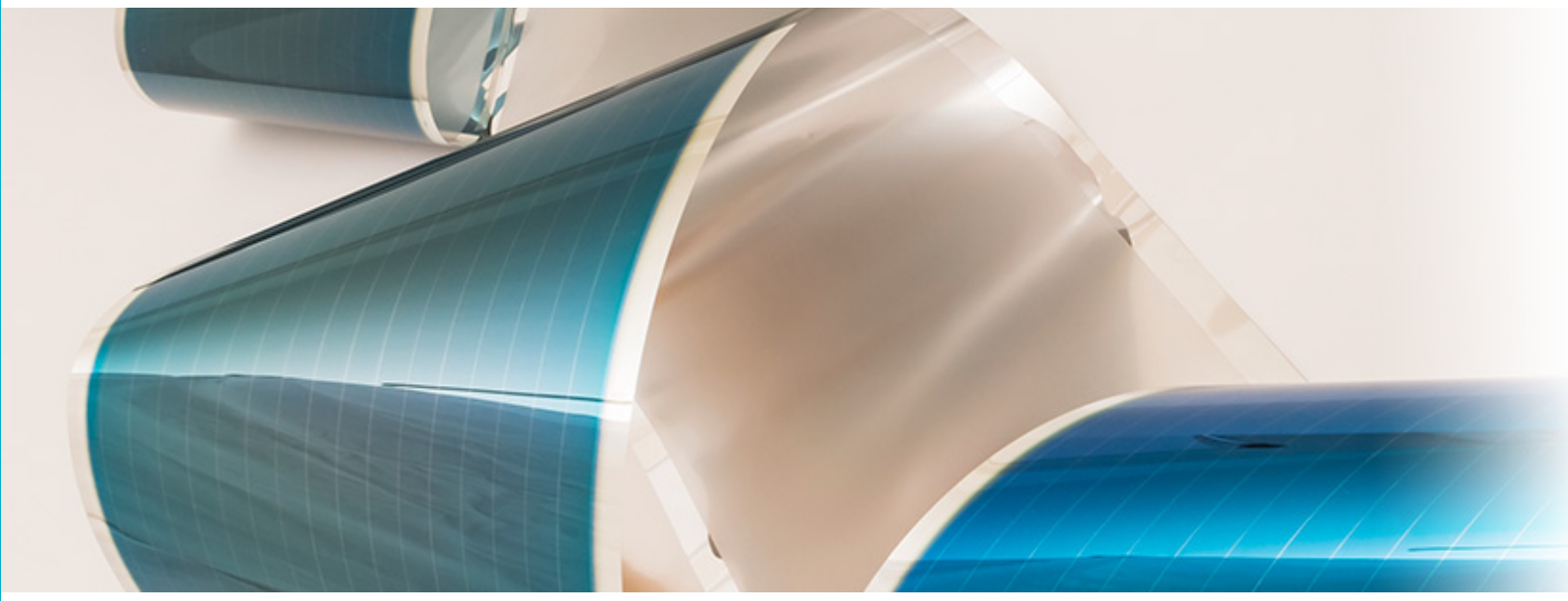


Figure 5 Heliatek HeliaFilm

The StartUp Heliatek is producing thin, flexible and transparent solar panels and has received a 47M investment from companies such as Engie and BPN Paribas.

Dutch StartUp Lumos recently received 40M in funding for their off-grid solar solutions. This company wants to provide off-grid communities, like the ones in Africa, with a sustainable and friendlier replacement for diesel generators.

The German StartUp Sonnen has received significant funding (80M) in 2016 for their customer energy storage system, and they are in direct competition with the much-talked-about Tesla PowerWall.

Company	Overview	Sector	Funding	Investors
Sonnen (Germany, 2010)	Energy storage system providers	Solar Energy > Hardware Developer > Balance of Systems > Storage	$85M	Envision Energy
Heliatek (Germany, 2006)	Manufactures organic solar films	Solar Energy > Hardware Developer > Generation Equipment > PV > Modules > Thin Film	$47M	innogy, Engie, BNP Paribas, CEE Group, eCAPITAL, High-Tech Grunderfonds, Innogy Venture Capital, TUDAG, Wellington Partners, BASF Venture Capital
Lumos (Netherlands, 2013)	Distributed solar power for off-grid regions	Solar Energy > Solar-as-a-service > Integrated > Residential	$40M	VLTCM, Pembani Remgro Group
Bboxx (UK, 2010)	Sells plug and play solar systems and compatible consumer products	Solar Energy > Solar Products > Charging Solutions > Residential	$20M	Engie, Khosla Impact, Bamboo Finance, Stichting DOEN, MacKinnon, Bennett & Company
Mainstream Renewable Power (UK, 2008)	Develops wind and solar plants	Solar Energy > Independent Power Producer > Utility	$16M	Undisclosed
Mobisol (Germany, 2010)	Offers solar systems with pay as you go model	Solar Energy > Solar Products > Lighting Solutions > Residential	$16M	IFC, FMO, German Investment, Africa Enterprise Challenge Fund

Disrupting startups that received funding in 2016

Figure 6 Dutch Startup Lumos Off Grid Solar

Figure 7 Sonnen Battery

Company	Overview	Sector	Funding	Investors
Sol Voltaics (Sweden, 2007)	Develops solar films made up pf GsAs nanowires	Solar Energy > Hardware Developer > Generation Equipment > PV > Modules > Others	$13M	Riyadh Valley, Umoe, Industrifonden, FAM
Oxford Photovoltaics (UK)	Develops perovskite solar cells	Solar Energy > Hardware Developer> Generation Equipment > PV > Cells	$10M	Statoil, Legal & General Capital
Gaelectric (UK, 2004)	Renewable Energy generation and energy storage system developer	Wind Energy > Independent Power Producer > Horizontal	$9M	European Union
NexWafe (Germany, 2015)	Kerfless wafers manufacture	Solar Energy > Hardware Developer > Generation Equipment > PV > Wafers	$7M	Undisclosed
Sustainable Marine Energy (UK, 2012)	Tidal energy turbine manufacturer	Marine Energy > Ocean Currents > Energy Generation Equipment > Underwater Turbines	$7M	SCHOTTEL, Scottish Enterprise

Disrupting startups that received funding in 2016

1.3 Acquired Disruptors

These are some of the standout Disruptors that were acquired in 2016.

The StartUp Future Blends, a company founded in 2012 that focuses on advanced biomass-based energy was acquired by Neste for an undisclosed amount.

Figure 8 Future Blends

Werpo, an Israeli company founded in 2014 has developed power stations to generate energy from ocean waves. It was acquired after only 2 years in business, by Sahar Energy.

Figure 9 WERPO Wave Energy

Company	Acquirer	Sector	Overview	Deal Size
Infinis Energy (UK, 2006)	3i Infrastructure	Wind Energy > Independent Power Producer > Utility > Onshore	Renewable Energy developer	Undisclosed
Future Blends (UK, 2012)	Neste	Bioenergy > Biofuels > Technology Developer	Fast pyrolysis process technology developer *The Carbon Trust*	Undisclosed
Sonnedix (France, 2009)	JP Morgan	Solar Energy > Independent Power Producer > Utility	Solar IPP	Undisclosed
Martifer Solar (Portugal, 2006)	Voltalia	Solar Energy > Project Developers > EPC	Developer of solar power solutions NYSERDA	$10M
Werpo (Israel, 2014)	Shahar Energy	Marine Energy > Wave > Energy Converters > Hydrodynamic	Wave energy generation systems based on hydraulic pressure	Undisclosed
Bioenergia Muvek Energiatermelo Hungary, 2006)	Veolia	Bioenergy > Energy Generation	Wooden pellets based energy generation plant	Undisclosed
Azienda Solare Italiana (Italy, 2011)	Quercus Investment Partners	Solar Energy > Independent Power Producer > Utility	Solar power developer *Antin*	Undisclosed
Wind Towers Scotland (UK, 2011)	CS Wind	Wind Energy > Hardware Developer > Wind Towers	Wind tower manufacturer *Highlands and Islands Enterprise, SSE*	Undisclosed

Acquired Disruptors in Renewable Energy in 2016

1.4 HCH –Watchlist for Renewable Energy

Based on the investment patterns that we've analysed, we expect to see a lot happening regarding better, thinner solar panels, especially connected to home batteries. Especially in sunny climates this will result in more 0-energy homes and therefore has the potential to disrupt the energy market. At the same time, it may open opportunities to deal with peak demand in the energy grid.

Companies to watch in this space are **HeliaTek** and **Sol Voltaics** for new types of solar panels, **Sonnen** (and **Tesla**) for batteries to store that solar power. Dutch **Lumos** also has a good chance to disrupt as well, but for now that will not likely have an impact on the European market.

2. DISRUPTING ENERGY STORAGE

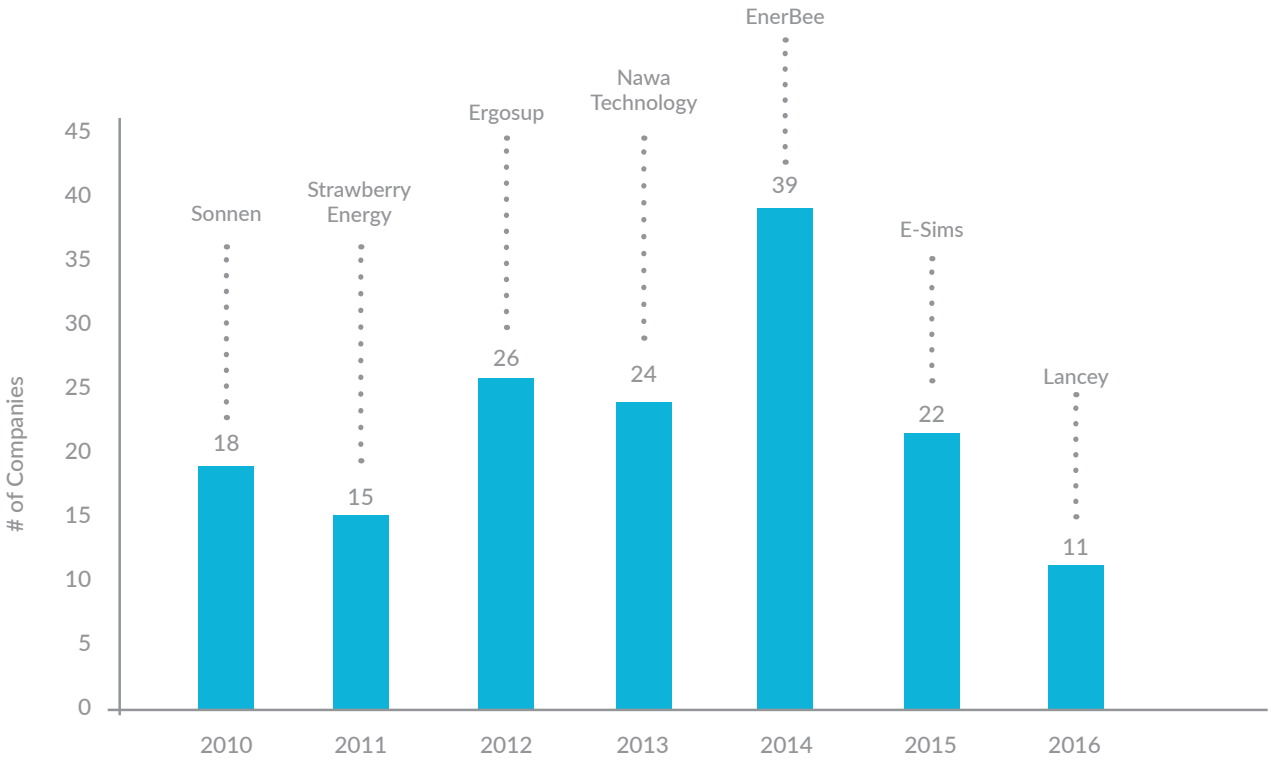
2.1 Funding Trends

After a quiet year in 2015 (188M invested), 2016 was a heavy investment year for the Energy Storage sub-sector. Some interesting facts:

1. More than 1 billion external investment dollars were received by startups. However, a large part of that investment was in the 8-year old Swiss company Alevo, which had it's USA daughter company file for bankruptcy. More on that later in this report.

2. Many of the top investments were made in startups that are developing battery-related and capacitor technologies, some of them looking for alternatives for Lithium Ion based batteries. At the same time, the younger (3-4 year old) startups that received investments, seem to focus more on integrated solutions and (personal) mobile solutions.

3. 11 new Energy Storage startups were founded in 2016, which is a 50% drop from the 3 years average.



Number of startups in Energy Storage founded in Europe per year

2.2 Recently funded disruption

We have looked at StartUps that were founded less than 10 years ago, and have recently received significant external funding. By using those parameters, we have a clear idea of where investors see a definite chance that these companies are going to disrupt the renewable energy storage market.

As mentioned above, 8-year old **Alevo** received the biggest investment of all, 700M in total, after closing a major investment round in 2014 as well. Their product is a grid sized battery based on a lithium-iron-phosphate chemistry. However, the American daughter company of Alevo filed for bankruptcy in August 2017 and the Swiss parent company is apparently in heavy weather as well. Alevo's own press statements point to problems with setting up production lines for their products. Incidentally this is something that many startups struggle within their road to maturity.

Figure 10 - Alevo Gridbank

Another interesting young startup that received 8M in funding in 2016 is UK based **Zap&Go**. The company has used research results from Oxford University to develop a carbon based (graphene & nano carbon) battery that can be used for power banks and potentially mobile phones and can be fully charged in 5 minutes, much more quickly than Lithion Ion materials.

The German StartUp **Adaptive Balancing Power** was founded in 2016 and received their first 5M funding in that same year. Not much about them is known, but their goal is a high efficiency flywheel that helps to dynamically balance those energy grids that have high dependency on renewable energy sources.

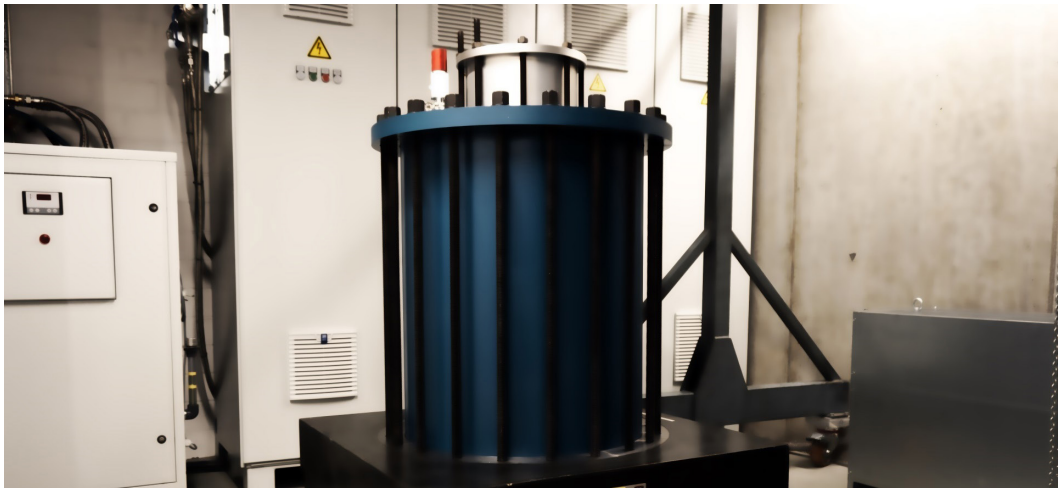


Figure 11– Adaptive Balancing Power: Flywheel

Company	Overview	Sector	Funding Amount	Investors
Alevo (Swizerland, 2009)	Grid scale energy storage solution provider	Energy Storage Systems > Grid Storage > Power Storage	$700M	Undisclosed
Sonnen (Germany, 2010)	Energy storage system providers	Energy Storage Systems > Behind-the-meter Storage > Power Storage	$85M	Envision Energy
Phinergy (Israel, 2008)	Metal-air battery technology for EVs	Batteries > Other Chemistries	$50M	Alcoa
Nexeon (UK, 2006)	Silicon based anode developers	Component Developer > Battery > Electrodes	$44M	Imperial Innovations; Invesco; Woodford Investment Management
Skeleton Tech (Germany, 2009)	Develops and manufactures ultra capacitors	Batteries > Capacitors	$15M	FirstFloor Capital; UP Invest; Harju Elekter Group
Drayson Technologies (UK, 2007)	RF Harvesting technology provider	Charging Solutions > Wireless Charging > Consumer and Power Electronics	$12M	Lansdowne Partners; Woodford Investment Management
ZapGo (UK, 2013)	Supercapacitor based charging solutions	Batteries > Capacitors	$8M	Undisclosed
REDT Energy (UK, 2009)	Manufacturing Vanadium Redox Flow Batteries	Batteries > Flow Batteries	$5M	Undisclosed
Hyperdrive Innovation (UK, 2010)	Batteries and battery management systems for electric vehicles	Batteries > Lithium-Ion	$5M	Hamilton Capital; Rivers Capital Partners

Disruptors in Energy Storage that received external funding in 2016. These companies are all younger than 10 years old.

Company	Overview	Sector	Funding Amount	Investors
Sunamp (UK, 2006)	Manufactures heat batteries	Energy Storage Systems > Integrated Energy Storage > Terrestrial Storage	$5M	Scottish Enterprise; Par Equity; Equity Gap; Highland Capital Partners; Old College Capital
Skeleton Tech (Germany, 2009)	Develops and manufactures ultra capacitors	Batteries > Capacitors	$4M	KIC InnoEnergy
Powervault (UK, 2012)	Energy storage integrated with solar	Energy Storage Systems > Behind-the-meter Storage > Power Storage	$2M	Undisclosed
Ferroamp (Sweden, 2010)	Smart Energy Management system developer	Energy Storage Systems > Behind-the-meter Storage > Power Storage	$2M	Almi Invest; Pacific Power

Disruptors in Energy Storage that received external funding in 2016. These companies are all younger than 10 years old.

2.3 Acquired Disruptors

Most of the acquisitions in 2016 were producers of Lithion-Ion batteries, like the Israelian company Ultra-Charge that was acquired in the year of founding.

However, there were a few different types of acquisitions as well:

- 10-year old German **N2telligence**, producer of Fuel cells, was acquired for an undisclosed amount by Fuji Electric.
- Danish **H2Logic**, founded in 2003 and producer of Hydrogen refueling stations was acquired for 39M by Nel Hydrogen.

Figure 12– H2 Logic - Hydrogen refuelling station

Date	Company	Acquirer	Business Model	Overview	Deal Size
Jun- 2016	**Humavox** (Israel, 2010)	Aurum	Charging Solutions > Wireless Charging > Consumer and Power Electronics	Near-field RF based wireless charging platform	$16M
May- 2016	**Ultracharge** (Israel, 2016)	Lithex	Batteries > Lithium-Ion	Developed nanotechnology-based Lithium-Ion battery	Undisclosed
Jan- 2016	**N2telligence** (Germany, 2006)	Fuji Electric	Fuel Cell > Developers	Fuel cell developers for Industrial use	Undisclosed
Jan- 2016	**Accutronics** (UK, 2009)	Ultralife Corporation	Batteries > Lithium-Ion	Custom Battery manufacturers *Catapult Ventures, Innovate UK*	$11M
Jul- 2015	**H2 Logic** (Denmark, 2003)	Nel	Fuel Cell > Component developers > Hydrogen	Hydrogen refueling stations	$39M

Acquired Disruptors in Energy Storage in 2016

2.4 HCH –Watchlist for Energy Storage

The investment patterns in the Energy Storage subsector paint a clear picture: Investors are looking for smart solutions to replace Lithium-Ion batteries, and for ways to balance the grids – especially since grids relying on renewable energy are harder to balance.

Interesting companies to watch in this space are the Israelian **Phinergy** which creates a special kind of metal-air batteries for Electric Vehicles, the UK company **SunAmp** which creates integrated heat batteries for solar. In the consumer space there is also **Zap&Go** (as mentioned above). And in the Netherlands the StartUp **Elestor**, founded in 2014, has received funding for their Hydrogen Bromide based batteries.

Hey, what about the rest of the report?

StartUps often use the Lean Startup approach. Part of this approach is to be very clear about the underlying assumptions of your business model from the start, and validate the crucial assumptions as early as possible.

Our assumption in writing this report is that there is a demand for this type of information, even though not everyone will realize that until they come across this paper.

To validate this assumption we made sure that we made the first half of this report as interesting as possible. We have the information and rough setup of the second part as well, with sections on **Smart Grids, Energy Efficiency** and **Electric Vehicles** and will finalize and release the full report as soon as we hear from our readers that they would like to see it!

In other words: if you got this far and want to read the rest (free of charge of course), please don't hestitate to email us on ***info@hetconsultancyhuis.nl*** or drop Erik a line on ***erik.van.eekelen@hetconsultancyhuis.nl.***

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