LANDSCAPE OF CHARGING INFRASTRUCTURE RESEARCH IN THE NETHERLANDS
Research areas

**CHARGING TECHNOLOGY**
Developing sparkling technological innovations, unthought combinations, smart charging solutions applying new principles and paradigms.

**ENERGY MODELLING**
Developing insights, models, scenarios and innovations in how to integrate EVs effectively in the grid.

**CONSUMER BEHAVIOUR**
Developing deeper understanding of consumer behaviour, preferences and change mechanisms.

**DATA ANALYSIS**
Applying computational sciences, ICT, software, simulations and modelling for optimizing rollout and utilization.
Institute:
Delft University of Technology, also known as TU Delft, is the largest and oldest Dutch public technological university, located in Delft, Netherlands.

Focus area:
Energy modelling, charging technology, energy networks, policy analysis, simulation, engineering

Current projects:

Dynamic Powering of EV’s using IPT (CT)
Inductive power transfer (IPT) is the process of transferring power between circuits without wired interconnects by the process of electromagnetic induction in the near-field.
Prof.dr.eng. P. Bauer, V. Prasanth

Electric Vehicle supported PV Smart Grid (EM)
The EV-PV project aims at combining the two technologies by creating an electric vehicle charging infrastructure using PV panels.
Prof.dr.eng. P. Bauer, R. Chandra Mouli

Integration of EV for Ancillary Services (EM)
The plug-in electric vehicles (PEVs) have great potential in the near future to be connected in a large number to the power systems.
Prof.dr.eng. P. Bauer, S. Izadkhast

Solar E-bike station (BM)
The goal is to create a stand-alone solar powered eBike charging station which is power neutral.
Prof.dr.eng. P. Bauer

Distribution technologies for smart buildings (EM)
The main goal of this project is to increase the efficiency of the electrical infrastructure in houses and buildings.
Prof.dr.eng. P. Bauer, dr.ir. L. M. Ramirez Elizondo

E-Hub (BM)
The E-Hub will be the fuel station of the future where electric cars can be charged in an efficient and effective manner, while combining the charging area with flexible working space and transferium opportunities.
dr.ir. G.M.Bonnema, Bob Elders

Past research:
• Silvester, S, Beella, SK, Timmeren, A van, Bauer, P, Quist, JN & Dijk, S van (2013). Exploring design scenarios for large-scale implementation of electric vehicles: the Amsterdam Airport Schiphol cas
• Does controlled electric vehicle charging substitute cross-border transmission capacity? (2014). R Verzijlbergh, CB Martinez-Anido, Z Lukso, L de Vries.
• Impacts of EVs on power system operation: Guangdong case, China (2014) Y Li, Z Lukszo.
• The potential of electric vehicles to facilitate a high wind power penetration (2013) Y Li, Z Lukszo, M Weijnen

Solar E-bike station
Institute:
The Eindhoven University of Technology is a university of technology located in Eindhoven, Netherlands. TU/e focuses on research, education and innovation. The Strategic Research Area of Smart Mobility represents over 200 researchers across 7 different faculties

Focus area:
Energy modelling, charging technology, agent based modelling

Current projects:
EV powertrain system design:
Integrated design optimization of the transmission system and vehicle control for electric vehicles
Dr.ir. T. Hofman and N. Janssen
Energy Efficiency Analysis and Comparison of Transmission Technologies for an Electric Vehicle
Dr.ir. T. Hofman, C.H. Dai

Power matching for large EV fleets
The goal is to optimally match the (dis)charging demand in large fleets of electric vehicles with the available (renewable) energy generation, under model-unawareness and privacy restrictions.
Dr. ing. Sergio Grammatico

3CCar (Integrated Components for Complexity Control in affordable electrified cars), ECSEL
Battery modelling and BMS design
prof.dr.ir. H.J. Bergveld, dr.ir. M.C.F.Donkers

EVERLASTING (Electric Vehicle Enhanced Range, Lifetime and Safety Through INGenious battery management), GV8-H2020
Range anxiety of electric vehicles
dr.ir. M.C.F. Donkers, dr.ir. I.J.M. Besselink

AUTODRIVE (Advancing fail-aware, fail-safe, and fail-operational electronic components, systems, and architectures for fully automated driving to make future mobility safer, affordable, and end-user acceptable), ECSEL
Ageing-aware charging of electric vehicles
prof.dr.ir. H.J. Bergveld, dr.ir. M.C.F.Donkers

SMARTER: Realizing the Smart grid: Aligning consumer behaviour with Technological opportunities (NWO together with UU and RuG)
The goal is to predict, explain, and influence consumer adoption and use of PV and Evs
Prof.dr. F. Alkemade

Locating electric vehicle charging stations: A multi-agent based dynamic simulation
Seheon Kim, Dujuan Yang, Soora Rasouli, H.J.P. Timmermans

Periodicity analysis of charging behavior of electric car drivers: Latent class hazard models
Seheon Kim, Dujuan Yang and Soora Rasouli

Agent-based Buying Charging Driving (ABCD) model
Integral model of EV uptake, charging infrastructure and mobility behavior with the goal of determining the impact on energy system and electricity grid and needed charging infrastructure
Drs. A. Hoekstra and prof. M. Steinbuch

FlexPower simulation model
Modeling the value of smart charging on electricity market assuming adoption rates of Wind, PV and Ev and taking realistic driving patterns.
Drs. A. Hoekstra and prof. H. Timmermans

Past research:
- R.P. Raju Arumugam (2014). Analysing the impacts of EV charging scenarios on an MV distribution grid and minimising them by applying different charging strategies (EM)
- Rasouli, S. and H.J.P. Timmermans (2013), Incorporating mechanisms of social adoption in the design and analysis of stated choice experiments: Illustration and application to the choice of electric cars, Transportation Research Record, 2344, 10-19.
University of Twente

Institute:
Research in the area of ICT of the University of Twente is organized within the Centre for Telematics and Information Technology (CTIT). It is one of the largest academic ICT research institutes in Europe, involving more than 475 researchers. Research on ICT for Smart Grids is one of the strategic research orientations of the CTIT.

Focus area:
Energy modelling, system engineering

Current projects:
No currently known projects

Past research:
- Bonnema, G. Maarten and Muller, Gerrit and Schuddeboom (2015). Electric mobility and charging: systems of systems and infrastructure systems (EM)
- Kempker, Pia and Dijk, Nico M. van and Scheinhardt, Werner and Berg, Hans van den and Hurink, Johann (2015) Optimization of charging strategies for electric vehicles in PowerMatcher-driven smart energy grids (EM)
- Klauw, Thijs van der and Gerards, Marco E.T. and Smit, Gerard J.M. and Hurink, Johann L. (2014). Optimal scheduling of electrical vehicle charging under two types of steering signals (EM)
- Höfer, Christina and Petit, Jonathan and Schmidt, Robert K. and Kargl, Frank (2013). POPCORN: privacy-preserving charging for eMobility (CB)
University of Groningen

Institute:
Energy is one of the three main research themes of the University of Groningen (RUG). The RUG aims to make major contributions to the transition to sustainable production and consumption of energy.

Focus area:
Consumer research, behavior and choice models, adoption models

Current projects:
ERSAS (CB)
This project aims to study how to develop efficient, reliable, sustainable and socially acceptable (decentralised) energy system integration (ESI) from an interdisciplinary perspective. prof. dr. E.M. (Linda) Steg and prof. dr. J.M.A. Scherpen

SMARTER
Realizing the smart grid: aligning consumer behaviour with technological opportunities. NWO project in collaboration with Utrecht University.

SMARTEST
Electric vehicle as gateway to smart and sustainable energy use. NWO project in collaboration with the TU Eindhoven.

Past research:
Radboud University

Institute:
Radboud University Nijmegen is a public university with a strong focus on research located in Nijmegen, the Netherlands. It was established on 17 October 1923 and is situated in the oldest city of the Netherlands.

Focus area:
BM

Current projects:
Charge & Go (BM)
Charge & Go ontwikkelt een serie samenhangende producten en bouwstenen die de (toekomstige) Elektrisch Vervoer-rijder ontzorgt en faciliteert bij het kiezen en vinden van de laadlocatie, de laadinfra exploitant ondersteunt in investeringsbeslissingen en in de exploitatie van de laadvoorzieningen.

Prof. E. van der Krabben
Institute:
The Centre for Energy (CfE) of the University of Amsterdam is an independent and interdisciplinary research centre. Research and education are aimed at the public and private energy systems, with emphasis on decentralized and sustainable forms of energy systems dedicated to the end user.

Focus area:
Computational sciences

Current projects:
No currently known projects

Past research:
Erasmus University

**Institute:**
DRIFT is the leading research institute in transitions towards sustainability. The main focus of its work is 'transitions'; structural systemic changes resulting from complex interactions in multiple domains and at multiple levels of society.

**Focus area:**
Energy modelling

**Current projects:**
Energy markets, pricing models, consumer economics

**Past research:**
**Utrecht University**

**Institute:**
Utrecht University is an internationally renowned research university conducting fundamental research covering a wide variety of scientific disciplines. Utrecht University makes active contributions to the development of a more sustainable society by disseminating scientific knowledge and by serving as an inspiring model of sustainability.

**Focus area:**
Innovation studies, energy markets, energy modelling, behavior models

**Current projects:**

**SMARTER (CB)**
This project aims to study the role of consumer adoption and behaviour in the integration of the energy and transport systems from an interdisciplinary perspective.

*Partners: UU Groningen, Utrecht University; PI: prof. dr. E.M. (Linda) Steg, co-PI: Dr. W.G.J.H.M. van Sark*

**Co-Evolution of Smart Energy Products and Services (CESEPS); BM, CB, EM**
Within this project, the role of EVs in smart grid pilots is analyzed. The focus lies on using EVs for integration of photovoltaics on the low-voltage (LV) grid while keeping user preferences into mind, finding business cases of aggregated EVs or charging stations, and testing impact of these business cases on LV grid in co-simulation environment.

*Partners, UTwente, UU, TUD, WUR, TUGraz, AIT, eseea PI: Angele Reinders (UtTwente), co-PI: Dr. W.G.J.H.M. van Sark*

**PARENT: PARticipatory platform for sustainable EEnergy managemenT; BM, CB, EM**
The PARENT project aims to increase engagement of individuals in the responsible management of their own electricity usage, thereby understanding how we can stimulate behavioral change in the area of energy consumption in households. It will develop an innovative and marketable platform for participatory energy management, fueled by novel analytics, visualization and gamification techniques. The project will operate in Amsterdam, Barcelona, Bergen and Brussels, and study social acceptance within the user communities of these cities.

*Partners: VU Brussel, UBerGen, UU, and others Co-PI: Dr. W.G.J.H.M. van Sark*

**SSC: Smart Solar Charging (EFRO); BM, CB, EM**
The SSC project aims to extend the experiments in the Lombok district on smart solar charging to different areas: Utrecht new centre, Utrecht Science Park, Houten, Zeist. These areas have different character (offices, housing) and will need different designs of smart solar charging management. nd study social acceptance within the user communities of these cities.

*Partners: Utrecht Sustainability Institute, Hogeschool Utrecht, Lomboxnet, and others PI: Dr. C. van Hemel, co-PI: Dr. W.G.J.H.M. van Sark*

**Past research:**
- Van der Kam, Mart; van Sark, Wilfried (2015) Smart charging of electric vehicles with photovoltaic power and vehicle-to-grid technology in a microgrid; a case study (EM)
- Kam, M. van der; Sark, W.G.J.H.M. van (2014) Increasing self-consumption of photovoltaic electricity by storing energy in electric vehicle using smart grid technology in the residential sector. A model for simulating different smart grid programs (EM)
Institute:
The Centre for Energy (CfE) of the University of Amsterdam is an independent and interdisciplinary research centre. Research and education are aimed at the public and private energy systems, with emphasis on decentralized and sustainable forms of energy systems dedicated to the end user.

Focus area:
Data analytics, engineering, consumer research, business modelling

Current projects:
Me2 (BM) me2 is een Europees Smart City project met als doel een nieuwe energie-marktplaats te creëren in een stedelijke omgeving. Lokale gebruikers van elektrische voertuigen (EV) en eigenaren van lokale slimme meters worden bijeen gebracht door een nieuw platform.
Partners: Catolica Lisbon School of Business and Economics (Portugal), MediaPrimer (Portugal), VPS Energy (Portugal), Lisboa E-NOVA (Portugal) en MOOSMOAR Energies (Oostenrijk).

IDO-LAAD (EM) Within the IDO-laad project research is being carried out and tools are being developed focusing on the roll-out of a cost-efficient and effective use of charging infrastructure for electric vehicles.
Partners: Gemeente Amsterdam, Den Haag, Rotterdam, Utrecht, Nuon, Cofely, EV-Box, Enexis, Overmorgen, metropoolregio Amsterdam, Universiteit van Amsterdam.

Seev4-City (BM) SEEV4-City supports the transition to a low-carbon economy in Europe’s Cities, combining electric transport, renewable energy and smart energy management. Gemeente Amsterdam, Amsterdam Arena, Universiteit Leuven, AVERE, POLIS, CENEX, Leicester City Council, Northumbria University, Oslo Kommune, e8energy

U-Smile (BM) In het U-SMILE project onderzoekt Urban Technology het effect van bestuurlijke prikkels en maatregelen die moeten leiden tot meer elektrisch vervoer en minder diesels in Amsterdam.

Vehicle2Grid (EM) Vehicle2Grid technology stands for the possibility to use the battery of an electric vehicle to temporary store electricity generated and to use it or feed it back to the grid at a later stage.
Rotterdam University of Applied Sciences

Institute:
The Rotterdam University of Applied Sciences is a vocational university located in the city of Rotterdam, Netherlands.

Focus area:
The Research Professor Future Mobility and the applied research team and programme Moving@Rotterdam have a strong focus on Automotive Smart e-Mobility and new logistic concepts in the Port and City. Research and education are intertwined, multidisciplinary and practice oriented.

Current projects:
Sia Raak INTRALOG, together with the HAN University and other knowledge institutes researches the market and technology for sustainable automated and autonomous driving truck at the harbour and freight distribution.

Surf STAD, together with the TU Delft and other partners, researches the cases and demonstrators for automated and autonomous driving passenger vehicles and shuttles (POD’s) in Urban Area’s.

Sia Raak LEVV Logic together with Amsterdam University of Applied Science and others partners, researches new light vehicle concepts for freight distribution in the inner cities.

Monitoring e-Busz for with the RET, researches the key performances of electric and fuel cell electric city busses in the Rotterdam practice. A new energy and fast charging infrastructure is subject of the study.

Zero Emission Stadslogistiek 010, researches the deployment of electric trucks in the city and the necessary charging infrastructure.

Active e-Trailer is a innovation research project together with e-Traction and Carrosserie.nl to develop and model new plug in hybrid electric truck-trailers

Past research:
• Sia Raak Pro eMobility-Lab, practice oriented research on EV’s together with EV pioneers
• E-Busz development together with RET, e-Traction and VDL
• LightMotion, market research for charging EV’s via a light pole concept (Lightwell and New Motion)
**Institute:**
HAN University of Applied Sciences (HAN) offers higher education of an outstanding quality in an inspiring, innovative and international environment. We strive to prepare our students to meet today’s challenges of globalisation, by combining unrivalled quality practical education with carefully specialised coaching delivered by skilled professionals.

**Focus area:**
Drive train technology, battery, fuel cells

**Current projects:**
**Electric Power Train (CT)**
Het onderzoeksprogramma Electric Power Train wil het tekort aan kennis binnen het domein van geëlektrificeerde aandrijvingen aanvullen met toepassingsgericht onderzoek. Met de opgedane kennis kan het MKB sneller en beter elektrische, hybride en brandstofcelvoertuigen (EHBV’s) ontwikkelen.

*Dr. ir. Bram Veenhuizen*
Institute:
TNO is an independent organisation for applied research. TNO connects people and knowledge to create innovations that improve the competitive strength of industry and the welfare of society. TNO's more than 4000 professionals work on various societal themes including Energy. Through innovations, TNO is working to ensure a sustainable, affordable and reliable supply of energy.

Focus area:
Emobility technology, policy analysis, consumer analysis

Current projects:
No currently known projects

Past research:
- Economic viability study of an on-road wireless charging system with a generic driving range estimation method (2016) (BM)
- Economic considerations for on-road wireless charging systems - A case study (2015) (BM)
- Generic methodology for driving range estimation of electric vehicle with on-road charging (2015) (BM)
- Fuel-electricity mix and efficiency in Dutch plug-in and range-extender vehicles on the road (2013) (CB)
- Constrained capacity management and cost minimisation of EV-charging in a parking garage (2013) (EM)
ElaadNL

Institute:
ElaadNL onderzoekt en test de mogelijkheden voor Smart Charging. Het is onze missie om ervoor te zorgen dat iedereen met een elektrische auto in de toekomst slim kan laden.

Focus area:
Energy markets, business modelling, simulation, regulations and legislation.

Current projects:

**Smart Chain (CB) (2016-2017)**
A complete smart charging system that takes into account the whole chain.
*Partners: ElaadNL, Driivz*

**FlexPower (BM) (2016-2017)**
Flexible charging when wind and sun energy generate lots of electricity.
*Initiatiefnemers: TU Eindhoven, The New Motion, Liander, GreenFlux, EVnetNL en ElaadNL*

**Jedlix (2016-2017)**
Jedlix is to function as an aggregator for the flexibility of ElaadNL's EVSE's toward different flexibility / capacity markets, taking into account grid constraints.

**FCR pilot with Senfal (2016-2017)**
Senfal is a start-up which develops a platform for smart management of flexible loads (for FCR). Next to existing flexible loads which are already managed, ElaadNL and Senfal cooperate to use EV(SE)’s in addition to this.

**Wildlands (2016-2017)**
The goal of this research is to apply (closed loop) smart charging based on sensing of the available grid capacity.

**Social charging (2016 - ..)**
Facilitate the increase of the throughput of charging EV’s by connecting the ‘Social Charging’ app to the ElaadNL (EVnetNL’s) stations.

**Inductive charging pilot Rotterdam (2016)**
The goal of this project is to gain experience with (interoperability matters) of inductive charging.

**OCA (2016 - ..)**
The further development of OCCP 1.6 is done within SDO OASIS. A compliance test tool has been developed. A best practice implementation will be developed.

E-clearing.net (2016 - ...)
This solution for e-mobility roaming has been established by ElaadNL. Together with other parties we do the further development of this platform as one of the European solutions for ‘e-roaming’.

Tender support (2016 - ..)
Support for communities and provinces on smart charging with tenders for charging infrastructure.

Internationalisation (2016 - ..)
Internationalisation has the focus to reach a broader standardisation of protocols in the area of smart charging.

Eflexibility as a service (2016 – 2018)
The intended result is a prototype product / service combination that convinces EV drivers for smart charging including related system design that can be integrated into the existing electricity system in the Netherlands.

Interflex (2016 – 2018)
A system to demonstrate the functioning of a local capacity market.

Invade (2016 – 2018)
Integrate into the smart grid: the flexibility management system, different IT systems and other developed components.

Past research:
- Assessment demand – responses & EV-roaming protocols (2016)
- Security requirements (2016)
- Spectre (2016)
- Pilot ISO/IEC 15118 (2016)
- Basic smart charging training (2016)
- Future proof connecting (2016)
ECN

Institute:
ECN is the largest Dutch research institute in applied energy research, providing sustainable solutions for the rapidly changing energy sector. ECN is an independent, non-profit research organisation, where over 600 professionals work to contribute to a future sustainable energy system by performing research and technology development and bringing it to implementation. ECN’s experts combine the latest insights in (inter)national policies and trends with in-depth, hands-on expertise with technology development.

Focus area:
Emobility technology, policy analysis, consumer analysis

Current projects:
No currently known projects

Past research:
• Usmani, O.A.; Rösler, H.; Wilde, H.P.J. de; Straver, K.; Weeda, M.; Sechi, F.; Contu, C; Giustiniani, G; Shingo Usami, D (2015). Policies and good practices to foster electromobility roll-out at the local, national and European level (BM)
• Usmani, O.A.; Rösler, H. (2015). Policy recommendations and stakeholder actions towards effective integration of EVs in the EU (BM)
• Bunzeck, I.G.; Feenstra, C.F.J.; Paukovic, M. (2011). User preferences for charging locations and charging schemes – a survey in eight EU countries (GB)