ESCUELA TÉCNICA SUPERIOR DE INGENIERÍA (ICAI)
Máster en Ingeniería Industrial

THE RESEARCH CAMPUS MOBILITY2GRID: AN ANALYSIS OF THE STAKEHOLDERS INVOLVED IN THE SUSTAINABLE INNOVATION PROCESS

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Madrid
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RESUMEN

La **Introducción** de este Trabajo de Fin de Máster presenta el reto de la Sostenibilidad en la sociedad actual. El desarrollo sostenible se ocupa de cómo satisfacer las necesidades básicas de las generaciones actuales sin poner en peligro la capacidad de las generaciones futuras para cumplir con las suyas.

En 2015, la ONU estableció 17 Objetivos de Desarrollo Sostenible (ODS) con el objetivo de haberlos cumplimentado en el año 2030. Los tres campos principales a abordar son el crecimiento económico, la inclusión social y la protección ambiental.

Todos los niveles de la sociedad deben contribuir al logro de los ODS, desarrollando una nueva manera de trabajar en conjunto: ni el gobierno, las instituciones privadas, las universidades o la sociedad civil son capaces de enfrentarse a este desafío trabajando por sí solos.

En el campus de investigación tecnológica objeto de estudio, Mobility2Grid (M2G), las empresas privadas trabajan en asociación con instituciones públicas para implementar soluciones innovadoras que garanticen un servicio asequible de energía, transporte y calefacción basado únicamente en el uso de energías renovables. El gobierno y la sociedad civil también forman parte del proceso de innovación.

En la en apartado del **Estado de la Cuestión**, se describen diferentes enfoques del concepto innovación. Con *Closed Innovation* o innovación cerrada, el desarrollo de un proyecto se lleva a cabo exclusivamente dentro de los límites de la empresa. *Open Innovation* o innovación abierta, sin embargo, agrega la participación de organizaciones externas o profesionales, incluyendo universidades y otras instituciones. Por último, la *User Innovation*, se centra en los consumidores finales en lugar de los productores como principales contribuyentes a la innovación. Esta última forma de innovación es la base de todo el proyecto.

Los *Living Labs* (LL) son espacios relacionados con la *User Innovation*. Un LL funciona como un banco de ensayos donde se implementan escenarios reales para que tanto los usuarios como los productores puedan participar como co-diseñadores en el proceso de innovación.

La innovación se produce a partir del conocimiento, un factor esencial en las Sociedades del Conocimiento que avanzan hacia el Desarrollo Sostenible. Existen cuatro fuentes principales de conocimiento diferentes, también tratadas como hélices.

- La primera hélice emerge en el subsistema educativo y comprende escuelas, universidades y centros de investigación.
- La segunda se refiere a industria y empresas, es el subsistema económico.
- La tercera hélice está compuesta por gobiernos y el sector público, e incluye gobiernos nacionales y locales, ministerios y la administración.
- La cuarta representa a la sociedad civil: ONG, fundaciones, emprendedores sociales y ciudadanos.

Estos cuatro subsistemas constituyen el modelo de la cuádruple hélice. Sin embargo, también hay una quinta hélice, esencial en el avance hacia las Sociedades del Conocimiento Sostenible. Se trata del entorno natural.

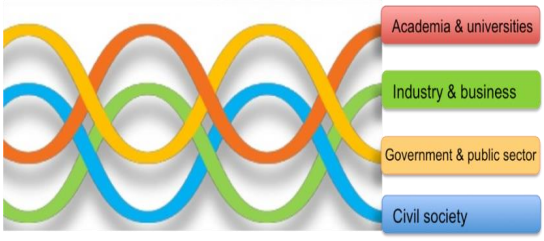

Figura 1: Modelo de la cuádruple hélice

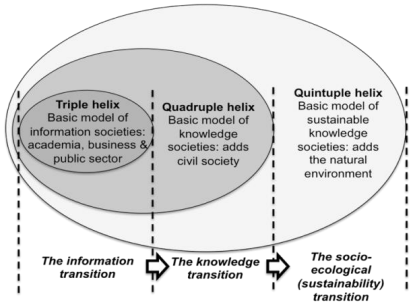

Figura 2: Modelo de la cuádruple hélice y transición a Sociedades del Conocimiento Sostenibles

El Campus de Investigación Tecnológica M2G se denota como un Living Lab, un modelo de cuádruple hélice en el que coexisten los actores de los cuatro subsistemas mencionados. Sin embargo, una serie de elementos en el Campus sugieren que una mejor denominación sería el Living Lab Sostenible, ya que el entorno natural es de gran importancia y está presente en todas las áreas de M2G.

Surgen una serie de temas de investigación:

a) ¿En qué medida estos cuatro subsistemas interactúan entre sí?
b) ¿Están sus roles claramente definidos?
c) ¿Comparten perspectivas u objetivos comunes?
d) ¿Cuán profunda es la participación de la sociedad civil?

Y varios **Objetivos** para resolverlos. El objeto principal de este Proyecto de Fin de Master es realizar un estudio detallado del Campus de Investigación Tecnológica M2G con el fin de comprender los roles de los actores involucrados en el proceso de creación de valor. Hay numerosos socios y miembros trabajando en el campus, clasificados en los cuatro grupos descritos. Es importante comprender qué actividades y acciones realiza cada una de las hélices.

Otro objetivo de esta tesis es proponer nuevas ideas sobre la participación de la sociedad civil en el proyecto, analizando, por ejemplo, las formas en que otros *Living Labs* integran a los ciudadanos.

La **Metodología** para lograr dichos objetivos incluye las siguientes tareas:

a) Para empezar, la herramienta del *Business Model Canvas*, añadiendo el aspecto de sostenibilidad, se utilizará para documentar el modelo de negocio existente.
b) Además, se realizarán una serie de entrevistas a expertos para analizar las posturas de los socios de M2G en el proyecto.

c) Por último, se realizarán encuestas ciudadanas, para obtener el punto de vista de la sociedad civil sobre el futuro escenario de movilidad urbana.

A continuación, en la sección del **Caso de Estudio: Mobility2Grid**, se presenta el contexto del proyecto.

Hay nueve Campus de Investigación Tecnológica en Alemania, financiados por el Ministerio de Educación e Investigación y basados en asociaciones público-privadas para la innovación. En estos espacios, los expertos se ocupan de cuestiones preocupantes del presente y del futuro, como la salud, la movilidad o el medio ambiente.

La Transición Energética es un desafío que concierne a la sociedad en su conjunto. Para que tenga éxito, la electrificación del tráfico debe ser considerada parte de la evolución. En M2G, los investigadores estudian la integración de la energía renovable y el transporte a través de una *micro smart grid*.

Sin embargo, debe tenerse en cuenta el hecho de que las energías renovables no son predecibles: no siempre están disponible cuando se precisan, lo que puede generar cuellos de botella en el suministro eléctrico. Por el contrario, en algunas situaciones, se genera más energía de la demandada.

La electrificación del transporte implica avanzar hacia la conexión de los sistemas de energía y de transporte, lo cual solo es posible considerando los nuevos métodos para equilibrar el consumo y la generación a través de *smart grids*, la mejora de los dispositivos de almacenamiento de electricidad y las mencionadas fluctuaciones de las energías renovables.

Después de contemplar el contexto del proyecto, las áreas de trabajo presentes en M2G se describen brevemente. Estas áreas representan los objetivos del campus de investigación: Aceptación y Participación, Infraestructuras de Red Inteligente, Movilidad Eléctrica Interconectada, Transporte Comercial y de Autobuses, Transferencia de Educación y Conocimiento y Espacios Digitales. Hay un "campo transversal" adicional llamado Operaciones y Comercialización.

A continuación, se representa y analiza el Modelo de Negocio M2G utilizando una plantilla alternativa al de Osterwalder: *The Flourishing Business Canvas*. Esta plantilla se desarrolla teniendo en cuenta que las empresas deben enfocar sus negocios no sólo para reducir el daño que causan al medio ambiente, sino también para mejorar el bienestar de las generaciones presentes y futuras.

Los *Living Labs* y otros modelos de sociedades del conocimiento implican formas alternativas de pensar y actuar, resultando en un cambio de paradigma de especial importancia en asuntos de energía.

En este trabajo, se describen también los posibles aspectos de la movilidad urbana en el futuro, y también el escenario más probable de la red eléctrica, que será descentralizada. Además, se tuvo en cuenta el punto de vista de los ciudadanos gracias a

una encuesta realizada, en la que se pidió a 285 personas de diferentes países, edades y ocupaciones que señalaran sus preferencias con respecto a la Transición Sostenible. También se les preguntó si conocían ciertos datos obtenidos de la Comisión Europea, para estimar en qué medida están informados: sólo 65 de los 285 encuestados sabían que más de 400 000 personas mueren cada año en la UE por la excesiva contaminación del aire; el 50% de los sabía que el 40% de las emisiones de CO2 del transporte se producen en las ciudades y también el 70% de otros contaminantes del aire.

En las **Conclusiones**, los papeles que cada subsistema de actores tiene en la sociedad y en el Campus se resumen en la siguiente tabla –los papeles que los grupos de interés desempeñan en la sociedad también son aplicables en el Campus (excepto la sociedad civil vista como residentes)–.

Subsistema de actores		En la sociedad	En el campus
Academia y universidades	Primera hélice o proveedores	Obtención de conocimiento Transferencia de conocimiento	Experimentos con la industria Contacto privilegiado con la sociedad civil
Industria y empresas	Segunda hélice o utilizadores	Proporcionan a la sociedad con productos o servicios, y puestos de trabajo	Colaboran con investigadores universitarios Se benefician de la cercanía de los usuarios
Govierno y sector público	Tercera hélice o habilitadores	Promueve leyes y regulaciones Asegura su cumplimiento	Financia el Proyecto de innovación Papel concienciador de la sociedad
Sociedad Civil	Cuarta hélice o usuarios	Compradores, residents, estudiantes, usuarios del transporte público, etc	Se benefician de conocimientos y aumentan concienciación Participan como *Informants* y *Testers*

Tabla 1: Actores presentes en el campus. Papeles en la sociedad y en M2G

También hay una quinta hélice muy relacionada con todas las actividades que tienen lugar en el campus: el entorno natural. El aspecto de sostenibilidad no solo es clave para posibilitar la transición socioecológica de forma sostenible, sino que también ayuda a comprender las motivaciones de la mayoría de los socios –actuales y potenciales– del *Living Lab* y a ver las interconexiones entre ellos, económica y socialmente.

Los entornos urbanos futuros incluirán menos o ningún automóvil de gasolina, mientras que el uso compartido de vehículos eléctricos ganará importancia. Además, es probable que se desarrolle más el transporte público y que también se fortalezca el tráfico de peatones y ciclistas.

La transición energética está relacionada con una red energética descentralizada con perfiles de carga complementarios que aumentarán el uso de energías renovables. El papel de los consumidores evolucionará hacia los "prosumidores", que producen y generan energía.

Respecto a la encuesta, las dos principales conclusiones que se obtuvieron fueron:

- Los ciudadanos están dispuestos a cambiar su comportamiento o su modo de vida, pero principalmente por razones financieras más que ecológicas.
- La conciencia y la comprensión ciudadana deben alcanzar niveles mayores. Además, el conocimiento llega antes que la concienciación, y la encuesta ha mostrado que la sociedad civil está bastante desinformada sobre algunos asuntos preocupantes.

Referencias bibliográficas

[1]. United Nations General Assembly, "Transforming our world: the 2030 Agenda for Sustainable Development". New York, 25-27, September, 2015.

[PAME09]. Pamela Matson, "The Sustainable Transition". 2009.

[CHES03]. William., Chesbrough, Henry (2003), "Open innovation: the new imperative for creating and profiting from technology"

[2]. Knowledge Societies Policy Platform, "Handbook – Chapter 4: Conceptual Framework - Structuring Knowledge Societies Policy". Retrieved from 'unksoc.org'

[CARA12]. Carayannis, E. G.; Barth, T. D.; Campbell, D. F. J. "The Quintuple Helix innovation model: global warming as a challenge and driver for innovation". 2012.

[3]. Fortschrittsbericht. Mobility2Grid: Energiewende und Elektromobilität in vernetzten urbanen Arealen. 2015.

[4]. http://www.flourishingbusiness.org/

[SURA14]. Surabh P., Bhola P., Guin K., "Reviewing the Knowledge Systems of Innovation and the Associated Roles of Major Stakeholders in the Indian Context". 2014

[5]. Forschungscampus. Öffentlich-private Partnerschaft für Innovationen. 2014.

[6]. https://www.forschungscampus.bmbf.de/forschungscampi

[KRON18]. A. Kronsell, D. Mukhtar-Landgren, "Experimental governance: the role of municipalities in urban living labs." March 2018.

[STÅH13]. Ståhlbröst, A. "A Living Lab as a Service: Creating Value for Micro-Enterprises through Collaboration and Innovation." November 2013.

[7]. "Questions and answers on the EU Clean Air Policy Package". European Commision – Memo. Brussels, 2013.

[JUUJ13]. S. Juujärvi and K. Pesso: "Actor Roles in an Urban Living Lab: What Can We Learn from Suurpelto, Finland?" November 2013.

[NYST14]. A. Nyström, S. Leminen, M. Westerlund, M. Kortelainen, "Actor roles and role patterns influencing innovation in living labs". January 2014.

[LEMI12]. Leminen, S., Westerlund, M., Nyström, A., "Living Labs as Open-Innovation Networks". September 2012.

ABSTRACT

The **Introduction** of this Master's Thesis presents the Sustainability challenge in today's society. Sustainable development deals with how to satisfy the basic needs of present generations without jeopardizing the ability of future generations to meet theirs.

In 2015, the UN set 17 Sustainable Development Goals (SDGs) with the objective of having them fulfilled by 2030. The three main fields to address are economic growth, social inclusion and environmental protection.

All levels of society must contribute to the accomplishment of the SDGs, by developing a new manner of working together: neither the government, private institutions, universities or civil society are capable of facing this challenge while operating on their own.

On the research campus object of study, Mobility2Grid (M2G), private companies work in partnership with public institutions to implement innovative solutions that will guarantee an affordable service of energy, transport and heat solely based on the use of renewable energies.

In the **Current Research** section, different innovation approaches are described. Closed Innovation implies that the development of a project takes place exclusively within the company's boundaries. Open Innovation, however, adds the involvement of external organizations or professionals, including universities and research institutions. Finally, User Innovation focuses on final consumers rather than producers as the main contributors to innovation.

Living Labs (LL) are spaces related to the user-driven innovation. Living Labs work as a test bench where real scenarios are implemented so that both users and producers can participate as co-designers in the innovation process.

Innovation is produced from knowledge, an essential factor in Knowledge Societies that advance towards Sustainable Development. There are four main different sources of knowledge, also addressed as helices.

- The first helix emerges in the education subsystem, and it comprises schools, universities and research centers.
- The second helix concerns industry and business, that is the economic subsystem.
- The third helix is composed of governments and public sector entities, and includes national and local governments, ministries, and public administrations.
- The fourth represents the civil society: NGOs, foundations, social entrepreneurs and citizens.

These four subsystems or helices constitute the quadruple helix model. However, there is also a fifth helix, essential in the advancement towards the Sustainable Knowledge Societies. It deals with the natural environment.

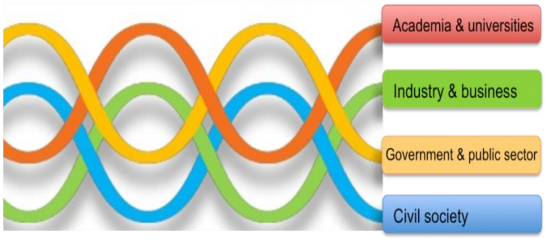

Figure 2: The quadruple helix model

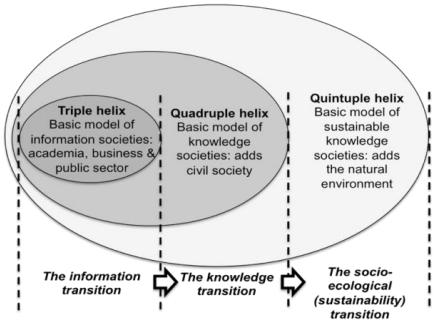

Figure 1: Helix model and transition to Sustainable Model Systems

The Research Campus M2G is addressed as a Living Lab, a Quadruple Helix Model where stakeholders from the four mentioned subsystems coexist. However, a number of elements on Campus suggest that a better denomination for it would be Sustainable Living Lab, since the natural environment is of great importance and present in all fields of M2G.

To answer the Research Questions that arise, such as:

a) To what extent do these four subsystems interact with each other?
b) Are their roles distinctly defined?
c) Do they share perspectives or common goals?
d) How deep is civil society involved?

Several **Objectives** are listed. The main objective of this Master's Thesis is carrying out a detailed study of the Research Campus M2G in order to understand the roles of the stakeholders involved in the value adding process. There are numerous partners and members working on the campus, classified in the four described groups. It is important to comprehend what activities and actions each of the helices perform.

Another objective of this thesis is to propose new ideas regarding the involvement of the civil society in the project, analyzing, for instance, the ways in which other Living Labs integrate citizens.

The **Methodology** to achieve the stated objectives includes the following tasks:

a) To begin with, the Business Model Canvas tool, plus the sustainability aspect, will be used to document the existing business model.
b) Additionally, a series of expert interviews will be performed to analyze the M2G partners' stances on the project.
c) Lastly, citizen surveys will be executed, to obtain the citizens' point of view regarding the future urban mobility scenario.

Following, in the section of the **Case Study: Mobility2Grid**, the context of the project is introduced.

There are nine Research Campus in Germany, funded by the Ministry of Education and Research and based on public-private partnerships for innovation. In these spaces, experts deal with worrying matters of the present and the future, such as health, mobility or the environment.

The Sustainable Energy Transition is a challenge that concerns society as a whole. For it to succeed, traffic electrification must be a part of the equation. On M2G, researchers study the integration of renewable energy and transport via smart grid.

Nevertheless, the fact that renewable energies are not predictable must be considered: renewable energy is not always available when it is needed, which can lead to bottlenecks in electricity supply. Contrarily, in some situations there is more energy generated than demanded.

The electrification of transport implies moving towards the connection of energy and traffic systems, which is only possible considering the new methods to balance consumption and generation, through smart grids, an amelioration of electricity storage devices and taking into consideration the fluctuations of renewable energies.

After contemplating the context of the project, the topic fields (TF) present on M2G are briefly described. The TF represent the objectives of the research campus: Acceptance and Participation, Smart Grid Infrastructures, Interconnected e-Mobility, Bus and Commercial Transportation, Education and Knowledge Transfer and Digital Spaces. There is an extra "cross sectional field" called Operation and Commercialization.

Next, the M2G Business Model is represented and analyzed using an alternative template to Osterwalder's: The Flourishing Business Canvas. The community that developed it consider that companies should run their business not only towards reducing the harm they cause to the environment, but also towards supporting the well-being of present and future generations.

The role of Living Labs and other models of knowledge societies suggest alternative ways of thinking and proceeding, resulting in a paradigm shift of special importance in energy matters.

In this work, future urban mobility environments are portrayed, and so is the most likely decentralized energy grid landscape. Additionally, the citizens' point of view was taken into consideration thanks to a survey performed, where 285 people of different countries, ages and occupations were asked to point their preferences regarding the sustainable transition. They were also asked whether they were aware of some data obtained from the European Commission, to estimate to what extent they are informed: Only 65 out of the 285 respondents knew that more than 400 000 people are estimated to die every year in the EU from air pollution; 50 % of the surveyed were aware that 40 % of CO_2 emissions from transportation are produced in cities and so is 70 % of other air pollutants.

In the **Conclusions**, the roles that each stakeholder subsystem play in society and on Campus are summarized in the following table: The roles that the stakeholders carry out in society are also applicable on Campus (except civil society as residents).

Stakeholder subsystem		In society	On M2G Campus
Academia and universities	First helix or providers	Obtain knowledge Transfer knowledge	Experiments with industry Privileged contact with civil society
Industry and business	Second helix or utilizers	Provide society with product or services and job positions	Collaborates with university researchers Benefits from the proximity of users
Government and public sector	Third helix or enablers	Promotes laws and regulations Ensures laws are embraced	Funds the innovative project Makes people more aware
Civil society	Fourth helix or users	Buyers, residents, students, users of public transport, etc	Profits from knowledge and awareness Participate as Informants and Testers

Table 1: Stakeholders present on Campus. Roles in society and on Campus

There is also a fifth helix highly related to all the activities that take place on campus: the natural environment. The sustainability aspect not only is key to make the socioecological sustainable transition possible, but also helps understand the motivations of most of the Living Lab actual and potential partners and to see the interconnections between them, economically and socially.

Future urban environments will involve fewer or none petrol fueled cars, while car sharing of electric vehicles will gain importance. Also, public transportation is likely to be further developed and pedestrian and biking traffic strengthened as well.

The energy transition is related to a decentralized energy grid with complementary user load profiles that will increase the user of renewable energies. The role of consumers will evolve to “prosumers”, who both produce and generate energy.

Regarding the survey, the two main the conclusions obtained were:

- Citizens are willing to change their behavior or their ways of living but mostly because of financial reasons rather than ecological.
- Citizen awareness and understanding must reach greater levels. Knowledge comes however before awareness, and the survey has shown that civil society is rather uninformed about some worrisome matters.

References

[1]. United Nations General Assembly, “Transforming our world: the 2030 Agenda for Sustainable Development”. New York, 25-27, September, 2015.

[PAME09]. Pamela Matson, “The Sustainable Transition”. 2009.

[CHES03]. William., Chesbrough, Henry (2003), “Open innovation: the new imperative for creating and profiting from technology”

[2]. Knowledge Societies Policy Platform, “Handbook – Chapter 4: Conceptual Framework - Structuring Knowledge Societies Policy”. Retrieved from ‘unksoc.org’

[CARA12]. Carayannis, E. G.; Barth, T. D.; Campbell, D. F. J. “The Quintuple Helix innovation model: global warming as a challenge and driver for innovation”. 2012.

[3]. Fortschrittsbericht. Mobility2Grid: Energiewende und Elektromobilität in vernetzten urbanen Arealen. 2015.

[4]. http://www.flourishingbusiness.org/

[SURA14]. Surabh P., Bhola P., Guin K., “Reviewing the Knowledge Systems of Innovation and the Associated Roles of Major Stakeholders in the Indian Context”. 2014

[5]. Forschungscampus – öffentlich-private Partnerschaft für Innovationen. Dezember 2014.

[6]. https://www.forschungscampus.bmbf.de/forschungscampi

[KRON18]. A. Kronsell, D. Mukhtar-Landgren, “Experimental governance: the role of municipalities in urban living labs.” March 2018.

[STÅH13]. Ståhlbröst, A. “A Living Lab as a Service: Creating Value for Micro-Enterprises through Collaboration and Innovation.” November 2013.

[7]. “Questions and answers on the EU Clean Air Policy Package”. European Commision – Memo. Brussels, 2013.

[JUUJ13]. S. Juujärvi and K. Pesso: “Actor Roles in an Urban Living Lab: What Can We Learn from Suurpelto, Finland?” November 2013.

[NYST14]. A. Nyström, S. Leminen, M. Westerlund, M. Kortelainen, “Actor roles and role patterns influencing innovation in living labs”. January 2014.

[LEMI12]. Leminen, S., Westerlund, M., Nyström, A., “Living Labs as Open-Innovation Networks”. September 2012.

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1 INTRODUCTION

The 21st century society faces several challenges, and among them Sustainability must be pointed out. The concept of Sustainability deals with how basic needs –such as food, water, shelter or energy– are met, while the planet is not excessively degraded. Certainly, the sustainability goal cannot be met overnight but, fortunately, our society is already starting to grow and evolve in a different way than it did in the past: today, important decisions are made with awareness, considering future consequences. This is commonly known as Sustainable Transition.

Nevertheless, the above-mentioned transition needs to occur faster. The human population keeps growing at notable rates, as well as the use of natural resources.

An example of the severity of the matter can be found analyzing the world's consumption of energy: Nowadays, more than 80% of this energy is obtained from fossil fuels, such as natural gas and oil. This percentage has been generally reduced since 1960 (see Figure 3) but it keeps growing in developing countries.

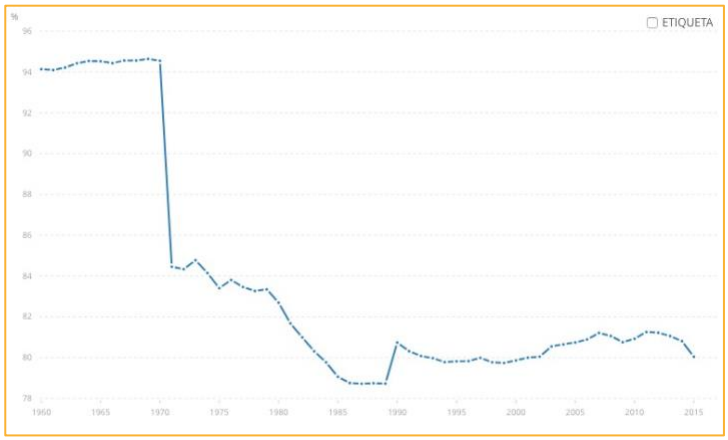


Figure 3: World's energy consumption from fossil fuels (% of total 1960 - 2015)

Between 1960 and 2015 Germany reduced the percentage of energy obtained from fossil fuels from 99 to 79'8% and Spain reduced it from 91'8 to 72'9%. However, some countries from Central Asia (high income excluded) increased it from 44'2 to 87'6 %.

The urge for a (sustainable) research plan was undeniable. Consequently, in 2015, the United Nations set 17 Sustainable Development Goals (SDGs) that were adopted by world leaders. In 2016, the Paris Agreement on Climate Change also addressed the necessity to concentrate on global warming.

1.1 SUSTAINABLE DEVELOPMENT

Sustainable Development deals with the development that can be carried out meeting the needs of the present generations but without jeopardizing the needs of the future ones. Sustainable development expects for society to build a sustainable future for both people and the planet.

The addressed sustainable research plan will focus on a technology and social system that can be broadly implemented, in a way that reduces harmful consequences for the environment. It should be noted that, to accelerate the sustainable transition, state of the art technology and science are vital, and so is constant innovation. Also, all the fields of knowledge need to work together in synergy.

For the Sustainable Development Goals to be achieved, countries need quality data collection, starting on a regional level, and contributing on the global one. The three main elements that must be interconnected are economic growth, social inclusion and environmental protection.

The 17 Goals are the following:

1. End of poverty in all forms everywhere.
   Even though the extreme poverty rates have been reduced more that 50% since 1990, there are still millions of people who live on less than $2 a day. Poverty includes hunger, malnutrition, and limited education or social discrimination.

2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture.
   Agriculture and fishing can grant food for everyone if the resources are managed correctly. Instead, soils, oceans and forests are being destroyed at high speed. A big change on the food system needs to take place to be able to feed all.

3. Ensure healthy lives and promote well-being for all at all ages.
   There have been major changes in increasing life expectancy, access to clean water and sanitation, reducing malaria and the spread of HIV. Yet, important efforts are still required.

4. Ensure inclusive and quality education for all and promote lifelong learning.
   With quality education, improving people's lives and reaching sustainable development would be achievable. There has already been an important progress for girls and women, but mostly in primary education and not at all levels.

5. Achieve gender equality and empower all women and girls.

Women and girls are still discriminated and suffer from violence all over the world. They need to be provided with equal access to education, health care, work and representation in political and economic processes.

6. Ensure access to water and sanitation for all.

There is sufficient water on the planet, but infrastructures are to be improved in order for everyone to have access to it.

7. Ensure access to affordable, reliable, sustainable and modern energy for all.

Energy means one of the biggest challenges of the modern society. Sustainable energy is an opportunity for everyone.

8. Promote inclusive and sustainable economic growth, employment and decent work for all.

Sustainable economic growth requires that societies create quality jobs that are not harmful for the environment.

9. Build resilient infrastructure, promote sustainable industrialization and foster innovation.

To achieve sustainable development, transport, energy and innovations and communication technology are essential. Technological progress reflects the effort to approach the environmental aims, such as energy efficiency.

"Without technology and innovation, industrialization will not happen, and without industrialization, development will not happen" (www.un.org).

10. Reduce inequality within and among countries.

There are still significant inequalities between developed and underdeveloped countries. Economic growth does not reduce poverty if does not include the three dimensions of sustainable development: environmental, economic and social.

11. Make cities inclusive, safe, resilient and sustainable.

Cities have always pushed people to progress (socially and economically speaking). Some current urban challenges are congestion, lack of basic services or decaying infrastructure. When trying to overcome them, endeavoring to reduce pollution and poverty is a must.

12. Ensure sustainable consumption and production patterns.

In other words, improving energy efficiency, sustainable infrastructure, green jobs, etc. The main target is being able to do more with less, and increasing life quality at the same time. It involves many different actors, such as businesses, researchers, public institutions, consumers…

13. Take urgent action to combat climate change and its impacts.

Climate change affects every country on the planet. The weather is changing, the sea level is rising and the greenhouse gas effect are continuing to increase. Because of the existing solutions, the change is turning slower as more people are starting to use renewable energies, among other things.

14. Conserve the sustainability of the seas, oceans and marine resources.

The oceans and seas of the world make the planet Earth habitable for human beings. The climate or the oxygen that we breathe are regulated by them. A careful management of this resource is vital for the future.

15. Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss.

Forests cover 30% of the surface of the planet and help combating climate change, apart from providing food and protecting biodiversity.

16. Promote just, peaceful and inclusive societies.

17. Revitalize the global partnership for sustainable development.

Partnerships between governments, business and civil society are required to achieve sustainable development. These partnerships function because they have been built with a common vision and shared goals.

Significant investments in energy, infrastructure and transport are needed specially in developing countries.

Everyone (either governments, civil society, the private sector, or academia) is expected to contribute in order to implement the SDGs successfully. Every country should take part to improve the lives of people –regardless of where they live–. But, as previously stated, a whole new way of working together is required to face the sustainability challenge: neither private institutions, academia, the government nor the civil society are capable of solving this problem working on their own.

In the Research Campus object of study, **Mobility2Grid or M2G** (in this document both terms will be used indistinctly to address the research campus), several of these SDGs are displayed: numbers 7, 9, 11, 12, 13 and 16.

On this research campus M2G, numerous private companies work in partnership with researchers from several disciplines to implement innovative solutions that will guarantee an economical service of electricity, transport and heat, all entirely based on the use of renewable energies.

The campus is located in a Berlin district, Schöneberg, in a 55 000 m^2 surface purchased by the company EUREF AG. This firm placed the site at the disposal of the different companies involved in the project (Siemens, Fraunhofer, Cisco, Deutsche Bahn, innoZ, inno2grid GmbH, GASAG, etc).

Figure 4: EUREF Campus in Berlin. © EUREF AG.

The fact that the campus is located in the middle of the city, allows M2G evaluate the impact that this initiative has on a small scale, before putting it in force on a broad scale. The campus is funded by the German Ministry of Education and Research.

One of the main goals that the Research Campus pursues is the "analysis and evaluation of social acceptability and political environment", while they explore new technology solutions. However, there is another implicit purpose that needs to be fulfilled: the suggested solutions must always be useful and above all, used.

A brochure of the research campus is attached at the end of the document, as Annex 1 (page 87).

1.2 USER NEEDS AND ECONOMIC NEEDS

The Research Campus Mobility2Grid is a Living Lab (LL). This implies that it functions as a test bench where users and producers can work and co-create innovative solutions, while government and academia also participate in the process. In the Living Lab area, public and private groups endeavor to create new products, services, processes, and infrastructures with which the user needs try to be satisfied.

Prototypes are developed and tested in the Living Lab quarter aiming to channel innovation towards the improvement of the welfare of the citizens, analyzing in advance if their suggested solutions will have proven effectiveness.

When committing towards innovation, there are a number of aspects to take into consideration. Amongst them, a previous analysis of the customs and ways of living of the civil society is indispensable. The innovation process must be directed towards the users' needs because, otherwise, the launched product cannot be guaranteed to be successfully accepted. Let us contemplate the case of a new electric vehicle: even though it might be on the market, maybe it is not exactly what the users are looking for and, for this reason, they do not feel the necessity to purchase it. The innovation process should be approached conversely: figuring out the user needs as a previous step.

Certainly, the private businesses also need to meet their economic needs. Hence, both users and companies benefit from an eventual symbiosis. This stated interdependence is the Living Lab's goal. Accordingly, in the Research Campus M2G, state of the art technology and innovation approaches are put into practice.

2 CURRENT RESEARCH

In this section of the document different innovation approaches will be described. First the **Open Innovation** concept will be presented, which arises in opposition to the classical research model carried out by companies: **Closed Innovation**. When companies work with a closed innovation approach, the project development takes place entirely within the boundaries of the company.

Subsequently, the User-driven Innovation or **User Innovation** will be submitted, which incorporates the user as a participant in the innovation process.

Lastly, the Living Lab concept will be introduced, as a brand of User Innovation.

2.1 OPEN INNOVATION

Open innovation is a concept neologized by Professor Henry Chesbrough and it regards a new strategy related to innovation, through which enterprises decide to cooperate with external organizations or different professionals than those to whom they are accustomed. The former knowledge of the company to this effect, is combined with the external knowledge of the professionals involved, in order to carry out different projects. Universities and research institutions are also significant within the open innovation process.

Leaving behind the classic research model that the companies usually follow, with which the developed projects start and end inside the own company (closed innovation). The fact of considering open innovation as an alternative, allows projects to be originated both inside and outside the company's boundaries. Additionally, companies can seize this manner of working at the beginning of an innovation process, but also during its intermediate stages.

Open innovation features numerous advantages: it reduces time and costs of some research and development projects, while it allows to consider solutions which would have never been promoted due to deadlines or previously unknown methodologies; they take innovation solutions from external companies and research centers, such as patents, products or ideas.

Creativity and innovation are crucial elements that will make a difference when comparing companies, and play an essential role in maintaining an advantageous position

in the market. In order to do so, companies must allow employees to deliver ideas and solutions, making open innovation an organizational value.

"As our business grows, it becomes increasingly necessary to delegate responsibility and to encourage men and women to exercise their initiative. This requires considerable tolerance. Those men and women, to whom we delegate authority and responsibility, if they are good people, are going to want to do their jobs in their own way. Mistakes will be made. But if a person is essentially right, the mistakes he or she makes are not as serious in the long run as the mistakes management will make if it undertakes to tell those in authority exactly how they must do their jobs." William L. McKnight, first 3M's chairman in 1949.

Apart from the open innovation regarding the internal employees, a series of systems must be established to promote communication between companies that have a similar business plan. By doing this, information flows also outside the company.

Open innovation can obviously imply some disadvantages, such as the possibility of sharing information that was not supposed to be shared and losing competitive advantages while doing so. Additionally, open innovation does not directly consider the final user in the value creation process.

2.2 USER INNOVATION

Unlike Open innovation, User innovation (or user-driven innovation) comes from those who consume products and services that companies manufacture. This type of innovation focuses on user firms or final consumers, rather than on the producers, who stop being the main contributors to innovation.

Embracing user innovation means that the final user becomes one of the stakeholders that participate in the value creation process, and in this manner, the consumer is an innovation source as well. The **lead users** are the ones that interact with a certain product (or service) and start demanding changes in it.

In some occasions, the users are organized in communities that are usually not supervised by the companies that produce and manufacture the commodities or provide the services. Hence, businesses are not able to supervise and go further in the relationships between the users and them. This new requirement materializes in form of a necessary system –that is to say **Living Lab**– where both users and companies can work together, putting into practice innovation as an interactive process.

2.2.1 LIVING LAB

A **Living Lab** is a space correlated to the research that fosters a manner of working with innovation. Living Labs' goal is adding value to the process of innovation. It is defined by the following conditions: it appears from the concept of open innovation, but is closer to the user innovation approach, as it focuses on the civil society; also, it forms a specific environment where the different agents act in a transversal and systemic manner. In other words, it is open because it includes users and other stakeholders in the research process, and it is systemic and transversal because it coordinates the perspectives and aims of the different actors involved.

Living Labs start developing because companies notice that there is a surplus of their manufactured products or offered services (compared to its low demand), and they need to change their market strategies for gaining competitive advantages over other manufacturers. To do so, they start focusing on innovation.

For Innovation to take place, new ideas and solutions need to be developed; the quality of the products needs to be improved as well, and for that to occur, some information about the user's experiences needs to be gathered.

When the offer of a product was not greater than its demand, keeping the secrecy before launching a product to the market had clear advantages. And by not keeping it, there were risks of losing the customers to the competitors. But when the scarcity of the products was over, companies considered applying some flexibility to the mentioned confidentiality.

The strategy was giving an initial social trial to the product, before launching it to the market, to allow the customers or potential users to share their experience. At the same time, the product could be redesigned or applied some changes in case of need.

To summarize, Living Labs are a place where experiments are carried out, through the implementation of real scenarios with the civil society; as a space for the creation of projects through co-design of both users and producers; and as a location where the different stakeholders involved can discover new market opportunities and projects.

Information societies appear at the same time as Living Labs, around 1970. Information societies have been evolving to **knowledge societies** and, in some cases, **sustainable knowledge societies**. Innovation is produced due to knowledge, which is an essential factor in Knowledge Societies that advance towards Sustainable Development. Living Labs have had a similar development but more focused in smaller areas. The question now is how are the different types of Knowledge created?

2.2.2 CREATION OF DIFFERENT TYPES OF KNOWLEDGE: KNOWLEDGE SOCIETIES

In this section, the role of the stakeholders involved in the innovation process is going to be introduced. The different types of knowledge will also be described.

Knowledge is fundamental for the Sustainable Development to success. "In the transformation to a knowledge-based society, it is possible to generate new and usable knowledge in conjunction with Sustainable Development", according to Carayannis, Barth and Campbell. Knowledge is created by innovation models and becomes available for the society as a whole.

The different sources of knowledge are also known as **helices**. These helices or subsystems interact with each other as part of the knowledge society system. The first four helices are shown in Figure 5.

The earliest (first) helix of knowledge emerges in the education subsystem: it is formed by the academia and the universities, and it referred to the role of university research. To the education subsystem belong schools, universities and research centers.

The second helix concerns industry and businesses (economic subsystem). The resulting double helix combined the education and the economic subsystems to produce knowledge. As part of the economic subsystem there are included big companies, startups, corporates and private sector, including trade organizations.

The third helix includes the governments and public sector entities, which added to the former two, builds the information society. They are considered part of the governance subsystem: national and regional governments, ministries and public administrations.

The fourth helix is the civil society. Therefore, the quadruple helix model of knowledge includes the civil society as stakeholders in the innovation process. The fourth helix includes NGOs, foundations, social entrepreneurs as well as citizens.

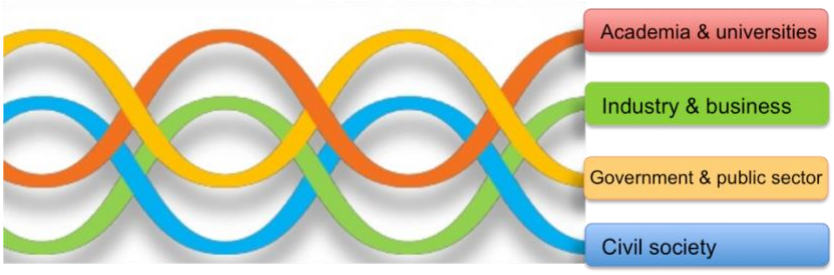


Figure 5: The Quadruple Helix Model as a basis for Knowledge Societies

The European Commission designates Living Labs "Public-Private-People-Partnerships (PPPP) for open innovation driven by users." Hence, Living Labs follow the Quadruple Helix Model.

Nevertheless, there is a **fifth helix** that is essential to advance towards the Sustainable Knowledge Societies. The fifth helix deals with the **natural environment** of society. The quintuple helix describes a new type of innovation vital for Sustainable Development.

The progression from the Model of Information Societies, to the Model of Knowledge Societies and, later on, to the Model of Sustainable Knowledge Societies is displayed in Figure 6.

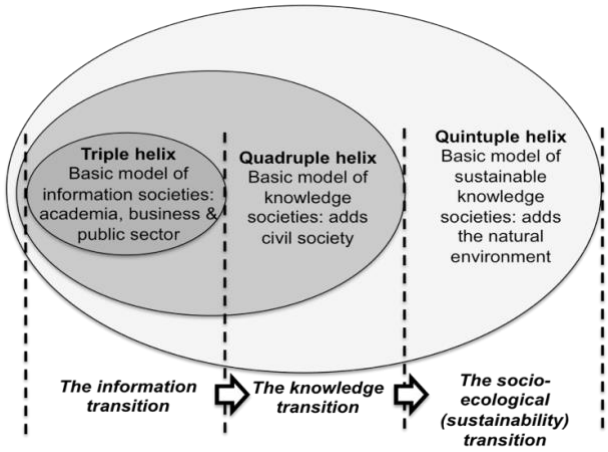


Figure 6: Helix Model and transition to Sustainable Model Systems

The **Research Campus Mobility2Grid** is referred to as a Living Lab, which would imply that it is a Quadruple Helix System (Model of Knowledge Societies). However, a number of elements on the campus area suggest that a better denomination would be **Sustainable Living Lab**.

On the other hand, whereas the natural environment is always present and cared for, the involvement degree of the civil society as a stakeholder is not always evident in each subdivision (helix) on campus.

Regarding the **stakeholders involved**, there are four clear groups of them (academia and universities, industry and businesses, government and public sector, and civil society). Another query to contemplate is whether or not they all must share similar perspectives or intentions for the innovation process to be successful, or simply efficient.

3 RESEARCH QUESTIONS

This section contains the objectives to be pursued in the development of this thesis. Out of the current research, which copes with concepts like open and user innovation, the Research Campus Mobility2Grid shows an appealing environment where the Model of Knowledge Societies can be profoundly examined.

The Campus Mobility2Grid is described as a Living Lab, where four groups of stakeholders (previously referred to as helices) are present: academia, businesses, government and civil society. However, some questions arise:

e) To what extent do these four subsystems interact with each other as part of the knowledge society system?
f) Are their roles distinctly defined?
g) Do they share perspectives or common goals?
h) How deep is civil society involved?

3.1 OBJECTIVES

The main objective of this Master's Thesis is to carry out a detailed study of the Research Campus Mobility2Grid in order to understand the roles of the stakeholders involved in the innovation process.

In the Sustainable Living Lab object of study, the first four helices described on section 2.2.2 work and interact in a sustainable environment looking into new innovative Technological ideas, which are related to the search of an integrated system (via Smart Grid) of both **energy and transport**. Nonetheless, it remains unclear if the stakeholders' perspectives and their aims differ broadly in the M2G ecosystem.

In theory, the innovation that takes place on the campus allows every subsystem to contribute equally: there are common objectives, and not only particular ones resolved by the powerful partners on the campus. Yet, there are power imbalances that cannot be avoided. Within the individual subsystems, do the roles vary in a significant manner with regard to their power or experience in the project?

There are numerous partners and members working on the campus, classified in the four described groups. It is important to comprehend what activities and actions each of the helices perform.

The government funds the project but they do not participate in the research process themselves: they employ the businesses and academia to do so.

Moreover, the businesses wish having new products or ideas developed profiting from the present synergy but maybe they are not deeply interested in disruptive changeovers regarding their existing products.

Finally, the user performs an important role, but civil society must have a greater representation.

Hence, another objective of this thesis is to propose new ideas regarding the role of the civil society in the project, analyzing, for instance, the ways in which other Living Labs integrate citizens.

4 METHODOLOGY

The tasks aimed at achieving the objectives outlined above are the following:

a) To begin with, the Business Model Canvas tool, initially proposed by Osterwalder, highlighting the sustainability aspect, will be used to document the existing business model.
b) Additionally, a series of expert interviews will be performed to analyze the M2G partners' stances on the project.
c) Lastly, citizen surveys will be executed, to endeavor to have knowledge of the interests of the civil society regarding their participation on the campus.

4.1 BUSINESS MODEL CANVAS

The Business Model Canvas template will help understand some of the company's activities, and will also assist in analyzing the partners of M2G. The latter will be of special interest while performing the expert interviews: as it was mentioned above, there are four different helices that interact in the M2G area, but each of those components has various subgroups that build the four subsystems (helices).

The canvas also grants an opportunity to concentrate on the problems that want to be solved, thinking about the benefits that this resolution will bring to the company.

4.2 QUALITATIVE RESEARCH

Qualitative Research will help reveal the perceptions and aims of the experts to be interviewed, through some descriptive information.

By using this approach, drivers and motivations, as well as opinions will be disclosed, through some individual interviews.

Qualitative Research can be of use in a project like this because it is not in the early stages of its development. The interviews will be of a semi structured degree kind: a series of questions are prepared, to cover the interview's extent. There will be guidelines used as orientation. In such manner, the formulation of the questions can be altered to acquire the interviewee's point of view. Unlike the intended citizen surveys, the expert interviews do not present a list of possible responses.

5 CASE STUDY: Mobility2Grid

In the process of moving towards a more sustainable and environmentally aware society, initiatives like the Mobility2Grid project represent significant help.

In the case of Germany, there are nine Research Campus based on public-private partnerships for innovation, where experts deal with worrying matters of the present and the future such as health, mobility or the environment. Among them, there is Mobility2Grid (campus object of study), where sustainable growth and innovation are encouraged, in a way where economy and science are connected.

The German Ministry of Education and Research started the funded initiative to support this manner of cooperation that involves researchers from both universities and non-university research institutions, and private companies. In nine Research Campus based on the described partnerships, the different sources of knowledge interact and work with each other to propose solutions regarding various complex topic fields. This manner of working presents an inviting resolution for topics with a **high research risk** as well as for subjects with **high potential for breakthrough innovations**.

Figure 7: Location of the nine Research Campus in Germany

5.1 CONTEXT OF THE PROJECT

This type of initiatives that encourage a more sustainable society, are funded by the Ministry of Education and Research and arise when analyzing a series of behaviors of the human being that derive in an accelerated deterioration of the environment.

Pollution is nowadays one of the most worrisome problems that affect our living conditions. It has increased significantly in the past few decades. Some of the causes of pollution are the use of pesticides in agricultural activities, excessive industrialization and the burning of conventional fuels used in transportation.

According to the European Commission, air pollution is a problem because it critically endangers health, causing cardiovascular and lung diseases and cancer. The groups that suffer the most are the elderly, children and citizens that suffer from asthma and other types of respiratory conditions.

Additionally, pollution has important economic consequences, as it increases medical costs and it reduces productivity due to the loss of working days. Air pollution has a clear impact on the environment as well, since it affects the quality of air, water and ecosystems.

In year 2010, at least 400 000 people died prematurely in countries partners of the European Union. Air pollution also damages buildings and some pollutants also behave like greenhouse gases that accelerate climate change.

The main air pollutants according to the European Commission are listed below:

- **"Particulate matter** (PM) is fine dust, emitted by road vehicles, shipping, power generation and households, and from natural sources such as sea salt, wind-blown soil and sand. Health concerns focus on particles of less than 10 micrometres (μm) in diameter (PM10) – especially those of less than 2.5 μm across (PM2.5). It can cause contributing to respiratory disease, cardiovascular disease, and lung cancer. **Black carbon** is the sooty part of particulates emitted from combustion.

- **Ground-level ozone** (O3) is a secondary pollutant produced by complex chemical reactions of NOx and VOCs (including methane) in sunlight. It can decrease lung function, aggravate asthma and other lung diseases, and causes damage to agricultural crops, forests, and plants, by reducing their growth rates.

- **Sulphur dioxide** (SO2) is emitted by power generation, industry, shipping and households. It harms human health through the formation of secondary PM and contributes to acidification3 of soils and inland waters.

- **Nitrogen oxides** (NOx) are emitted by road vehicles, shipping, power generation, industry and households. Like SO2, they harm human health by forming secondary PM and contribute to acid rain, but it also causes eutrophication and also a key component in increased levels of ground-level ozone (O3).

- **Ammonia** (NH3) is emitted by activities linked to manure and fertilisers management in agriculture and the use of fertilisers in agriculture. It harms human health as a building block for secondary PM, and contributes to acidification and eutrophication.

- **Volatile organic compounds** (VOC) are emitted from solvents in products and industry, road vehicles, household heating and power generation. VOCs are the key component in the formation of ground-level ozone.

- **Methane** (CH4) is emitted by natural sources such as wetlands, as well as human activities such as leakage from natural gas systems and the raising of livestock. Methane is a key building block in the formation of ozone, as well as a powerful greenhouse gas."

As mentioned before, pollution is caused by activities like industry, agriculture and transport. The Mobility2Grid research campus focuses on the latter, having set some long-term research objectives that are pursued by the stakeholders involved in the sustainable innovation process. The main goal is being able to implement innovative solutions regarding the energy transition and electromobility in urban areas.

The Sustainable Energy Transition is a big challenge that concerns society as a whole. For it to be successful, traffic electrification must be part of the equation. The project carried out by M2G studies how to integrate, in urban areas, a micro smart grid with transport infrastructures. The aim is developing solutions that will allow power, transportation and heat supply safe, with reasonable costs and on top of it, fully based on renewable energy sources. However, in Germany –and in the rest of the world–, several changes need to take place for this situation to become a reality. Some of these changes are social, but they present are economic and technical challenges regarding the energy transition.

5.1.1 GERMANY'S ENERGY MIX

Now, the power production from renewable energy sources reaches a third of the total, for the most part coming from wind offshore and onshore (16%), biomass (7%), solar (6%), and hydropower (3%).

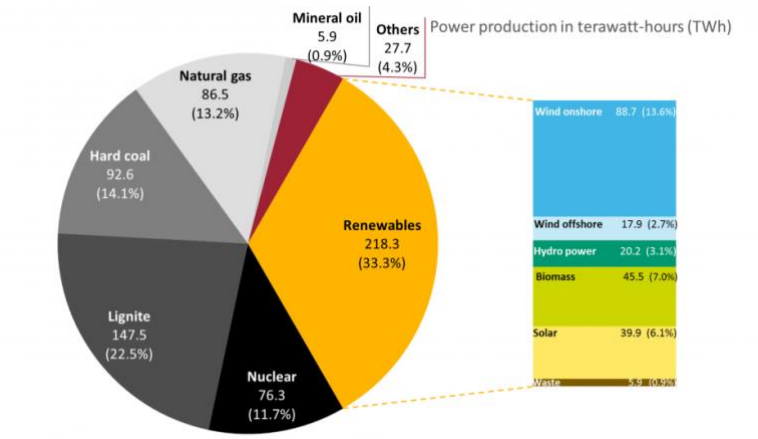


Figure 8: Energy sources in gross Germany power production in 2017. AG Energiebilanzen 2018

The energy transition shows a visible evolution regarding the increase of renewable energies and the decrease of some harmful sources that provoke air pollution, such as lignite and hard coal. This evolution is particularly pronounced in the past 10 years and the fastest rate regarding the power production from renewable sources (Figure 9).

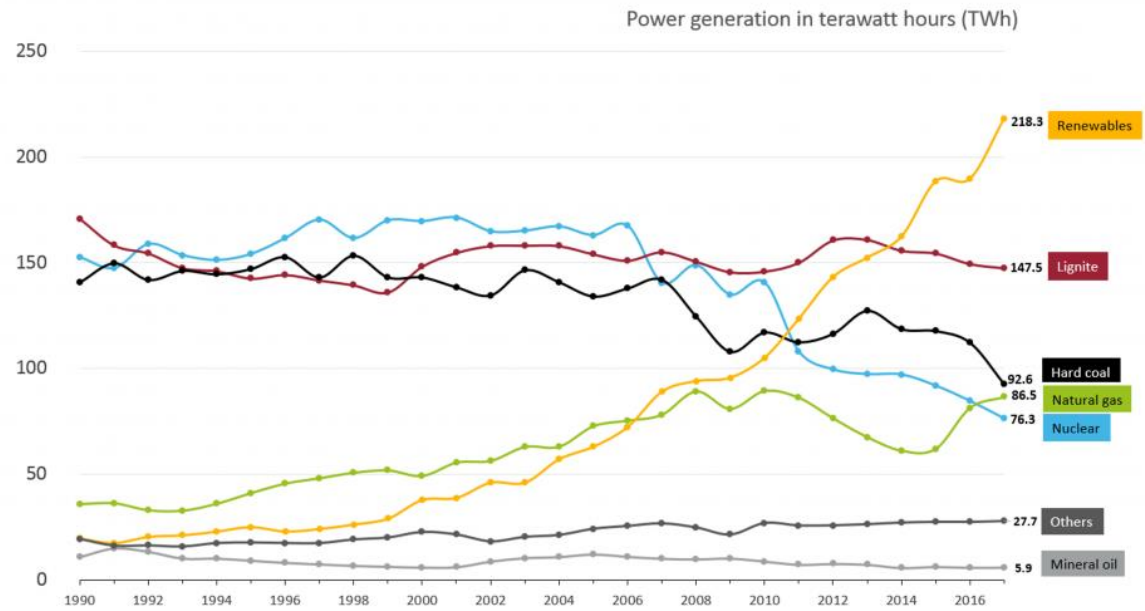


Figure 9: Gross power production in Germany 1990-2017. AG Energiebilanzen 2017

However, reaching the said 60% will only be a reality in the long term. Meanwhile, the general evolution between now and the coming years must also pursue compromise between:

- Energy independence, influenced by the geopolitics of fuel. This energy independence would be guaranteed by combining conventional energies and energy from renewable sources (autochthonous energy).
- Sustainability: lowering the greenhouse gas emissions, boosting renewable energies, and techniques such as CO_2 capture and storage.
- Viability of the national electrical system, with the assurance of manageability (base and peak energies) and electrical stability (inertia of thermal and nuclear power plants). Renewable energies are harder to manage, but self-consumption could soften peak demand.
- Other factors, such as distributed generation, robustness to face changes in the regulatory framework, fostering new technologies or improving the interconnection of the European electricity grid could help making the fact that renewable energies are not predictable less of an issue, since they would be less influenced by local anomalies.

In the process of turning Germany's Energy Mix into a more sustainable one, there are some key aspects that need to be considered. One of them deals with fluctuations in energy production, that is to say, renewable energies are not predictable. Electricity from wind turbines and solar panels will only be produced when there is wind blowing or sun shining: the energy is not always available in the moments that it is needed, and this fact can lead to bottlenecks in electricity supply. Contrarily, in some situations of strong wind, there is more energy generated that what is needed at that time. Therefore, the storage of this surplus of energy from renewable energy sources is able to grant electricity supply even in times of high energy demand.

It is well known, that for a stable power supply, the same amount of electricity being consumed must be constantly generated. Usually that meant that the generation from power plants was determined by the electricity demand from consumers, but with the increase of awareness about renewable energies, this situation is experiencing a transition. As stated above, the generation of electricity from wind and sun is not always predictable –it depends on natural conditions– but they have a lot of potential and provide cheap energy that, at times, cannot be used. How can the supply system (including consumers), adapt to these fluctuations?

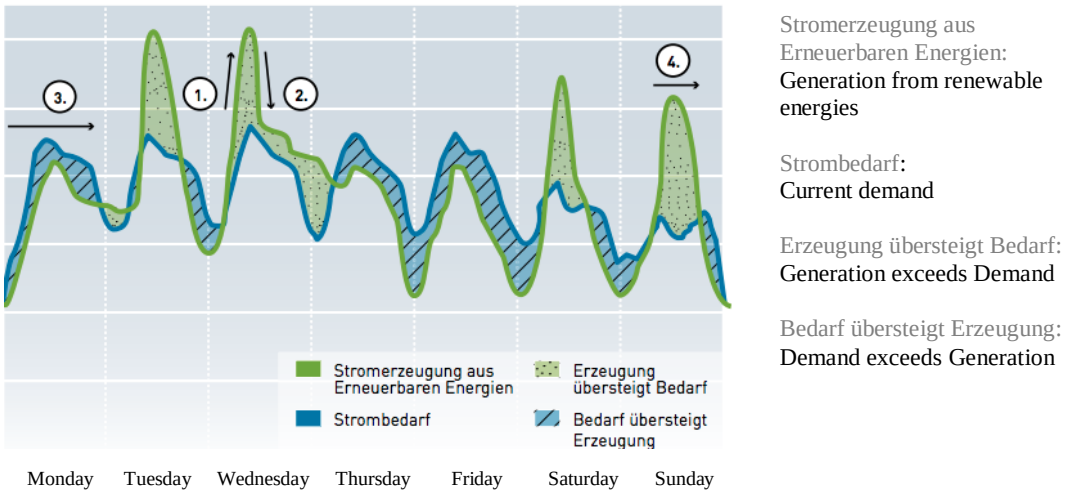


Figure 10: Fluctuations in energy production (Source: Agentur für Erneuerbare Energien)

1. The generation from renewable energy sources is increasing. Notice midday peak due to solar generation.
2. Electricity production from renewable energy is decreasing.
3. Demand exceeds generation: variable electricity consumers such as electric vehicles must reduce their consumption. Electricity storage: electricity to the grid.
4. Generation exceeds demand: Electricity consumers such as electric vehicles must absorb the surplus electricity.

The new balances between generation and consumption must be determined through smart generation, which requires an increase of storage facilities to be able to transfer electricity in times of favorable supply. This is one of the many reasons why the amount and significance of smart houses or storage devices is continuously growing. Moreover, all these applications must be connected and controlled via a smart grid, a power grid with communication technology.

In other respects, and as mentioned above, one of the most detrimental causes of pollution are excessive industrialization and the fuels burnt in petrol vehicles. Besides, it is estimated that the share of transportation in energy consumption will continue to raise rapidly: a sustainable energy transition can definitely not take place without considering transport.

The electrification of transport implies moving towards the connection of energy and traffic systems, which is only possible considering the new methods to balance consumption and generation, through smart grids, an amelioration of electricity storage devices and taking into consideration the fluctuations of renewable energies.

5.2 RESEARCH CAMPUS MOBILITY2GRID

The electrification of transportation involves both traffic and energy systems, a fact that connotes synergy by itself. Accordingly, the research campus M2G exploits this, in order to design electrification technologies for all mobility areas and combining it with a decentralized energy network.

On the research campus Mobility2Grid, more than 30 institutions work on a partnership “at eye level”. The common aim is working on a solution that will allow the integration of private and commercial electric vehicles into decentralized energy networks.

The research campus is located in the EUREF Campus, which is a limited area, so it also needs assistance of the urban neighborhood that surrounds it (Berlin Schöneberg) to fully conduct the energy and transport change. One of the reasons why the involvement of the civil society is relevant, is that this transition to electrified means of transport will not only be experienced by passenger cars, but also by the public and commercial transportation. Since the campus is also a (Sustainable) Living Lab, the civil society (fourth helix - Figure 5) plays an important role in the creation of knowledge.

Additionally, it is desired for all means of transport to develop into vehicles that use energy proceeding from renewable sources. This change of paradigm can only be achieved if there is social acceptance and participation on society’s side. Hence, the research campus works on matters related to energy and traffic, but obviously on its social context as well.

There are six different topics of research, which are unfolding new innovative business models, and an extra field “cross sectional field” that connects all of them. The Topic Fields (TF) are the following: Acceptance and Participation, Smart Grid Infrastructures, Interconnected e-Mobility, Bus and Commercial Transportation, Education and Knowledge Transfer and Digital Spaces. The extra “cross sectional field” is called Operation and Commercialization.

TF 1. Acceptance and Participation.

Combining energy and transport presents challenges regarding legal, economic and social terms. It is obvious that, for the transformation to succeed, the participation of the civil society is key, due to the necessity of new solutions being tested, taking into account the citizen's perspectives.

The EUREF site is a model that wants to be transferred to other decentralized areas, with different social profiles. Therefore, exhaustive work on acceptance and participation is required beforehand.

Partners in TF 1. WZB/Science Policy Research Group (Coordination), TU-Berlin/IBBA, Schneider Electric, Institute for Work Studies.

TF 2. Smart Grid Infrastructures.

In TF 2, the implementation of mobility and energy through renewable energies is developed. The triple interaction between electricity, electromobility and heat supply is studied on Campus. The combination of the limited campus area with the micro smart grid, offers the unique possibility of testing and development in the Living Lab. The micro smart grid consists of regenerative energy generators, energy storage systems and charging infrastructures.

Partners in TF 2: TU Berlin-Sense (Coordination), TU Berlin MPM, TU Berlin-DAI Labor, BLS Energieplan GmbH, Fraunhofer ISE, DB Energie, HTW Berlin, Schneider Electric, Stromnetz Berlin GmbH.

TF 3. Interconnected e-Mobility.

The EUREF Campus provides an appropriate area for testing the implementation of integrated energy and transport, due to its location and structure. TF 3 focuses on the campus and its surroundings, aiming to use electric cars as storage for the grid: the concept of "green charging" is applied, and additionally the use of non-electrified vehicles on campus is not allowed.

The research partners in TF 3 contribute with charging stations, bidirectionally chargeable electric vehicles or electric scooters.

Partners in TF 3: InnoZ GmbH (Coordination); DB FuhrparkService GmbH; TU Berlin-SPB, MMD Automobile GmbH (MMDA), eMio Share-a-Scooter, BMW AG.

TF 4. Bus and Commercial Transportation.

This topic field works with fleets of commercial vehicles to study if they could be potential electric means of transport. Operators of public transport are usually interested in introducing emission-free vehicles in their urban fleets, but vehicle producers must still improve the efficiency of energy storage and operation costs, to reduce the existing technology risks.

A bidirectional charging device for an electric public bus is installed on the EUREF campus and connected to the grid. With the said bus, some electric vans and bikes the study can be carried out, and conclusions regarding intelligent charging technology and network integration can be obtained.

Partners in TF 4: TU Berlin-MPM (Coordination); *Berliner Stadtreinigung* (Berlin City Cleaning), *Berliner Verkehrsbetriebe* (BVG - Berlin transport company), Scharlipp Service, Velogikas, Siemens, TU Berlin-SPB, TU Berlin-SENSE, TU Berlin-Logistics.

TF 5. Education and Knowledge Transfer.

The Master and Professional Training Programs offered on Campus are essential within the energy and transport changeover, since it is the appropriate procedure to promote young talent and to further develop the qualification of specialists. Knowledge Transfer to the entire society is also necessary to increase the general acceptance of the integration of energy and mobility. Additionally, TF 5 is in charge of reaching further target groups, who are not aware of the connection between transport and energy.

Education offers are continuously improved, to meet the partners' and citizens' requirements and needs, thanks several feedback processes.

Partners in TF 5: TU Berlin-ARTE, TU Berlin-EVUR, TU Berlin-FG, BSR, Velogikas, TU Berlin-Logistics, EUREF Campus, KKI, Constin GmbH, German E-Cars GmbH, KFZ Technik Oberstufenzentrum.

TF 6. Digital Spaces.

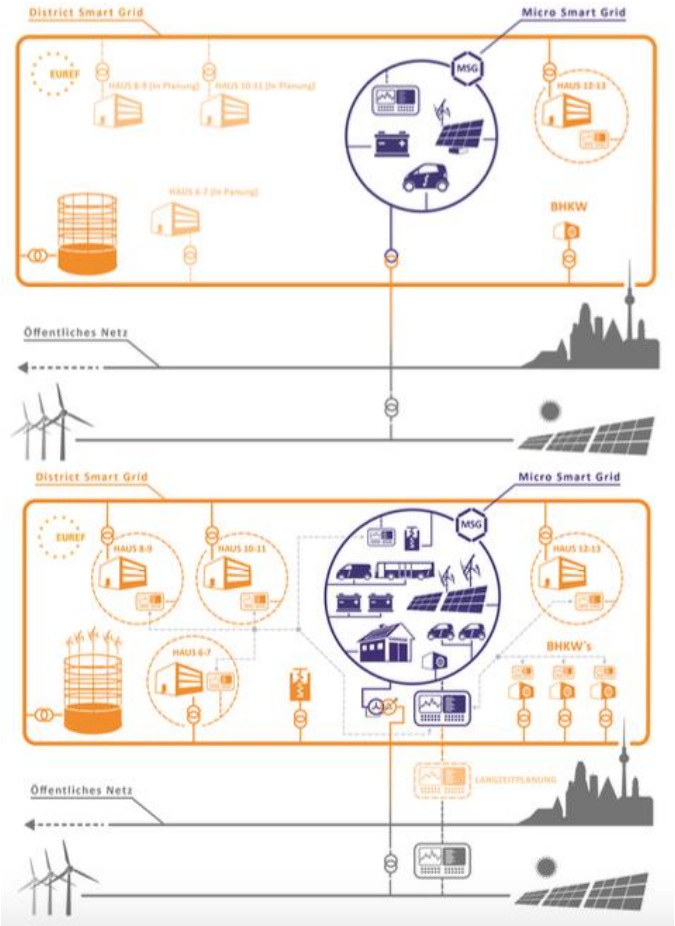
Digital platforms connote significant importance for the sectors that involve energy and transport. They can assist in optimizing bids, increasing their availability, transparency or security. Regarding the energy system, there is data on energy generation, energy flows and energy consumption which is available through digitalization.

In TF 6 researchers deal with numerous matters, such as the ways of capturing all kinds of information (e.g. free parking spots) via sensors and communicating it in real time. They also cope with new digital interaction forms or new possible business models.

Partners in TF 6. InnoZ GmbH (Coordination), Cisco, TU Berlin-DAI Lab, Climate KIC, FZI, EICT.

TF 7. Operation and Commercialization.

To develop a competitive operating strategy, the interactions between generation, storage and consumption must be carefully studied. In the Living Lab, energy and mobility systems have to work correctly in a non-stopping manner, without interruptions or errors. Otherwise, it would not be possible to exploit them in a profitable way.



The cross-sectional field TF 7 oversees the correct operation of the Micro Smart Grid and tests new innovative strategies and operating situations as well: they integrate the individual components into an operative system while using the research results on products and services being developed on Campus.

Inno2Grid GmbH (one of the partners) will gradually assume control of some of the facilities, such as photovoltaic systems, storage devices, and the charging infrastructures.

Figure 11: Expected development of the Mobility2Grid infrastructure – 2015 to 2020. © InnoZ

Partners in TF 7. Inno2grid GmbH (Coordination), DB Energie, InnoZ, Bürgerenergie Berlin, DB Fleet Service, GASAG, Competence Center for Critical Infrastructures (KKI), Lumenza, Schneider Electric, Stromnetz Berlin

5.2.1 BUSINESS MODEL OVERVIEW

Business models represent the road map that a company plans to pursue in order to generate revenues and to remain a profitable operating business. A classic business plan describes the products or services that the company object of study intends to manufacture, and the techniques they are going to apply to fulfill their objectives.

The value proposition represents what the company offers that differentiates it from similar businesses. Sources of financing and expected revenues and expenses should also be reflected on the business model.

The Business Model Canvas is a system to represent the company's key activities, partners, the resources that they will need for the manufacturing process, as well as the value proposition and the revenue streams.

Given the research campus's nature, the sustainability aspect is essential to understand the motivations of the partners –or potential partners– to join the project. Therefore, an alternative to the Business Model Canvas will be presented in this section of the document, and will be further developed to describe Mobility2Grid Business Model.

Flourishing Business Canvas

The Flourishing Business Canvas (Figure 12) is an initiative developed by the Strongly Sustainable Business Model Group (SSBMG), a community at Toronto's OCAD University (http://www.flourishingbusiness.org).

The SSBMG consider that companies should run their business not only towards reducing the harm they cause to the environment, but also towards supporting the well-being of both present and future generations. By doing this, they participate in the accomplishment of the Sustainable Development Goals (0) set in 2015 by the United Nations. The SDGs deal with three main blocks: environmental protection and regeneration, social inclusion (reflected on social benefits regarding the companies), and economic growth (or financial returns for the companies).

The enterprises willing to cooperate towards this development will obtain the mentioned triple profit –environmental, social and economic– but, on the other hand, they need to be prepared to broaden their levels of innovation. By innovating a company's business model, an important social and environmental impact can be created, while the success of the firm will also be visible in economic terms.

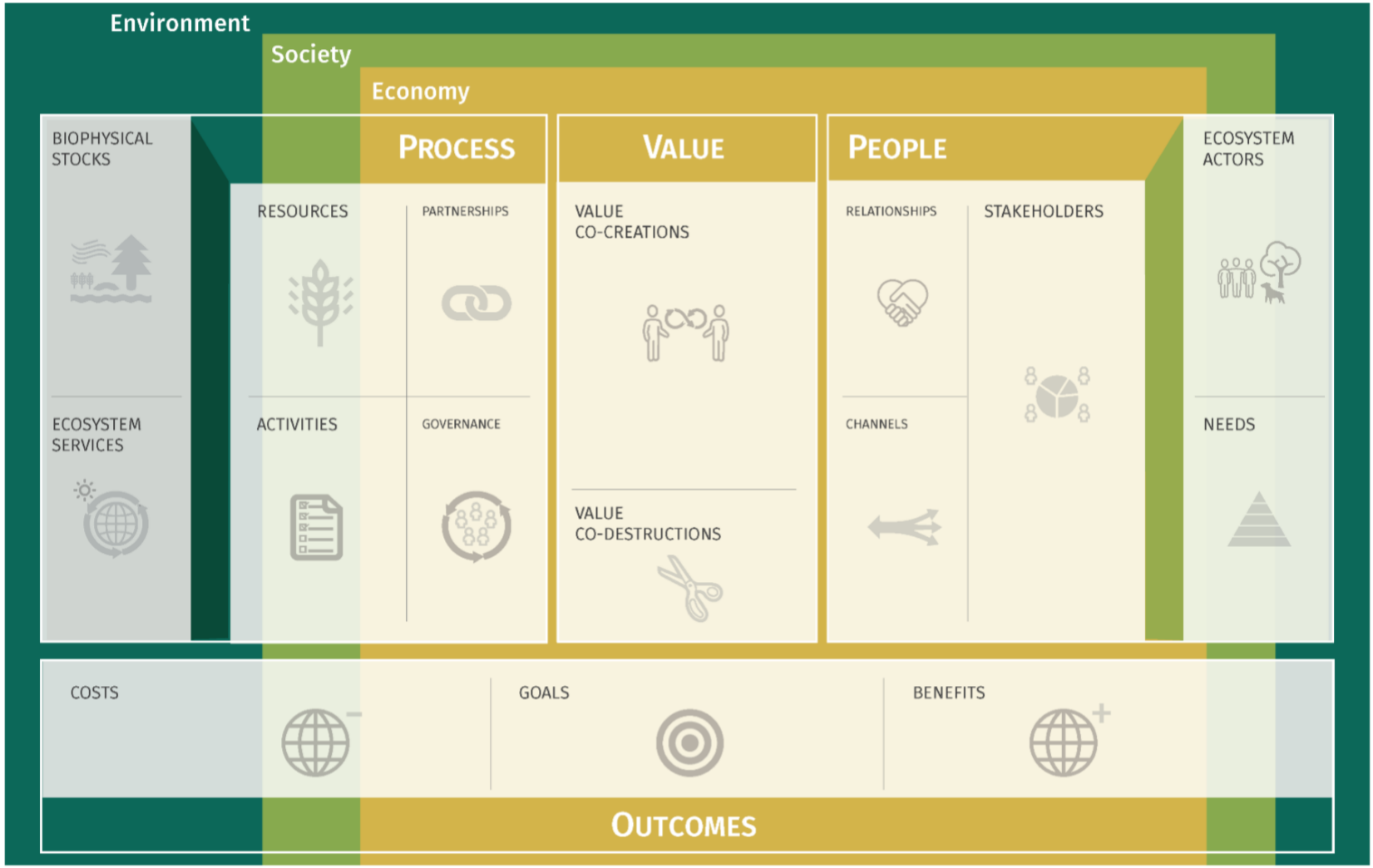


Figure 12: Flourishing Business Canvas – Template. © Antony Upward, 2014.

On the following pages, the sections and blocks that constitute the presented canvas (Flourishing Business Canvas, Figure 12) will be briefly described. Additionally, some of them will be detailed in relation to the research campus object of study.

Environment

Since every business compounds a segment of economy, it is automatically part of society too, and in turn, society depends on the environment.

Each business is part of a number or organizations, communities and other subsystems, including the environment. Hence, the importance of taking care of the surroundings when carrying out a business plan, because otherwise, apart from being detrimental to the sustainable transition, the consequences of the company's actions will ultimately affect the company per se.

The research campus M2G works on innovative solutions that link the energy transition with the electromobility concept. On the one hand, to provide society with a future city model, and on the other hand, because its participation in the sustainable transition, which cannot take place without considering a changeover in the means of transportation.

- **Outcomes**

  The outcomes of the businesses' activities affect the three mentioned fields environment, society and economy, with social and environmental costs and benefits.

  Some outcomes show if the company has achieved the awaited goals. This is usually synonymous with meeting up with the Stakeholder's expectations (regarding the enterprise's definition of success).

  The Business Canvas represents the techniques that the company uses to measure whether or not the outcomes are accomplished (in environmental, social and monetary terms).

  Costs

  This block refers to how the business measures the three types of costs that they provoke (environmental, social and economic).

  In M2G, TF 7 oversees operation and commercialization. Regarding the social and environmental costs, TF 1 and TF 5 work on several

processes to improve the acceptance of the Educations programs, for instance, or to learn the effects that the business has on nearby society.

The campus also possesses various Sustainable Value Indicators on the Energy Efficiency Buildings (built following some Standards of the future). The amount of people that go to work by bus, bike or on foot is also quantified.

Some of the environmental costs are related to the 78-meter-high gasometer on Campus, which is considered a historic structure in the Schöneberg quarter of Berlin. There are plans about raising and renovating some buildings or infrastructures around the gasometer, but they shall not be higher than 57 meters (including roof structures).

This fact affects the construction of technical elements such as windmills as well. Any striking changes regarding the gasometer, risk of being criticized by the protection of historical monuments.

Benefits

In contrast to the block that deals with costs, this block refers to the methods that the business uses to measure the different benefits that they cause environmental, social and economically speaking.

On the EUREF Campus, companies collaborate with academia to create a future model of a city where energy and transport are connected in a sustainable way (this is a notable benefit in the long run).

Some other benefits include the consequences of obtaining electrical energy from renewable sources on campus, aiming to consume it later on, whether as an alternative fuel for the vehicles on EUREF, or as lighting or heating for the buildings.

This involves less consumption of petrol to boost vehicles and a clean generation of energy overall. Besides, thanks to the promotion of public means of transportation, there is also less congestion regarding traffic.

More environmental (and social) benefits have relation with the education programs, because they make the society delve into their involvement in the project, and slowly change some harmful practices.

The economic benefits are easily understood when thinking about the way the companies work in the EUREF area “under the same roof” and at “eye level”.

Synergies are created and exploited, organizations learn from each other and the businesses are not seen as individuals but communities of experts.

Resources are shared and new ideas put into practice. This boosting in the innovation development process is one of the most important benefits of this campus.

Society

To begin with, society is part of the environment, and economy is created by society. Furthermore, citizens create: some of them reflect their needs and others take advantage from them to develop innovative ideas.

In a similar way, businesses are part of society, and have the duty to transform it into a reinvented and more desirable ecosystem. This responsibility is far greater than appears, because it will influence the company's surroundings and largely affect present and future generations. This duty concept receives the name of Corporate Social Responsibility (CSR) –business who participate on it are also referred to as Sustainable Responsible Businesses–.

Corporate Social Responsibility should function as self-regulation in classic companies, to assure their adherence to regulations or ethical standards. Nevertheless, the term Sustainability is already part of the definition of the research campus M2G.

- **Process**

  The processes that take place in the development of the business activities also affect environment, society and economy. They indicate where and with what a business forecasts to add value to its activities to be able to achieve its Goals.

  Resources

  Here, tangible and intangible resources needed to develop the business's activities are listed.

  In order to fulfill the stakeholders' goals, M2G requires a number of resources. Some of them are tangible, like the EUREF site acquired by EUREF AG, where companies and academia can work together developing their projects; the renewable energy sources, used to obtain electrical energy to carry out the sustainable activities on campus; or researchers from university and other institutions. And other resources are intangible, such as the know-how of the workers, the values reflected on the business's activities, the rules and regulations, etc.

  The buildings are important resources, either offices, lecture rooms, restaurants, the gasometer, etc.

  But there is also the micro smart grid infrastructure, the fleet of electric vehicles (cars, bikes, scooters, vans), the charging stations, the energy storage devices, the solar panels and wind mills, the sensors and

devices that measure and transfer real time information, and the digital platforms.

Likewise, the researchers from TU and from other institutions are very important. And so are the students and professionals that attend the educations programs.

Other resources to consider can be the information and data about the Schöneberg quarter, regarding the acceptance of the citizens or their changes of attitude regarding sustainability matters in general.

Activities

What series of processes or activities do companies perform to achieve the expected goals?

In this case, the activities performed are summed up in the 7 topic fields: Acceptance and Participation, Smart Grid Infrastructures, Interconnected e-Mobility, Bus and Commercial Transportation, Education and Knowledge Transfer and Digital Spaces, besides the sectional cross field Operation and Commercialization.

These fields together work on the study of solutions to integrate energy and transport systems, exclusively by sustainable means (renewable energies are produced and consumed). They also experiment in and out of the EUREF area to analyze what a future model city would look like, while promoting the use of electric vehicles and clean energies.

M2G also assures that the micro smart grid is integrated into the Berlin grid, local mobility ideas into a greater mobility network and the developed digital applications into the existing infrastructures.

- **People**

Ecosystem actors

This block of the Flourishing Model Canvas deals with the people or groups of people that might have a special interest in this company. Not only as shareholders, but as partners somehow involved.

In the M2G situation, there are countless actors who are interested. To start with, the human beings from today and from tomorrow. Also, the government (German Federal Ministry of Education and Research) has

shown special interest and they are the ones funding the project during the early stages. The public transport operators of Berlin and the local community also play roles in the M2G ecosystem.

Needs

In this block, the fundamental Needs of the previously stated Ecosystem Actors can be described. To develop this section, the Flourishing Business Canvas authors recommend the use of Maslow's Hierarchy of Needs or Max-Neef's Fundamental Human Needs, which are the following: subsistence, protection, affection, understanding, participation, leisure, creation, identity and freedom.

This project object of study, focuses on a human need related to obtaining energy in a sustainable way at an affordable cost.

The removal of fossil fuels, either regarding mobility or household applications, plays an important role in the decrease of air pollution and, therefore, in the decrease of diseases and even deaths that contamination causes.

Economy

For any business to be sustainable in the long run, having reasonable profit is indispensable. These benefits can either be monetary, typical in industrial businesses, or they can be understood within a greater framework, as in social and environmental benefits.

In this last case, enterprises would have a positive influence in people's health and wellbeing and in lowering the use of certain resources due to the implementation of circular economy.

Circular economy presents an innovative model of economy that optimizes stocks and material, energy and waste flow. By applying this economic model, it is possible to face the current scarcity of some natural resources. Circular economy also contributes to biodiversity preservation and it fights against the climate change.

It should be noted, that some monetary profits in the short run can be related to loses in the future. Hence, the importance of focusing on environmental and social aspects while running a business.

- **Process**

  As stated above, the processes affect environment, society and economy. They indicate how a business intends to add value to its work to achieve its Objectives.

  - **Partnerships**

    This block deals with the Stakeholders that are actual partners of the business. Some of them take part in activities for the business in different ways that others.

    Partners of M2G are the Federal Ministry of Education, who funds the project; EUREF AG, that owns the area where the Campus is located; transport companies like Berliner Verkehrsbetriebe (BVG – Berlin Transport Company), Deutsche Bahn (DB); and other active partners as Schneider Electric or Siemens. Also, some members of the company Inno2Grid GmbH can become shareholders of M2G.

Governance

The Governance includes the stakeholders with capacity to make decisions about the business's goals, the processes and activities, and its value proposition.

In order for the research campus Mobility2Grid to achieve its goals, they have developed an organizational structure.

On the one hand, there is the association "Mobility2Grid e.V.", that consists of all the partners of the project. They coordinate the research studies. On the other hand, there is "Inno2Grid GmbH" (I2G), an own company whose members can, in some cases, become shareholders. They oversee the planning and the operations.

Local, regional and national authorities do not take part in the decision-making of M2G, but they provide the laws and regulations that need to be followed.

- **Outcomes**

As previously explained, the outcomes affect environment, society and economy as well, with social and environmental costs and social and environmental benefits. Other outcomes show if the company accomplishes its objectives.

The Business Model Canvas represents the company's techniques to measure the outcome's magnitude.

Goals

The targeted goals that the stakeholders pursue, stated in the business plan. If the goals are achieved, the business is considered successful: environmentally, socially and economically.

The research campus Mobility2Grid has some immediate goals and other future ones. Currently, the project finds itself in the main phase, having left behind the preliminary phase. The focus is finding out how commercial and private electric vehicles can become part of the smart grid, by supporting the energy and transport changeover thought the use of decentralized grids and information structures.

Another objective includes working on the development of the Master programs implemented.

All in all, these and other goals are to be dealt with in the six topic fields (and the seventh cross sectional field). They all pursue the overall target of promoting circular economy, which will be detailed in the next section of this document.

- **Value**

This section is comparable to the value proposition on the Business Model Canvas developed by Osterwalder, where the proposition shows the competitive advantages of the company.

The main difference between this model and the latter is that here, both co-created and co-destroyed value are considered.

Also, the Flourishing Business Canvas emphasizes the fact that this value can be of importance in the present or in the future.

The value is studied between this business and the stakeholders involved in the innovation process.

Value co-creations

The EUREF site offers a place where companies and research institutions are able to work together profiting from the synergies that these interactions provide. Additionally, it is a Sustainable Living Lab for mobility concepts connected with a decentralized energy supply, and powered exclusively with energy from renewable sources.

The M2G campus creates curiosity among the users (internal or external), which is essential in relation to the involvement of the stakeholders, and not only within the campus limits.

Value co-destructions

A negative value proposition of this business is that, even though it encourages local companies to get involved and participate from the innovation processes that takes place on campus, there are certain barriers of entry, for instance, for startups: the Ministry of Education and Research is not willing to fund small business when it is not sure that they will exist and be making profit in the near-future.

Furthermore, if the share of each group of stakeholders in the Living Lab is not optimized, and does not match the actual structure of society, results obtained after the studies that are carried out, **might not represent citizens as it was awaited**, affecting important decisions taken based on those analyses.

- **People**

  - **Relationships**

    What type of relationships with the stakeholders should take place (via Channels) for the business to achieve its goals through the activities?

  - **Stakeholders**

    This block works differently in Osterwalder's Business Model Canvas and in the Flourishing Business Canvas.

    In the former, partners can represent providers, investors, distributors or shareholders in general. However, in the Flourishing Business Canvas, the partnership is studied from another point of view, including a wider range of stakeholders involved in the business's activities.

    Some of the stakeholders of M2G are the Federal Ministry of Education, who provides funding for the project; EUREF AG, that owns the area where the Campus is located; Inno2Grid GmbH; TU Berlin, with some buildings to teach master and professional training programs, and researchers working on Campus; transport companies like Berliner Verkehrsbetriebe (BVG – Berlin Transport Company), Deutsche Bahn (DB – German train); consulting groups such as EUREF Consulting or Berlin Energy and Mobility Consultants; and other active partners as Schneider Electric or Siemens.

    More stakeholders are the members of the civil society that live in the surroundings of the campus, including the students that visit the master programs and the children from the schools nearby that learn during workshops; the city Administration and regional authorities (tax claim, applicable laws); financing societies, insurance companies, etc.

    There are obviously other roles such as material suppliers and investors. But, ultimately, the *future* civil society will own a system

developed by Mobility2Grid which will ameliorate the environment situation and promote the use of local and sustainable energies.

A further development of the stakeholder block can be seen in the next section of the document.

Channels

What channels does the company employ to communicate with the above stated stakeholders? It certainly depends on the type of stakeholder.

For instance, with potential partner companies or groups of people that could be interested in the idea of the campus, the communication is established (at first) via conferences, fairs (e.g. Berlin Trade Fair), an annual symposium…

When the stakeholders are partner companies, the communication takes place through the phone, email, o meetings that take place in the EUREF site.

To reach the civil society, there are surveys or workshops that are developed; there is also the internet site; the lectures and praxis that are carried out inside the campus…

The sustainability concept is an important asset for the research campus Mobility2Grid, and a very interesting incentive to encourage partners to join the project.

The results of its business plan analysis are shown in Figure 11: The Business Model Canvas developed by Osterwalder, adding some sustainability blocks. The template has been filled in according to the criteria suggested by the Flourishing Business Canvas.

The Business Model Canvas

Designed for:	Designed by:	Date:	Version:
Mobility2Grid	Sara Jiménez Herráez	14.08.2018	3

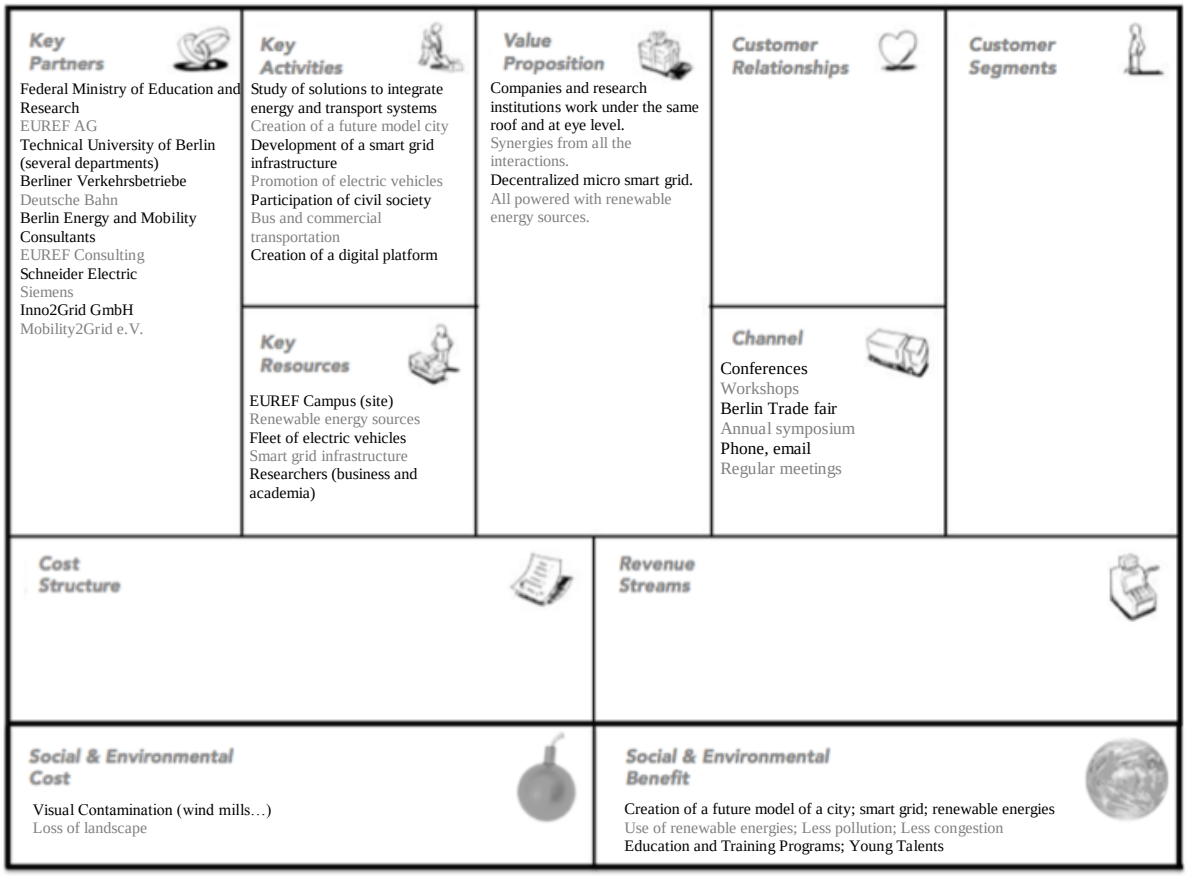


Figure 13: Business Model Canvas Osterwalder plus Sustainability

5.2.2 STAKEHOLDERS' PERSPECTIVES

In the Sustainable Living Lab, Mobility2Grid, object of this study the first four helices described on section 2.2.2 work and interact in a sustainable environment, trying to develop new innovative technological ideas regarding the integration of two concepts via a micro smart grid: electromobility and energy.

It should be noted, that one of the facts that make this research campus different, is that it works exclusively thanks to energy from renewable sources: especially solar and wind energy.

The stakeholders' individual (or group) objectives in the Mobility2Grid ecosystem have not been specified. In theory, the innovation that takes place on campus allows every subsystem or helix to contribute equally. This means that there are common targets and goals, and not only particular ones suggested by some members.

To begin analyzing these perspectives, the circular economy term should be introduced, because it is deeply related with sustainability. This model is highly related to sustainable development, because it forces companies to forget about linear production and use instead a more efficient use of resources.

The European Commission adopted in 2015 a new package on the circular economy to stimulate Europe's transition to a circular economy. According to the European Commission: "In a circular economy, the value of products and materials is maintained for as long as possible. Waste and resource use are minimized, and when a product reaches the end of its life, it is used again to create further value. This can bring major economic benefits, contributing to innovation, growth and job creation".

Circular economy is an economic model which, if reached, can also boost competitiveness in a global manner and, overall, promote sustainable economic growth. Fields such as research and development are deeply affected by the changes that circular economy requires.

All stakeholders in a project that aims to reach the circular economy model should be involved and participate. The final user's engagement is indispensable, as their choices fix the products that are put into circulation. They need to be aware of their responsibility towards the environment.

Going back to the Knowledge Societies, and considering that Mobility2Grid is a "PPPP (Public-Private-People-Partnerships) for open innovation driven by users", in line with the European Commission, the campus has all the elements to be pictured as a

Quadruple Helix System.

However, besides the first four helices, there is a fifth that is highly related to all the activities that take place on campus: the natural environment. The sustainability principle not only is essential to make the socioecological sustainable transition possible, but also helps to understand the motivations of most of the Living Lab partners (actual and potential) and to see the interconnections between them. Both economically and socially.

The concern about the natural environment is of far greater importance that what it appears. Sustainability works as a cohesion cement present everywhere on campus, that keeps the other four helices transversely linked.

To continue with the analysis of the stakeholders and their interconnections, the Quadruple Helix Model (Figure 14) will be addressed, presuming that the natural environment is part of each of the circles.

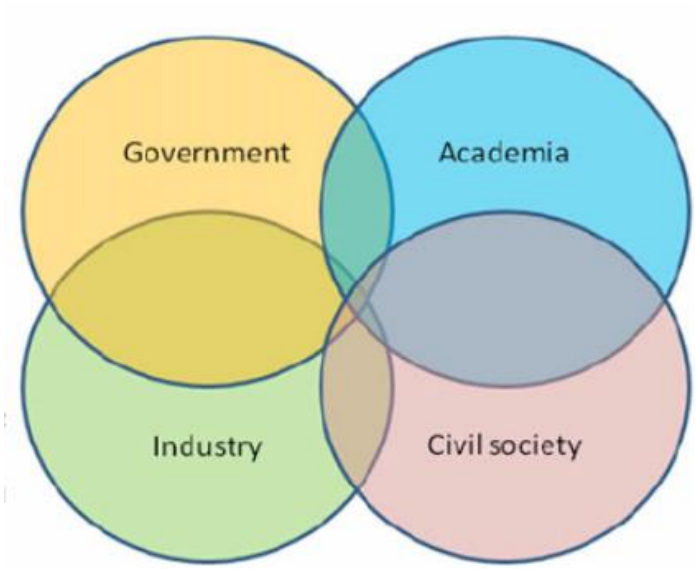


Figure 14: Quadruple Helix Innovation System

The Government and Public sector will be the first subsystem to be described, since it has already been introduced in this section, in the form of international institutions as the European Commission.

Government and Public Sector

Government and public sector entities compose the third helix. This subsystem includes international, national and regional governments, as well as ministries and public administrations.

The European Commission (EC) is in charge of proposing legislation, and taking decisions to manage the EU daily business.

The EC functions as an independent authority not linked to governments, and it could be said that the European Commission has power over the European Union, as a kind of European Government.

The European Commission has been mentioned several times in this document, as it provides data about air pollutions and its consequences, and implements decisions consequently. European States are expected to transfer the European Directives into their national legislation. Conclusively, this legislation will be embraced by the research campus management.

Some of the impositions proposed by the European Commission relate to a reduction in CO_2 emissions and an improvement in air quality, and the to the application of the circular economy model.

The Federal Government is responsible for promoting legislation that will be approved by **the Parliament**, following society's general interests (which obviously include health, environment, education…).

The Parliament is the core of the German government system, and it is a national entity in Germany. The Parliament is responsible for originating all legislation.

Also on the national level, **The Ministry of Education and Research** is especially Involved in the innovation process of the research campus Mobility2Grid, as well as the other eight Campus funded by them. They decided to fund this initiatives that eases cooperation between researchers from universities and from other institutions. In all the nine research campus professionals work and interact to propose solutions for topics about health, mobility and sustainability. The research risk that these studies

implies, is assumed by the Ministry to certain extent.

The regional and local governments oversee functions as law enforcement and education. The cooperation with the government in M2G is very important, but they do not always share their interest with the Campus stakeholders.

For this reason, **the District Administration of Schöneberg** and **the Senate of Berlin** (executive body that governs Berlin) do not always favor the process of finding new rules and regulations, which are required for the development of some innovative products or ideas.

An example of this conflict appears with the bidirectional charging device. Since it is about technology that is not widely used yet, there are no regulations regarding who should benefit when an electric vehicle sends energy to the grid: it could be the car owner, the owner of the battery, the person who produced the energy in the first place, the manufacturer, etc.

Another situation when regulations can be problematic is the planning of the area. The district has certain regulations which do not allow the researchers to perform like they would like.

However, this issue affects not only the EUREF Campus, because the law creation process is generally quite complex, and the government usually needs a long planning phase to make decisions in a city.

Another sector of the government that is involved in the research campus is the **Public Administration**. This sector includes politicians and civil servants.

It is usually said that there is a high demand of urban planners within the public administration, issue that they address by attending the Master Programs taught on Campus.

We are writing the application for the second main phase now, and all topic fields agree that we need public administration as part of the main project, so that we have some sort of official structure to talk to them.

The Sustainable Mobility Management program allows graduates to work in consulting, but not in large energy corporations (unlike with the Energy Management

Program). There are not many large mobility corporations –besides car manufacturers– in the Mobility Sector. Car manufacturers do not require mobility planners: after studying urban planning, traffic planning or mobility planning it is quite likely ending up in administration or politics.

A number of politicians also took part in a series of lectures about the "future research" concept, to obtain an idea related to how to plan not only traffic systems that existed years ago, but also future existing systems. After receiving the knowledge about how will the traffic systems (most likely) develop in the future, acting consequently results easier.

In spite of the involvement of the government and the public sector, all topic fields agree that public administrations must be a part of the main project, because an official structure is required to address them more efficiently.

To summarize, the government and the public sector affects several areas of the campus, even if they do not seem as involved in the process. The third helix participates by promoting laws and ensuring they are embraced, they fund the program and foment the innovation process, and they also participate in some education programs.

Academia and Universities

Academia and universities lead to the earliest helix of knowledge. The Education subsystem deals with the role of universities regarding university research, and knowledge acquisition and distribution. This helix includes school, universities and research centers.

The first helix is present if every topic field developed on the Mobility2Grid Campus. Their main objectives are related to knowledge because:

a) they contribute with their former knowledge,
b) and, from the experience of participating in the overall project, they acquire more knowledge,
c) that is transmitted to society: to today generations and to future ones.

- How does academia interact with other researchers on Campus?

The campus works as a funding source for academia and its research projects. As a matter of fact, an idea on the whole research campus is that university does not work on basic research, but on research with results that can be applied to business who are also part of the ecosystem.

They institution that evaluates research and growth priorities and makes recommendations regarding the development of future projects is the association Mobility2Grid e.V. They coordinate all activities of M2G and promote cooperation with other research institutions and other relevant actors on the EUREF Campus.

Universities and academia ultimately make use of the campus as a real experimentation field where theoretical scientific ideas can be applied and brought to the technical reality. Additionally, they have the opportunity to analyze the effect that these concepts have on consumers.

It should also be noted that, since the EUREF Campus area is limited, and houses cannot be built, academia is also responsible for running some activities that bring the companies together, as some companies still do not know the rest of the members.

However, the focus on the campus as a Living Lab that integrates mobility, energy and communication networks does not imply that the study area only addresses the EUREF area.

On the contrary: the micro smart grid must be integrated into the main grid; local mobility concepts integrated into the urban mobility network and digital applications into existing infrastructures.

How does academia interact with civil society?

In particular, the tasks developed by Topic Fields 1 (Acceptance and Participation) and 5 (Education and Knowledge Transfer) are of special importance regarding the involvement of the user.

- **Topic Field 1** (Acceptance and Participation) is divided in two areas:

    - In *Acceptance*, quantitative and qualitative research is prepared, to find special user examples. Next, workers (that represent users) are interviewed.

      For example, about the e-Bus that works with bidirectional charge. There are several drivers that work outside the campus, and this research focuses on their experiences after some weeks working with it: whether they find the technique useful or not, their expectations, etc.

    - The *Participation* area endeavors to make workers and stakeholders participate. They are informed about some new planned techniques and the provide some useful feedback about what they want, need, expect…

- The Education and Knowledge Transfer Field **(Topic Field 5)** is also quite related to the user, and they also strengthen the network inside the Campus.

    - The Master Programs belong to the Education part, and they are aimed to transfer knowledge from research to education programs. This way, this vehicle to grid solution is transferred to people who will use it in their professional life, regardless of it being on campus or not.

- Professional Training are mostly addressed to companies and cope with various vehicle to grid concepts. Some of them are technical and others deal with business models.

Master programs and Professional Trainings are continuously evolving at the hands of the first helix.

Regarding the masters, some new components are added, they vary to reach a broader target of students, etc. About the Professional Trainings, they are incessantly adapted to the needs or demands of the companies that attend them.

It should be noted that the tasks that take place on campus present a high technical level, with challenged that can only be partially addressed in the education programs. The interconnection of all topic fields is handled on campus through interdisciplinary and practical offers for both students and professional workers.

There is an e-school as well, where TU researchers cooperate with the nearby elementary school. Children visit the Campus once a year and work on some small electric cars, race each other… By doing this, kids start learning when they are young. The researchers' objective is raising interest and awareness on the sustainability topic.

Additionally, university and academia analyze the effect that these innovative concepts have on consumers, either through workshops, surveys, or citizen reports (as the *Bürgergutachten* that will be discussed in another section of this document). The data that industry obtains via marketing feedback is also processed in similar ways.

The Campus and its surroundings present a place to maintain privileged contact with society, because it allows researchers to know the citizen's demands or expectations. By doing this, professionals can guide their research more efficiently and, in brief, make it user oriented.

In conclusion, universities and academia are involved in every topic addressed on campus, and one of their main goals is obtaining knowledge and subsequently transferring it. The first helix participates by promoting interconnections between actors on campus, and by analyzing the citizens' reactions to the developed ideas. Another important target is getting groups from outside the campus to be interested in the research subjects and raising awareness on the sustainability part.

Industry and Businesses

Industry and businesses for the economic subsystem, also addressed as second helix. This subsystem is formed by big companies, startups, corporates and private sector, including trade organizations.

Business join the Mobility2Grid Campus for a number of reasons:

a) On the one hand, companies are not as close to civil society as university and academia, but they definitely must know what citizens require from their offered products or services, in order to obtain profit and remain in a privileged market position.

   If a business wants to correctly provide a service, and be profitable in the long run, they need to understand the consumers' expectations desires.

b) On the other hand, the campus presents a unique area where new mobility solutions are studied and tested while the natural environment is considered of great importance. Additionally, business and academia interactions on campus are far more powerful than in other alternative networks.

The second helix collaborate with university researchers, as they work on subjects that companies consider useful or interesting: The fact that these universities and companies coexist "under the same roof" reflects on some of the university research being directly applied or experimented in the companies themselves.

By doing this, results originating from theoretical investigation are efficiently tested in practical ways.

Companies and scientific stakeholders work together on campus but not in a classical way, as they do not tend to have a specific product in Mobility2Grid.

The economic subsystem in M2G is mostly represented by start-ups and big companies. For both types of companies, the campus provides an opportunity to take advantage of the synergies that are naturally developed.

- **Some big corporations**, like Siemens or Schneider Electric, are very **receptive and active** in M2G. They participate not only with research results but also with infrastructures to benefit the overall study. Examples of these include some charging stations.

- **Other big companies** may provide funding for the project but are **not deeply involved** or active on campus, because they are drawn by new innovative ideas but they rather proceed with the experimentation and analysis on their own.

- Regarding **start-ups** that are trying to create an innovative concept within the Mobility2Grid Campus, their modus operandi is different from larger corporations'.

  Companies that already established in the market have at their disposal marketing and production departments composed of experts that perform studies before launching a product.

  Unlike them, start-ups present their idea, have experiences with the users and adapt the product until consumers accept it. In this context, an area like the EUREF Campus makes it easier to contact the user. Thus, it is possible for start-ups to introduce a product, such as an electric bike, being in close contact with the users.

  In other respects, getting start-ups as partners of M2G is not always simple. The Ministry of Education and Research is not in accord with funding companies that might disappear in the near-future. They need to prove a certain financial stability. At this point, since it is harder from them to obtain results without funding, their degree of involvement depends on their interest in the project and on whether or not the topic would help them with their rising company. In any case, start-ups tend to be more focused on developing their business model that on promoting research.

There are other companies that also cooperate taking some of the ideas and some of the innovations to the neighboring quarters. For instance, cleaning services as *Berliner Stadtreinigung* (Berlin City Cleaning) or urban transport operators as *Berliner Verkehrsbetriebe* (BVG - Berlin transport company). The latter, are interviewed by the campus researchers and provide their professional point of view regarding products like the e-Bus, although they do not belong to the researching part of a company with technological purposes.

Some corporations participate in a different way as well, as professionals that attend the education programs or trainings, with the aim of strengthening their knowledge.

Schneider Electric and DB Energie have founded a collecting society called "Inno2Grid GmbH", with the exploitation of the research findings and the operation of the Campus environment as targets. The business activities of Inno2Grid are divided in four fields:

- Technical and operational management.
- Commercial exploitation of research results via marketing. This includes consulting –advising clients on energy and mobility solutions–, design –planning of those customized solutions–, and building and implementation of smart energy and mobility infrastructures.
- Exhibit of the research results and facilities of the research campus.
- Business activities outside the research campus.

Figure 15: Inno2Grid GmbH partner network.

Source: www.inno2grid.com

The collecting society Inno2Grid is open to new membership applications.

Regardless of the shares, every stakeholder has the right to one single vote.

About the sustainability concept that has been said to be present in all subsystems that coexist on the campus, there is not an existing way of controlling the consciousness of the companies. However, business prove to their customers that they are aware of the sustainability issue simple by making the decision of being part of the EUREF Campus. They attest that it is important for them to have their companies in a green area.

The campus provides an opportunity of showing the importance of eco-friendly everyday behavior inside and outside the companies themselves. The green consciousness is transferred to the workers, assuring they understand how their participation can help in the Sustainable Transition.

To summarize, industry and business are involved in various research areas of the campus. Their involvement reaches different extents with regard to the company's size, interest and resources. The economic subsystem participates by researching, by helping build infrastructures, and by offering their services to the neighboring areas, in exchange of some feedback about the experience. They collaborate economically as well, and attend some training programs to become more educated professionals.

It should be noted that potential partner companies are also of significant importance. They find out about M2G thanks to conferences, the Berlin Trade fair, or simply due to the Mobility2Grid's network.

Civil Society

The fourth helix is the civil society. The quadruple helix model of knowledge includes as stakeholders the government, academia, businesses, and civil society. The fourth subsystem generally includes NGOs, foundations, social entrepreneurs and citizens.

As detailed above, the Mobility2Grid campus is a Living Lab located on the EUREF Campus that studies solutions for the integration of energy and transport systems.

However, this innovative research is not limited to the EUREF area: micro smart grids must be integrated into the main grid, and the developed mobility concepts have to be included in the urban mobility network.

In a similar way, the fourth helix is not exclusively portrayed on campus. Civil society is a key element in the sustainable innovation process, also outside the EUREF Campus. Actually, user involvement is one of the elements that characterize Living Labs, since it provides a different perspective regarding innovation.

The civil society is part of Mobility2Grid and they have representation in various sections. However, most of times, citizens must be stimulated and initiated in order for them to reveal their interest in participating. In other words, when citizens are called to participate in a campus such as M2G, they are willing to help and will certainly collaborate. But if they find no guidance or ease to interact, the effect can turn counter-productive.

This is the reason why the role of the Facilitator is required. The Facilitator is in charge of providing resources for a more efficient interaction within the users and the Living Lab. The Facilitator role was first mentioned by Nyström, Leminen, Westerlund and Kortelainen in their article “Actor roles and role patterns influencing innovation in Living Labs”.

Once the facilities have been provided, in form of well organized activities and social scientists as intermediaries, the users will join the value creation process straightaway.

Some examples regarding these organized activities in Mobility2Grid are a series of workshops and gatherings that took place in 2014. They are described below:

- "*Technologie-Salon: Best-Case-Szenario Mobility2Grid 2025.*"

  Fourteen experts where invited to spend two days in the Castle Genshagen, where they were encouraged to discuss the said subject (the most likely situation in ten years from now) and develop plausible solutions. The workshop committee was composed of experts from the fields of renewable energies, power grids, electric vehicles, battery storage, politics, and infrastructures.

  During those days, the group of professionals was part of a moderated procedure with the starting point of a previously sent input paper ("The EUREF campus as a starting point for the development of a 100% renewable power supply and economically meaningful buffering of the power grid by stationary storage and traction batteries of electric vehicles.").

  They alternated discussions with dialogues and small group conversations to address technic, economic and ecological matters.

- Citizen report: "Intelligent energy and transport change in Berlin's city quarters". ("*Intelligente Energie- und Verkehrswende in Berliner Stadtquartieren*".) A randomized sample of eighty-eight Berlin citizens, of different ages and occupations, were gathered with the objective of collecting proposals or recommendations regarding the mobility and energy transition from their point of view.

In those two cases, citizens –either as experts or not– play the **Informant role**, because they "bring users' knowledge, understanding and opinions to the Living Lab", according to Nyström, Leminen, Westerlund and Kortelainen.

On campus, civil society also has the opportunity to play the **Tester role**, for instance by using the charging stations for electric cars paying a fee. There was another initiative regarding electric car sharing but it did not figure out as expected, which also represents a valid result.

Another thinkable role that citizens can perform is the **Co-creator role**. In this case, the user is considered part of the development process as a co-designer of the product or service in question. Co-creators work directly with the Research and

Development department, without the need of intermediaries. They are not only informants or testers, but close collaborators. Nevertheless, the Co-creator role is not represented yet in the Living Lab object of study.

In addition to the above, and given that the involvement of users is not limited to the campus area, there are some further aspects that should be mentioned regarding the overall civil society, of both today and the future.

- The proximity users (citizens of the Schöneberg neighborhood) will have, in the near-future, a smart grid system available. Due to this fact, they will be able to consume or generate their own electric energy proceeding from renewable sources, resulting in a cleaner and less polluted neighborhood.

  This clean energy will also be accessible for other users and made available to the main grid.

- In the long run and in society in general, this kind of projects or initiatives grant a significant evolution in relation to the decrease of air pollution (as it has already been stated, air pollution is responsible for more than 400 000 deaths in the European Union every year, as well as lung and respiratory diseases).

  The availability of local renewable energies will slow down global warming and allow a certain independence on raw materials that come from geopolitically unstable countries.

In general terms, residents find urban areas with active Living Labs attractive, because the innovation activities that take place in them are part of the value co-creation in their neighborhood.

However, this type of areas such as the EUREF Campus cannot be further designed unless understood as a model that also boosts a society transition. For this reason, citizen Acceptance and Participation are defined as some of the main objectives of the M2G research campus.

In summary, civil society is considered a very important asset of the campus. Their involvement is not as robust in all areas of the Living Lab, but citizens are usually willing to participate within the campus activities, if they are stimulated to do so.

Acceptance and Participation are two matters deeply related with the user's cooperation, and so is Education. For this reason, citizens are invited to participate in workshops and other guided activities, so that they bring their knowledge and opinions to the Living Lab. And about Education, they are welcome to attend as students some of the master programs offered on campus.

The fourth helix participates by testing some of the working devices, such as charging stations, or services, as the electric bus that drives nearby. Their feedback on these experiences if highly influential, and a method of consolidating the user as a part of the innovation process as well.

However, they are not co-creators yet. This role is strongly advisable to a further value creation on the Living Lab system.

The path of sustainability marked by this type of initiatives will also make society more aware of the need to move towards a model based on circular economy as an alternative to linear. With this economy model, products are reused at the end of their life, so that it can create further value instead of being classified as waste.

This new mentality also implies a lower dependence on raw materials, an improvement of air quality and the development of new economy models that will result in new job positions in technologically advanced sectors.

5.3 A PORTRAIT OF THE PRESENT'S AND FUTURE'S SOCIETY

Today's society is becoming more aware of the consequences that human actions entail, and is starting to make decisions in a more sustainable manner.

As part of this Sustainable Transition, Living Labs and other models of knowledge societies are suggesting alternative ways of thinking and acting. To put it briefly, society is facing a paradigm shift.

This shift is of special importance in energy matters. And an energy changeover cannot be addressed without including the mobility transition as well.

Future urban environments will be very different from the current ones, due to the need of reducing pollutants, noise included among them. Some of the following situations are very likely to take place in the foreseeable future:

- The circulation of the most polluting vehicles will have to be reduced or even forbidden,
- some activities such as Car-Sharing will gradually become more common,
- and the use of lightweight means of transport (electric motorcycles and bikes) will be encouraged.

Another matter that must be dealt with is the quality of public transportation, with an improvement of waiting times, among others. Even if the public transportation works well, a number of parking spaces is required in the city outskirts and suburbs, so that automobiles are not forced to drive in the center of the cities.

Additionally, a very important issue in reducing the CO_2 emissions and air pollutants that are harder to diminish due to logistic matters. That is to say that, in spite of decreasing (or forbidding) petrol powered vehicles in cities, a solution needs to be proposed to replace, for instance, the current food supply or trash collection systems.

The sustainable energy transition is quite related to a decentralized energy grid landscape, where complementary user load profiles (some consume while others generate) are very likely to accelerate the expansion of renewable energies as well as the implementation of a circular economy model where energy use is minimized via smart grids. Above all, the high number of expected consumers connected will contribute to security the energy supply.

The role of consumers will change: “Prosumers” are active energy consumers. They both produce and consume electricity. This new consumer profile is changing the whole electricity system.

The European Parliament defines several types of prosumers:

- Residential prosumers who produce electricity at home, generally through solar panels.
- Energy cooperatives led by citizens
- Housing associations.
- Industries whose main business activity differs from electricity generation.
- Public institutions such as hospitals or schools.

Since the cost of renewable energies has decreased in the past few years, the number of prosumers has consequently risen. In some Member States, solar panels produce electricity at the same or lower cost than the electric retail rates.

The prosumers are also connected to the grid, and their profitability is related to the share of produced energy that they consume. However, if the number of prosumers keeps rising, the situation can cause problems for grid operators and traditional power generators.

While the EU does not have any specific regulations about prosumers, the Energy Efficiency Directive, the Renewable Energy Directive and Guidelines on State Aid do cover some stipulations related to electricity producers in a small scale.

Nevertheless, the European Parliament is working on new energy regulations to encourage prosumers to invest into generation capacity for themselves.

In any case, a future supply structure can no longer be perceived from the perspective of the major power plants and energy corporations. The urban environments’ schemes are changing as well, gradually including new mobility solutions and new concerns regarding pollution and, ultimately, the natural environment.

But for this reshaping to be done correctly, the citizen awareness and understanding must reach greater levels.

5.3.1 CIVIL SOCIETY AND LIVING LABS

Living Labs are model platforms to understand the users' needs and expectations, either as residents or citizens.

Besides, user's involvement is essential in the value co-creation process, so user participation benefits all enablers (government and public sector, third helix), providers (academia, first helix), utilizers (industry and business, second helix), and certainly the users themselves (fourth helix). This manner of denoting the different subsystems interacting in a Living Lab is used by Leminen, Westerlund and Nyström in "Living Labs as Open-Innovation Networks.

In Living Labs, where the four stakeholder subsystems are present, academia and universities collaborate with systematic knowledge augmentation and innovative working methods; the economic subsystem receive long-term benefits due to the synergies and the different approaches that are offered in the Living Lab; the third helix comprises the government and public sector, who facilitate the inspiring vision with funds and proposed common goals; and the users, who are usually bonded to the Living Lab because they have a moral claim on the innovation activities and not because of a contract, habitually play roles as Informant, Tester, Contributor or Co-Creator.

There is another distinction made by Ståhlbröst, Ihlström Eriksson and Bergvall-Kåreborn regarding the types of users coexisting in a Living Lab. Instead of just referring to civil society as users, there are analyzed as three different types: technology users, technology affectees and problem owners. Each type is briefly described below:

- Technology users: the ones that will be actually making use of the innovation once it is entirely implemented. These users collaborate providing their needs and goals. This stakeholder has a moral claim on the innovations developed in the Living Lab, as they might be subsequently implemented in their city.

- Technology affectees: some groups of people can be affected by a certain technology without being necessary users of it. They live in the Living Lab area or visit the buildings but do not interact with the innovative technology. They do not usually participate or influence the development of the technology.

  An important task of the Living Lab is finding ways to stimulate these affectees to become technology users and contribute to the innovations.

- Lastly, problem owners: They are the ones that find problems in their context, or even start with the Living Lab activities to solve an issue that they encounter. They participate actively in the Living Lab activities because they long to have these problems solved.

Nowadays, there are more than 400 active Living Labs, including countries like Finland, Sweden, South Africa or Spain, and they all share the overall purpose of developing user innovation –user-centered innovation– for different stakeholders and, most importantly, in real world surrounding conditions.

The role of Civil Society in Mobility2Grid and differences with other Living Labs

On Mobility2Grid, civil society plays two very differentiated roles: Tester role and Informant role. They are testers because they check innovative products or services in real-life environments. They are also informants because they give their opinions and knowledge and bring it to the Living Lab.

The Contributor and Co-designer roles are not as clear, but will gain importance in the following phases of the project.

Regarding the different types of users proposed (Ståhlbröst, Ihlström Eriksson and Bergvall-Kåreborn), the most represented group is the technology users, composed of the citizens form the surroundings of M2G. There are also technology affectees, since every person that visits the campus might not be fully informed about the procedures and processes that take place there.

The main difference between M2G and some other urban Living Labs is that citizens is, in this case, not a synonym of residents. Buildings on Campus are mostly offices or research areas. There are restaurants too, but not houses.

If residents where included as a subgroup of the civil society, the Mobility2Grid Living Lab would be more similar to Suurpelto, an urban Living Lab in the city of Espoo in southern Finland. In both Suurpelto and M2G, workplaces, culture and leisure activities are within walking distance, with the additional benefit of being in an ecological city or urban area.

Another approach to optimize the use of the M2G Living Lab and to co-create value would be introducing projects or activities after office hours. Considering that the

whole campus is solely powered by renewable energies and these suffer from variable fluctuations (solar energy and wind power are not always predictable), there is a certain amount of electricity that is produced but not consumed at the same time –even when this energy is managed by a smart grid–. Therefore, an increase of storage facilities is required, in order to use that energy in times of need. See Figure 10 on page 25: renewable energy (generation and consumption) fluctuations during a week.

However, it is always preferable to consume that energy when it is produced, because of the performance of batteries and other devices involved.

One possible solution to this issue could be offering the charging stations for electric vehicles at a different rate at night, to encourage nearby citizens to use the facilities after working hours.

The micro smart grid minimizes the use of energy thanks to the complementary load profiles, as some users consume while others generate. In any case, the most efficient form of making use of this system is consuming the energy at the same time that it is being generated.

5.3.2 CITIZEN SURVEYS

As a part of the present work, a survey aimed at civil society was carried out to inquire into the citizens' perception with regards to electric Mobility and Smart grids.

The citizen survey was performed with a bilateral objective.

a) In the first place, it is about ascertaining the degree of knowledge of society about the seriousness of the sustainability issue.

   If citizens are not aware of the gravity of the situation, the decisions that they make (or the changes that they apply in their behavior) will not be focused on collaborating with the sustainable transition.

b) Secondly, the preferences of the respondents regarding the future mobility concept and the smart grid implementation are evaluated.

In Annex 3 the survey scheme is attached (page 107)

It should be noted that researchers from Topic Field 1 carried out a similar study regarding "Intelligent energy and transport change in Berlin's city quarters", where 88 randomly chosen Berlin citizens met to discuss future mobility solutions for the city of Berlin and made some recommendations from their user-biased point of view.

However, in this case, a wider scope was preferred, so a total of 285 citizens from 17 countries were surveyed. The shares were the following:

Country	Number of answers	Country	Number of answers
Spain	160	Ireland	2
France	47	Colombia	2
Germany	37	Luxembourg	2
Australia	7	Italy	2
Portugal	4	Poland	2
United Kingdom	4	Denmark	1
Morocco	4	Austria	1
Belgium	3	Albania	1
Switzerland	3	China	1
Canada	2		

Table 1: Countries that took part in the citizen survey

The average age of the respondents is also different from that in Berlin. The group of 18 to 25 is the one that has more representation, while only one person over 66 years old responded. About the gender distribution, there are 52 more men than women.

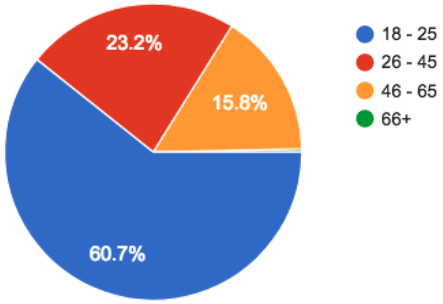


Chart 1: Age distribution in the citizen survey

Sex	Number of answers	Share
Female	115	40,4 %
Male	167	58,6 %
Prefer not to say	3	1,1 %

Table 2: Gender distribution in the citizen survey

Respondents were also asked for their current job occupation, where most of them answered as students or recent graduates.

a) As it was explained before, one of the goals of performing this survey was finding out how well informed society is, regarding pollution in general, population density in cities and pollution due to transportation.

To the question: "Did you know that more than 400 000 people are estimated to die prematurely each year in the EU from air pollution? (source: EU Commission)", 220 of respondents answered negatively, while only 65 previously knew the number of yearly deaths.

About the population density in cities (60 % of people in the European Union live in areas with a population greater than 10 000 inhabitants, while this percentage will increase to 80 % in 2050, also according to the European Commission), 196 people out of 285 were not aware of this information (that is 68,8 %).

Lastly, around half of the people were aware that 40 % of CO_2 emissions from transport are produced in cities, and is are 70 % of other air pollutants.

Only 28 people out of the 285 respondents answered "Yes" to the three questions.

On tables 3, 4 and 5, results about the former awareness questions:

	Number of answers	Share
Yes	65	22,80%
No	220	77,20%

Table 3

Number of answers	Share
89	31,20%
196	68,80%

Table 4

Number of answers	Share
142	49,80%
143	50,20%

Table 5

On charts 2, 3 and 4, the answers to the awareness questions:

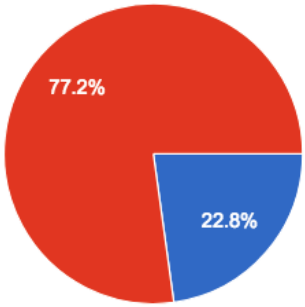


Chart 2: Answers to Q1

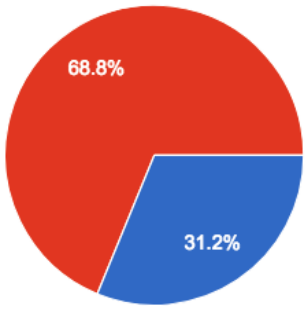


Chart 3: Answers to Q2

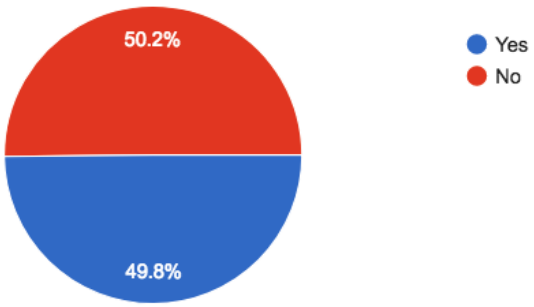


Chart 4: Answers to Q3

According to charts 2, 3 and 4, the first issue to solve with regard to the sustainable transition is the lack of knowledge that a large part of society shows about the magnitude of the problem. Knowledge is certainly needed before awareness.

b) In the second part of the questionnaire, citizens were asked about their preferences regarding future urban mobility and about theoretical smart grids in their city quarters.

An interesting part of the study has been analyzing the additional answers proposed by some of the respondents.

The first question in section b) was, including possible answers:

"Which of the following measures would you say is most important in the future urban mobility scenario?

- Strengthen general pedestrian and bicycle traffic
- Develop a private Car-Sharing network to reduce the number of private vehicles
- Develop company-managed Car-Sharing networks (e.g. Car2Go, etc.)
- Grow the public transport network with shorter waiting times and more available destinations
- Other"

And the responses were the following:

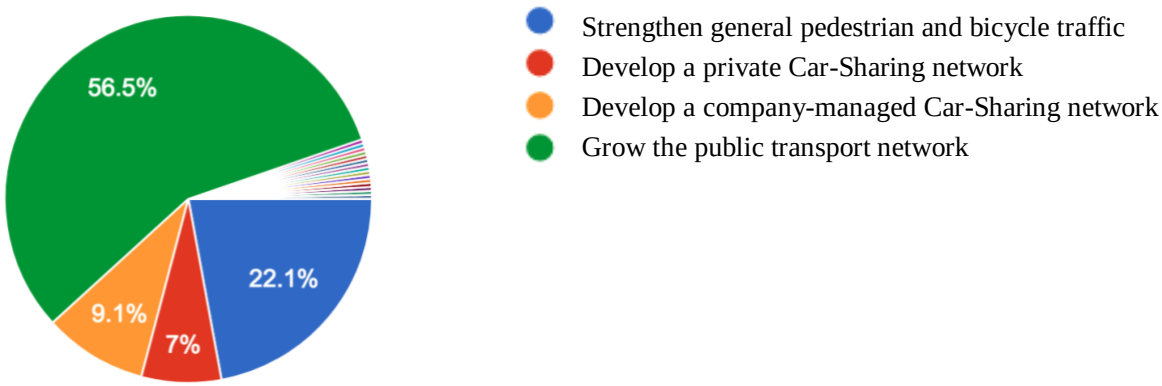


Chart 5: Measures in the future urban mobility scenario

Out of the 285, 63 people are of the opinion that pedestrian and bicycle traffic should be strengthen, which could be done improving the quality of the biking lanes or walking paths, as well as the number of them. 16,1 % consider that the Car-Sharing networks should be developed. But more than half of the respondents think that a well-managed public transport is key regarding future urban mobility.

Some other answers that were provided were: "Increase of the number of electric vehicles", "design the distribution of resident sites with regard to job sites", so workers reduce the use of private vehicles, "improve public transport information because people are not informed", "Education and awareness" and several times a combination of some of the given four options.

An interesting response goes as follows: "Only the first proposal allies, but I wanted to add a comment. Solutions based on motorized vehicles may seem a good idea, but won't solve the problem or reduce the emissions. For example, car sharing makes it easier to travel, fewer cars on the road, cheaper, so more and more people will want to use that mean of transport and the number of cars won't reduce. It is a good short term solution, but such a problem won't be solved with such a simple solution.", says a French engineering student.

To summarize, the greater part of the respondents consider that the future urban mobility solution will not characterized by private vehicles as the present solution. They are of the opinion that public transportation, the use of bicycles and displacements on foot will gain importance instead.

Next question implied: "If you had to choose now an alternative to diesel/petrol powered cars, what kind of transport would you prefer?"

And the given answers were "Hybrid vehicles, Natural gas vehicles, electric vehicles of hydrogen vehicles.

Option	Number of answers	Share
Hybrid vehicle	79	27,7 %
Natural gas vehicle	20	7 %
Electric vehicle	137	48,1 %
Hydrogen vehicle	47	16,5 %
Other	2	0,7 %

The two extra answers were:

- "Gas for buses and hybrid for others, but as a transitional thing"
- "Bicycling"

Table 6: Chosen alternatives to petrol/diesel powered vehicles

The electric car is the most voted answer, shared by almost half of the surveyed.

However, it should be noted that more than there is a certain number of respondents that imply that they have no interest in buying an electric vehicle: 5 people (1,8 %) in Chart 6 and 10 people (3,5 %) in Chart 7.

When they were asked about the most important condition that had to be met for them to purchase an electric vehicle, they were given the following options:

- Low acquisition and exploitation costs
- Autonomy greater than 500 km
- That it's powered by electricity from only renewable energy sources
- Availability of charging stations
- I would never buy and electric vehicle
- Other

And the answers are reflected in the following chart:

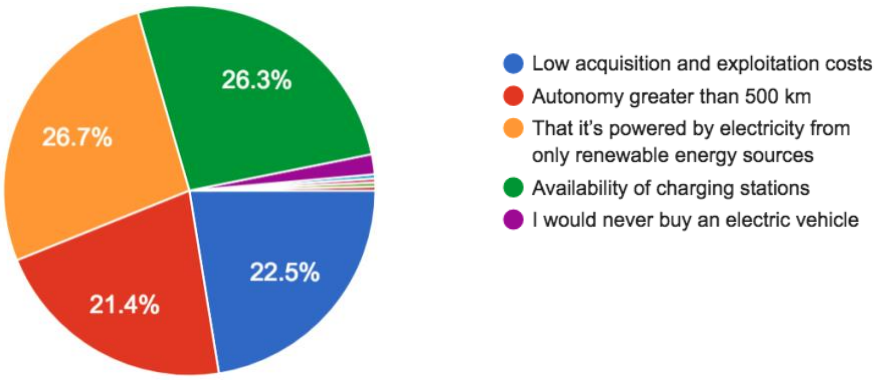


Chart 6: Most important conditions to be met to buy an electric car in the future

Other interesting responses were: "Options 2-4", "options 3 and 4" and "Sustainability of the battery (lithium is not sustainable, we don't have enough on Earth to equip every car with lithium)"

The most voted answer here was "That it is powered by electricity from only renewable energy sources", which makes sense, because most of the citizens that participated in this survey (61,8 %) consider that they would acquire an electric vehicle for ecological reasons (See Chart 7). And charging it with electricity that has emitted of CO_2 during its generation, would not be in accordance with the above.

To sum up and being the former the most popular answer, inversion and exploitation costs (first option: 22,5 %), autonomy (second option: 21,4 %) and availability of charging stations (fourth option: 26,3 %) are quite close in number of votes.

Another question asked was: "What would encourage you to buy an electric car?" To what citizens answered:

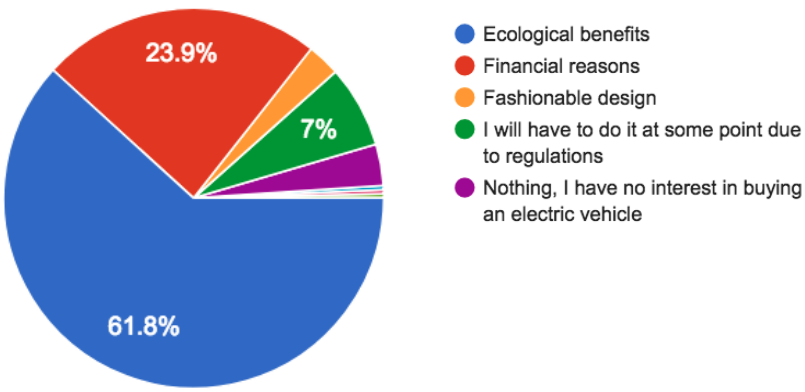


Chart 7: Reasons to but an electric vehicle

Citizens point as their main motivation "Ecological benefits". Nevertheless, the share of respondents who would purchase an electrical vehicle is the acquisition or exploitation costs ("Financial reasons") is not insignificant either.

Again, some of the surveyed would never buy an electric vehicle.

A different answer from the above was: "the development of a new energy production source, allowing us to reduce the electricity production environmental costs. An electric car is an investment, it costs a lot to produce (batteries, rare metals, etc.)"

That answer points out a very important fact: If electric cars pollute considerably during its manufacture, does it really make sense buying one for *ecological reasons*?

Moving to the preferred charging technology of the respondents:

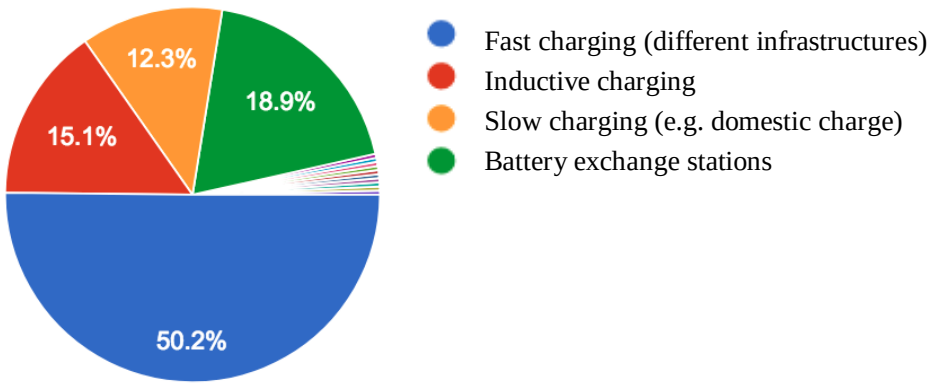


Chart 8: Charging technologies for electric vehicles

The remaining 3,5 % that answered none of the above, were either not informed and did not know what to choose, or proposed another solution such as "A technology that only uses renewable energy sources", "The one that keeps the lifetime the longest".

It seems like fast charging presents itself as the most attractive charging technology but, as one of the surveyed citizens commented, does it assure no damage to the battery? Also, it should be noted that not all charging infrastructures are equal:

- Standard charge at home or in the office at 3,7 kW: it takes between 8 and 10 hours for the battery to be charged.
- Quick charge (in the office or at public parking spaces at 7,4 kW.
- Rapid charge (on public roads and electric stations at 22 – 50 kW): the battery will be charged in less than an hour.

How often does the surveyed sample use Car-Sharing?

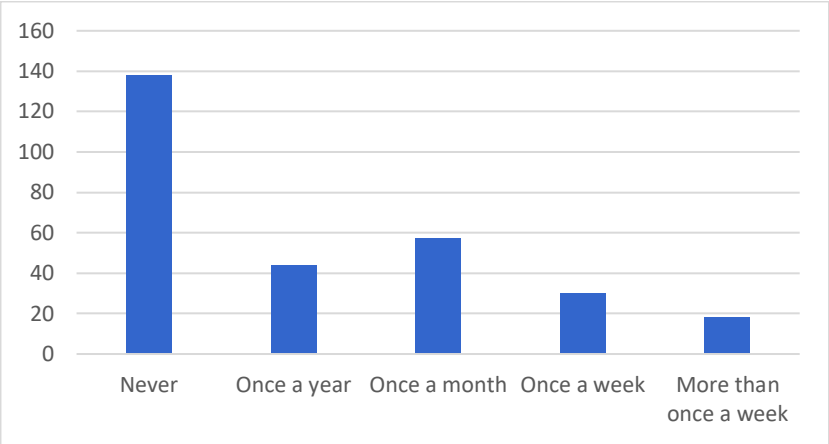


Chart 9: Frequency of use of Car-Sharing

And the considered most important aspects regarding this methodology:

Option	Number of answers	Share
Privileges when parking	32	11,2 %
Lower prices than private vehicles or taxis	135	47,4 %
Fare depending on distance and not time	18	6,3 %
That it's powered by energy from renewable energy sources	50	17,5 %
That it covers a large area, not only city center but also suburbs	41	14,4 %
Other	9	3,2 %

Table 7: Most important aspects regarding Car-Sharing

Some of the benefits of using Car-Sharing are the above, and also having fewer cars in cities and not having to own a car.

Four people answered that they do not know Car-Sharing service and needed more information.

In this case, this answer is not based on future expectations but on the current situations. The question shows that the use of Car-Sharing is mainly motivated by advantages in **the costs**.

The next two questions are related to the idea of prosumer that was described earlier in this chapter.

"Would you install clean power generation systems (solar panels, wind mills…) in your property for your own consumption?"

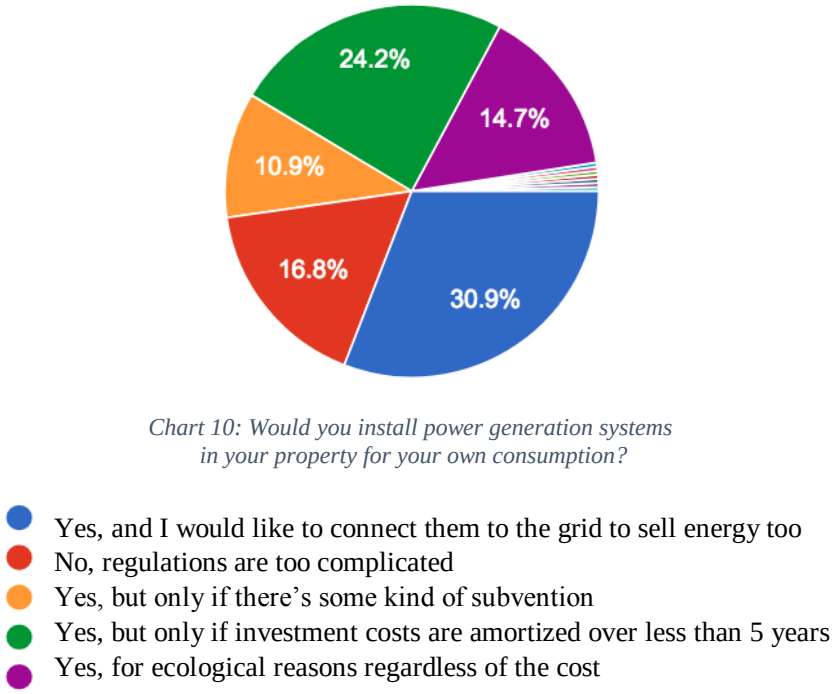


Chart 10: Would you install power generation systems in your property for your own consumption?

Some other interesting suggested options include: "Yes, as far as it's not taxed", "No, dedicated industrial systems are more efficient than small house systems", "Yes, but only if the investment costs are amortized over the next 5 years, including grey energy and effective (not theoretical) recycling possible", "Yes, in order to be self-sufficient".

It could be said that only a small share of respondents would install clean power generation systems for ecological reasons (14,7 %). In the rest of the answers, they submit again economic o legal reasons.

Finally, citizens were asked if they would belong to an energy cooperative in their neighborhood, one that obtains (and shares via micro smart grid) energy from renewable sources and is not connected to the main grid. The following possible answers were given:

- Yes, if price is lower than the electric rate by 5 %
- Yes, for ecological reasons, even if the price remains the same
- Yes, for ecological reasons, even if the electric rate is 10 % more expensive
- No, there will always be a small supply risk
- Other

Obtaining the following results:

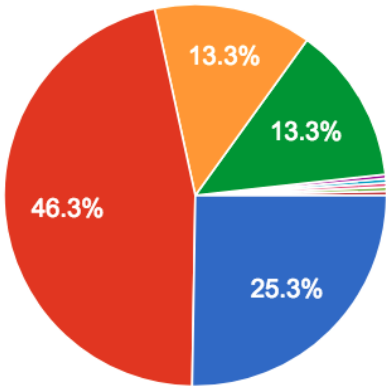


Chart 11: Would you belong to a sustainable energy cooperative in your neighborhood?

Where some additional answers were: "No, you have to be connected to the grid", "Only if they assured me complete transparency", "No, I already belong to one".

Again, only 13,3 % of the respondents would be willing to pay more for their energy bill for *ecological reasons.* This means that the cost is the element that the respondents indicate (one way or another) as key in the Sustainable Transition.

In conclusion, people seem quite willing to change their ways of living, mostly for economic and ecological reasons, but some decisions that they would take, would not be correctly substantiated because of the lack of knowledge present in society (Chart 2, 3 and 4).

6 CONCLUSIONS

A new way of working together is required to face the sustainability challenge: neither academia, businesses, the government nor civil society can face this problem working on their own.

In the process of moving towards a more sustainable and environmentally aware society, initiatives like Mobility2Grid represent an important help.

There are various groups of stakeholders involved in the sustainable innovation process about finding an integrated system of energy and transport. In the following table, the four groups are shown, as well as their roles in society and on Campus. It should be noted that the roles that each subsystem plays within society is also applicable on M2G, with the exception of civil society as residents.

Stakeholder subsystem		In society	On M2G Campus
Academia and universities	First helix or providers	Obtain knowledge Transfer knowledge	Experiments with industry Privileged contact with civil society
Industry and business	Second helix or utilizers	Provide society with product or services and job positions	Collaborates with university researchers Benefits from the proximity of users
Government and public sector	Third helix or enablers	Promotes laws and regulations Ensures laws are embraced	Funds the innovative project Makes people more aware
Civil society	Fourth helix or users	Buyers, residents, students, users of public transport, etc	Profits from knowledge and awareness Participate as Informants and Testers

Table 8: Stakeholders present on Campus. Roles in society and on Campus.

Universities are responsible for obtaining knowledge and transferring it. On campus, they work together with researchers from the economic subsystem and study the citizens' expectations and needs. They are also in charge of education programs on M2G and play an important role as they increase their awareness on sustainability issues.

The industries involvement depends on their size, resources and interests. Companies collaborate economically and attend some professional training programs. They also research together with university in an environment that is close to the user: this also presents itself as a matchless opportunity for start-ups.

International, national and regional governments compose the third subsystem. They participate by promoting laws and ensuring they are embraced, and they fund the project, which shows that they foster sustainable innovative ways of living.

Citizens on Campus play the Informant role, because they provide users' knowledge and opinions to the Living Lab. The also play the Tester role by using, for

instance, charging stations or the e-bus that drives in the neighborhood. Their feedback on these experiences if of great importance, and a way of reinforcing the user as a part of the innovation process.

There is also a fifth helix highly related to all the activities that take place on campus: the natural environment. The sustainability aspect not only is key to make the socioecological sustainable transition possible, but also helps understand the motivations of most of the Living Lab actual and potential partners and to see the interconnections between them, economically and socially.

As described on these pages, society is facing a paradigm shift highly related with energy issues. And the energy changeover cannot take place without addressing it together with mobility.

Future urban environments will involve fewer or none petrol fueled cars, while car sharing of electric vehicles will gain importance. Also, public transportation is likely to be further developed and pedestrian and biking traffic strengthened as well.

The energy transition is related to a decentralized energy grid with complementary user load profiles that will increase the user of renewable energies. The role of consumers will evolve to "prosumers", who both produce and generate energy.

But for this reshaping to be done correctly, the citizen awareness and understanding must reach greater levels. Knowledge comes however before awareness, and a citizen survey has shown that civil society is really uninformed about some worrisome matters. They were asked is they were aware of some information provided by the ED: more than 400 000 people die yearly in the EU due to excessive air pollution (Q1), 60 % of people in the EU live in areas with more than 10 000 inhabitants, and this percentage will increase to 80 % in 2050 (Q2) and 40 % of CO_2 emissions from transport are produced in cities, and so are 70 % of other air pollutants (Q3). The results were:

	Number of answers	Share
Yes	65	22,80%
No	220	77,20%

Table 9: Q1

	Number of answers	Share
	89	31,20%
	196	68,80%

Table 10: Q2

	Number of answers	Share
	142	49,80%
	143	50,20%

Table 11: Q3

A total of 285 citizens were asked some questions regarding the sustainable transition, and one of the conclusions obtained is that they are willing to change their behavior or their ways of living but mostly because of financial reasons rather than ecological. For instance, when they were asked if they would belong to an energy cooperative that obtains (and shares via micro smart grid) energy from renewable sources and is not connected to the main grid. The results were as follows:

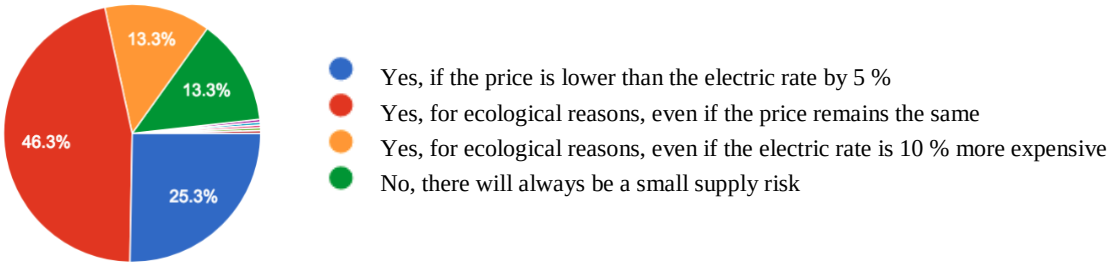


Chart 12: Would you belong to a sustainable energy cooperative in your neighborhood?

Just 13,3 % of the respondents would be willing to pay more for their energy bill, even though it would all be powered by renewable energies. The cost is also key in the Sustainable Transition, from the consumers point of view.

To summarize, knowledge transfer is essential to meet the sustainable goals that concern the whole society. The awareness of population will further and they will therefore be able to make substantiated decisions about future energy solutions, including mobility aspects.

7 REFERENCES

[8]. United Nations General Assembly, "Transforming our world: the 2030 Agenda for Sustainable Development". New York, 25-27, September, 2015.

[MARK12]. Jochen Markard, Rob Raven, Bernhard Truffer, "Sustainability transitions: An emerging field of research and its prospects". July 2012.

[CLAR07]. W. C. Clark, "Sustainability Science: A Room of its Own," *Proceedings of the National Academy of Sciences of the U.S.A.* 104 (2007): 1737–1738.

[PAME09]. Pamela Matson, "The Sustainable Transition". 2009.

[9]. https://datos.bancomundial.org/

[10]. https://www.un.org/sustainabledevelopment/sustainable-development-goals/

[11]. https://www.uv.es/uvweb/evomobile/es/proyecto/presentacion/presentacion-1285919769066.html

[CHES03]. William., Chesbrough, Henry (2003), "Open innovation: the new imperative for creating and profiting from technology"

[12]. "Artículo sobre las ventajas de la innovación abierta, sobre algunos de sus modelos y sobre su role en las políticas públicas de innovación", espacio digital Cynertia, noviembre de 2009.

[BOGE10]. Bogers, Marcel; Afuah, Allan; Bastian, Bettina, "Users as innovators: A review, critique and future research directions", Journal of Management, 36 (4). 2010.

[13]. http://www.mtbinnovation.com/user-innovation/

[14]. www.livinglabing.com

[15]. Knowledge Societies Policy Platform, "Handbook – Chapter 4: Conceptual Framework - Structuring Knowledge Societies Policy". Retrieved from 'unksoc.org'

[CARA12]. Carayannis, E. G.; Barth, T. D.; Campbell, D. F. J. "The Quintuple Helix innovation model: global warming as a challenge and driver for innovation". 2012.

[CARA10]. Carayannis, E. G. & Campbell, D. F. J., "Triple Helix, Quadruple Helix and Quintuple Helix and How Do Knowledge, Innovation and the Environment Relate To Each Other? A Proposed Frame- work for a Trans-disciplinary Analysis of Sustainable Development and Social Ecology."

[16]. Rábago Marín, J., "The Business Model Canvas" (Innovation and Entrepreneurship Lecture Notes). 2012. Retrieved from 'sifo.comillas.edu'

[17]. Borkert, M., “Qualitative Market Research” (Prototyping Eco-Innovation Lecture Notes). 2017.

[18]. Fortschrittsbericht. Mobility2Grid: Energiewende und Elektromobilität in vernetzten urbanen Arealen. 2015.

[BÖHM17]. Konstellationsanalyse im Rahmen von AP 1.3 – Partizipation. Technische Universität - Dr. Birgit Böhm unter Mitarbeit von Simone Kreklau. 2017.

[19]. www.cleanenergywire.org

[20]. https://blog.oxfamintermon.org/

[21]. http://www.flourishingbusiness.org/

[22]. https://www.youtube.com/watch?v=0D4lauPi0SY

[23]. Fraunhofer Institute for Solar Energy Systems

[24]. AG Energiebilanzen e.V.

[25]. Bundesregierung 2014, Energie der Zukunft. Eine Gesamtstrategie für die Energiewende, Berlin, S. 4)

[SURA14]. Surabh P., Bhola P., Guin K., “Reviewing the Knowledge Systems of Innovation and the Associated Roles of Major Stakeholders in the Indian Context”. 2014

[26]. https://www.innoz.de/en

[27]. https://inno2grid.com/

[28]. www.bosch.com > e-Scooter Sharing in Berlin – with Coup | Bosch Global

[29]. https://www.fona.de/de/forschungscampus-mobility2grid-nimmt-innovativeladestation-in-betrieb-23294.html

[30]. Forschungscampus – öffentlich-private Partnerschaft für Innovationen. Dezember 2014.

[31]. https://www.forschungscampus.bmbf.de/forschungscampi

[32]. https://bi-gasometer.de/about/

[33]. https://www.investopedia.com/terms/b/businessmodel.asp

[34]. https://www.unendlich-viel-energie.de/mediathek/hintergrundpapiere

[KRON18]. A. Kronsell, D. Mukhtar-Landgren, “Experimental governance: the role of municipalities in urban living labs.” March 2018.

[35]. Bürgergutachten "Intelligente Energie- und Verkehrswende in Berliner Stadtquartieren", Berlin, 2014.

[36]. Prof Dr. H. Dienel, Dr. B. Böhm, A. Manthey, E. Hernandez., " Technologie-Salon: Best-Case-Szenario Mobility2Grid 2025". 2014.

[STÅH13]. Ståhlbröst, A. "A Living Lab as a Service: Creating Value for Micro-Enterprises through Collaboration and Innovation." November 2013.

[37]. Agentur für Erneuerbare Energien, Renews Spezial, Ausgabe 58, Juni 2012, S. 12

[38]. https://repositorio.comillas.edu/rest/bitstreams/99770/retrieve

[39]. https://ec.europa.eu/growth/industry/sustainability/circular-economy_en

[40]. "Paquete sobre la economía circular: preguntas y respuestas". Comisión Europea – Hoja informativa. Bruselas, 2015.

[41]. "Questions and answers on the EU Clean Air Policy Package". European Commision – Memo. Brussels, 2013.

[42]. http://www.europarl.europa.eu/

[LIND12]. M. Lindberg & M. Lindgren & J. Packendorff. "Quadruple Helix as a Way to Bridge the Gender Gap in Entrepreneurship: The Case of an Innovation System Project in the Baltic Sea Region." June 2012.

[JUUJ13]. S. Juujärvi and K. Pesso: "Actor Roles in an Urban Living Lab: What Can We Learn from Suurpelto, Finland?" November 2013.

[43]. "European Commission swears oath to respect the EU Treaties." May 2010.

[44]. www.bundesregierung.de

[NYST14]. A. Nyström, S. Leminen, M. Westerlund, M. Kortelainen, "Actor roles and role patterns influencing innovation in living labs". January 2014.

[LEMI12]. Leminen, S., Westerlund, M., Nyström, A., "Living Labs as Open-Innovation Networks". September 2012.

[ELMQ18]. T. Elmqvist, X. Bai, N. Frantzeskaki, C. Griffith, D. Maddox, T. McPhearson, S. Parnell, P. Romero-Lankao, D. Simon, M. Watkins, "Urban Planet: Knowledge Towards Sustainable Cities". Cambridge, 2018.

8 ANNEXES

8.1 ANNEX 1. BROCHURE OF RESEARCH CAMPUS MOBILITY2GRID

Forschungscampus Mobility 2 Grid EUREF

Renewable Energy and Electromobility for Smart Urban Environments

The proliferation of **electric vehicles** provides a unique opportunity to develop **integrated energy and transport systems**. The Mobility2Grid Research Campus, situated within the EUREF quarter in Berlin-Schöneberg, will assess and implement innovative solutions to ensure an affordable and secure supply of **electricity, heat and transport** fully based on **renewable energy**.

Research Topics

- Integrating commercial and private **electric road vehicles** into **decentralised energy systems**
- Creating a **reference quarter** to showcase synergies between electromobility and power grids as well as heat distribution networks

Mobility2Grid Timeline

Concept Development | Implementation | Advancement/ Exploitation

Main phase I

01/2016 – 01/2021

Main Goals

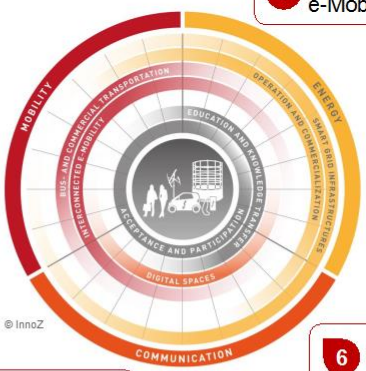
- Research and development of new technology options
- Analysis and evaluation of social acceptability and political environment
- Economic uses of research results
- Development of new education and training formats

Topic Fields

1 Acceptance and Participation

2 Smart Grid Infrastructures

3 Interconnected e-Mobility



6 Digital Spaces

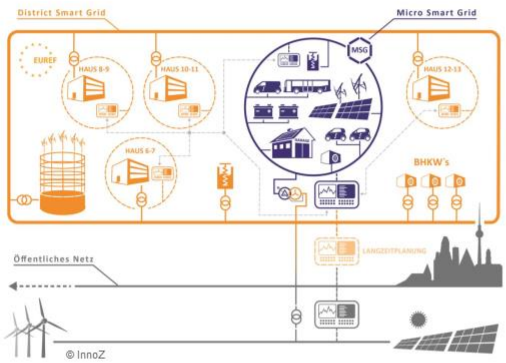
4 Bus and Commercial Transportation

5 Education and Knowledge Transfer

7 Operation and Commercialization

A Real Life Test Bench: M2G Micro Smart Grid

Planned expansion of the Micro Smart Grid 2020:



The Research Campus Mobility2Grid is coordinated by the **Mobility2Grid e.V.** association.
Further information: **www.mobility2grid.de**

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Chairman: Prof. Dr.-Ing. Dietmar Göhlich and Carl Tille **Manager:** Franziska Kaiser [Status: 11-2016]

8.2 ANNEX 2. EXPERT INTERVIEWS – ACADEMIA

8.2.1 TU BERLIN. SENIOR RESEARCHER TF 1

As you already know, the topic of my thesis is "The Research Campus Mobility2Grid: An Analysis on the Stakeholders Involved in the Sustainable Innovation Process". Regarding this innovation process, the user has to be involved so that the developed products and services are accepted within the civil society. If they don't need the product to be provided the innovation process loses its purpose. You are a Senior Researcher working in Topic Fields 1 and 5, both quite related to the user, so you are more informed about the extent to which the user participates in the innovation process in the Research Campus Mobility2Grid: the way they work with businesses and with the TU Berlin. Could you tell me more about TF1?

In the *Theme Felder 1* (Topic Field 1) we have two main topics. One is the Research about Acceptance about M2G and the other is about Participative Formats.

We are two partners in this project and it is divided in these two parts. The other partner is researching about the Acceptance, preparing and doing quantitative and qualitative research, in order to find special user examples. Then they try to interview the workers (users). As an example, the e-Bus on the EUREF Campus has a new charging station, which is bidirectional. There are several drivers of the e-Bus and also passengers and in this case the research focuses on the experiences that they all have on the e-Bus: whether they find the technique useful and practical; they expectations that they have; if they find it harder to use… All of this once they have used it for some weeks or for some months.

The other topic is Participation. In this area, we try to make the stakeholders and the workers of the companies of the EUREF Campus participate, because the EUREF Campus is an area where people work (they do not live there). There are no buildings for living, there are buildings for offices. We are looking into topics such as the development of an EUREF Campus Mobility App and then into workshop formats, *Werkstatt* in German, where the workers in the companies receive information about the planned techniques (for example the App) and they can give their feedback: what they want, what they need, what they think about it… Afterwards, engineers know how to keep working to improve these techniques.

Is this always regarding the people that are working on the Campus?

At the moment, we are only working with the companies because there we find

the people that are working on the Campus. The Campus is our *Real Labor* as we say in German (Living Lab). Maybe in the second phase of the project we will work with citizens in other areas, but that is another format we will work with in the next year: it is a format that is called *Bürgergutachten*, like a citizen report. We are planning to do it with the e-Bus. In this format, we have randomized samples that you take in the *Einwohnermeldeamt* (Resident Registration Office) and then you can reach "normal" people from the streets where the e-Bus drives to let them participate and know their experience and what should be redesigned.

So that is the planned new format for the coming year, but the bus is already driving outside the Campus, isn't it?

The bus is already driving outside the campus and around the city, but the e-Station where it is charged it's inside the EUREF area.

Now, I would like to ask you some questions about the *Konstellationsanalyse* document. My thesis focuses on the roles of the stakeholders involved in the Research Campus M2G. I am more interested in understanding the perspectives that each of the four helices have: the government, the business, the TU Berlin and the civil society. However, in this figure (Figure 14), do the circles refer to companies that work together on similar topics but don't share a business plan?

Not exactly. We have some companies and some scientific stakeholders that are working together but it is not in a classical way: they don't have a specific product in Mobility2Grid. The EUREF AG[1] was very successful, with these buildings on the EUREF Campus that are working together, as an example, for a good mobility concept on the Campus: there are only electric vehicles allowed, some areas are destined to be used by only people and not vehicles… The corporation is functioning well, however, in some areas where particular products are being developed they (companies) don't work together so closely.

Notice that the cooperation with the government is also important, but the *Bezirksverwaltung* (district administration) or the *Senatsverwaltung* (Senate) sometimes have other interests different form the stakeholders on the EUREF Campus. The other

[1] The EUREF AG is a real estate project developer in Berlin with a connected architecture and construction management office. Since acquiring the site around the gasometer in Berlin-Schöneberg in 2007, Reinhard Müller and his team have been developing the EUREF campus here.

point is that the government normally needs a very long planning phase and very long processes to make decisions in a city. These processes to find new rules or regulations for things that could be innovative products are very complex. So basically, you cannot carry out this product because the regulations are not ready in time. This is a problem everywhere, not only in the EUREF Campus.

So you can see that this (pointing at the circle on the top left) functions very well. This, however, (top corner on the right) is more the idea of the future and here (bottom part) we can see some obstacles that need to be solved to be able to develop your ideas. Sometimes the problems are as simple as not having enough vehicles to be charged in a bidirectional way.

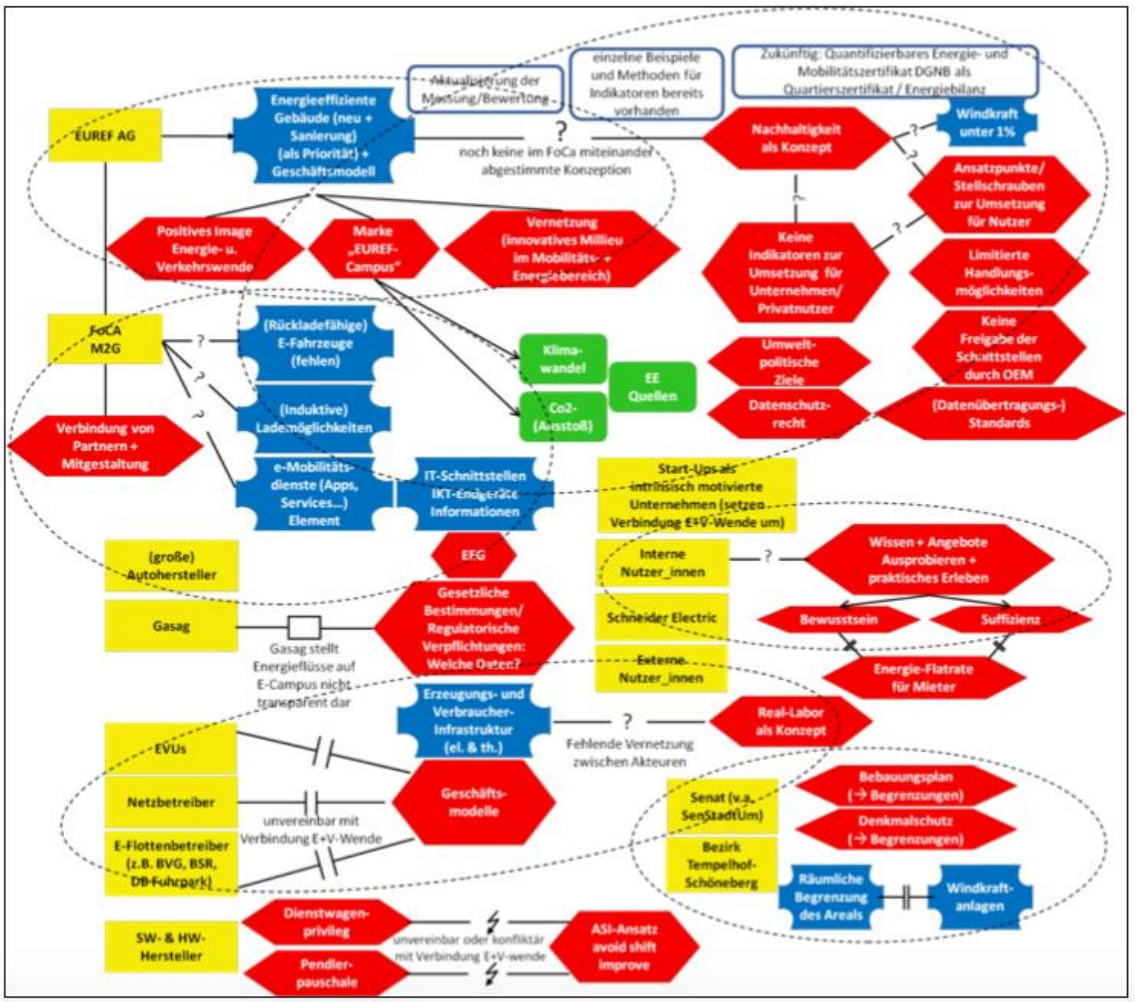

Figure 14: Current Constellation EUREF Campus as a Model Quarter for the Connection of Energy and Transport

I have been told that not many manufactures are developing the bidirectional charging devices for their vehicles. They don't know yet if it's going work or be successful, so they are using the research of the academia in the M2G Campus for future applications.

Yes, sometimes this happens. In the pre-phase of the Research Campus M2G, in 2014, we did a *Bürgergutachten* about Mobility2Grid. We invited in a randomized way people in Berlin and worked with them for two days on questions about M2G. In a hypothetical way, we asked them whether they imagined a smart grid in their neighborhood, and if they were invited to use their electric car in this smart grid. They were asked about their expectations on the model, among other things. And it works, we can work with these "normal" people and ask them about these things.

That's very interesting. The participation of the civil society thanks to TF1 is really what makes Mobility2Grid a Living Lab. But there are other partners involved. Regarding the industry and business helix, would you say that small companies such as startups are more connected to the user or do they have the same involvement than the other business that work on the Campus?

I am not an economist so I can only answer this question from my perspective as a social scientist. On the one hand, we have the kind of organized civil society. This are the organizations *Vereine, Verbände* (clubs/associations) and so on*;* on the other hand, we have the ordinary people like you and me: we are customers and users of the product.

I think that if you have a startup, you have an idea and you have a product which you start to develop. I think you could be considered closer to the people. A big company usually has marketing and product development experts and they perform studies before they launch a product. They are using the safe way, and the startups are trying to do something, then having experiences with the users and then adapting the product until the users say that the product is good enough. I think that maybe your question means that an area like the EUREF Campus is better or easier to come in contact with the user. So I would say yes, because it is possible to bring a product (like an electric bike) to the Campus and then being nearby the users.

Emmy is an example of a very successful startup that has gone bigger and bigger and is leaving the Campus because the area is too small.

But there are also bigger companies on the EUREF Campus. It's easier for them being on the Campus and profiting from the information that all the other companies provide.

Yes, I think that's true. They can profit from this close companies and people. They can organize meetings together in an easier way and, on the Campus, you have many companies with renewable energies, electromobility… They are working on these fields and they have common interests and important perspectives. I think that startups can profit from this kind of area.

This is also connected to this question. In the Konstellationsanalyse document, there's a distinction between internal and external users. The workers of the companies that coexist on the Campus are users, but they can't act as if they were citizens because they need to meet their company's expectations. They work for the company but are also individuals that enjoy the facilities.

Yes, because they are using the roads on the Campus, the restaurants on the Campus, they are using the spots where the electric bikes can be connected… They are also limited on some aspects, because they are not allowed to use petrol cars inside the Campus. They are workers but definitely also individual users.

And they are also part of the Participation programs you mentioned before. Then they can learn where the energy that they are using comes from. Also, what are your thoughts on the transparency of the companies regarding their energy consumption? Is it interesting (for them and for the Campus) showing the amount of energy used?

It depends on the consciousness of the company. If you have a green consciousness and you want to show your workers how important it is to use a low amount of energy, public traffic or bicycles. On the EUREF Campus you have a good opportunity to show them the consequences of their everyday behaviors. You can also give them incentives so that they use environmentally friendly resources. The EUREF Campus is a model of a "future" area. The workers can be told that they are a part of this development, and that their contribution can help in a sustainable way.

However, we still don't have a way of controlling if the companies are doing this or not, but we know some companies, simply by making the decision of being on the EUREF Campus, are telling their customers that they support this approach, and that it is important for them to have their companies in a green area.

Are the Sustainable-Value-Indicators part of this transparency?

There are Indicator of the Energy Efficiency Buildings, because they are built following Standards of the future. There are measures being taken on the Research Campus M2G about the amount of people that take the public transport to go to work, or how many prefer the bicycle or the car. So there are some indicators, which are also used to see the changes from 2017 to 2018, but there are not Indicators for everything, or they are not publically available at the moment.

The renewable energies are what make this Living Lab a Sustainable Living Lab: you are not allowed to drive petrol cars; the energy comes from solar panels and wind mills… Is that what *Marke-EUREF Campus* means?

There is a difference between EUREF Campus and *Forschungscampus (*Research Campus). EUREF Campus is the area and it's the brand *europäisches Energieforum* of the EUREF AG but they want to have an area of Sustainable Development. They are building a new car park where you can use petrol cars, but there are many charging stations for electric vehicles too.

I think that the *Marke* will show that Sustainability is an important asset for the EUREF Campus.

Both EUREF Campus and the Research Campus give the positive image that attracts the companies with similar values regarding sustainability.

Yes. If you see the history of the EUREF Campus, it starts with some companies like InnoZ (*Innovationszentrum für Mobilität und gesellschaftlichen Wandel GmbH)* that have a scientific profile and private economy. They study a new mobility concept and so on. They started finding other companies in this area of renewable energy in the electromobility sector. So it is a *Marke* and the Research Campus supports this *Marke*.

To conclude, what is your perspective on the future of the project? Do you think the Campus will expand and will include houses instead of only offices, as a first step to making Berlin more sustainable?

First, the area is limited. You cannot build more houses, so in the near-future you have this area and the companies in the area. It will be important doing some activities that will bring the companies together, because many businesses still don't know each

other. We hope that the idea and the concept will encourage other quarters and other cities. In fact, there will be another EUREF Campus in Essen and another Campus in China. It is an export model. We have to build more of these central smart grids. We have to build more charging stations that use renewable energy near to houses.

At the moment, we don't have the infrastructure. If you are the owner of a house you can buy an electric vehicle and charge it in your garage. But if you are living in a flat you don't have this opportunity. We need to build this infrastructure in the new quarters of the city. I think that many people from other countries visit the EUREF Campus because they are aware that it is a quarter from the future and want to learn about how it works. This model needs to evolve to one where people can live and work but we need more quarters like this one to do that.

I understand that the EUREF Campus is a limited area, but there are many houses and parks close by, which maybe could be considered part of the Living Lab even though they are not on the Campus. For instance, regarding the power supply of electric vehicles.

Yes, they can use the charging stations paying a fee. Some other examples didn't function as we wished. There was an initiative about electric car sharing but it didn't work as expected. Maybe in the future it will.

8.2.2 TU BERLIN. RESEARCHER TF 5, COORDINATOR OF THE RESEARCH CAMPUS

The topic of my thesis is "The Research Campus Mobility2Grid: An Analysis on the Stakeholders Involved in the Sustainable Innovation Process". In this innovation process, the user has to be involved so that the products and services that the companies provide are accepted within the civil society. You are one of the two Research Campus Process Managers, and you also work in Topic Field 5, Education and Knowledge Transfer, a field quite related to the user. I would like to know: does the Education and Knowledge Transfer work like some kind of publicity for the Campus?

It's not publicity in the classic sense.

The Education part are Master programs. We created some Master Programs, in part for the Research Campus. We use this programs to transfer knowledge from research to the education programs, so that this whole vehicle to grid idea and solution is transferred to people who can hopefully use it in their professional life. It can be used in different areas such as energy management, mobility… They obtain an idea about this concept and then, they can use it.

Then there's the Professional Trainings, which are relevant, mostly for companies, in order to apply different vehicle to grid concepts. People from companies or businesses can book the trainings. They are mostly technical but also, some of them, are related to business models regarding the vehicle to grid idea. We adapt flexibly to the needs and demands of the companies.

It is not really publicity work. It's more like transferring knowledge into specific fields where it might be relevant.

There's an e-school, maybe you've heard about it, where we cooperate with the nearby elementary school. The children come here once a year and get experimental "lectures". They work on some model electric cars, we make races with them… Plus, there is an annual symposium, and this is actually quite open and also closest to publicity: we usually invite a broad audience. In the symposium, we focus on a different topic field every year and talk about results of the projects.

Since the elementary school that you mentioned is close to the Research Campus, it could be said that the children represent the involvement of the civil society in the Living Lab. They learn about the topic since a young age…

Yes, and they can talk to their families but we also want to raise interest in the topics, because it's something that is not part of the teaching plan at elementary schools. But teachers are usually happy to have projects like this and it's a good opportunity for us to raise interest in the topic.

For example, in TF 1 there are two differentiated parts that are Acceptance and Participation. But Education and Knowledge Transfer probably go together. Or are there people that work exclusively on Education?

Well, the Master programs are more on the education side and I'm more involved in the master programs, but I also work on the training and a bit on the symposium, which is more on the Knowledge Transfer side. But you could say that they're both Knowledge Transfer and Education together.

When you were talking about the masters. Can anyone apply? Or is it only for students from the TU?

No, there are Master programs so anyone can apply. But there are certain access regulations. You need a university degree (bachelors for instance) and because they are training master programs, you need to have one year of professional experience after you graduate. The typical profile of a student is a graduate in sciences, engineering or economics, who has worked for a company for one or two years (not necessarily required that this experience is in a related field). And then, of course, the programs are international so anyone can apply from the whole world, but there are fees. The degree is by TU Berlin but students need to pay for the fees because the programs are considered specific professional education instead of "general" education.

Do companies contribute to this TF 5 (Education and Knowledge Transfer) or is it only researchers from TU? Or do they get involved with the Trainings but they don't participate further?

They are involved. The Technical University is the only partner from TF 5 that gets funding but then there are companies which engage in some other ways. For instance, some of their workers participate in the master programs and give lectures or trainings. And then, of course, partners receive the training that we offer, but they also add some

knowledge. Otherwise our engagements are also contributing to our research. For example, there's a small partner that's not located in EUREF Campus but close to *Innsbrucker Platz*. It's a company that develops all kinds of small electric vehicles and that can also be part of the trainings. It's called Constin.

Then we also have the *KKI*, the *Kompetenzzentrum Kritische Infrastrukturen* (Competence Center for Critical Infrastructures), who were interested in hosting summer schools. I didn't mention it before but we also have summer schools, and the KKI wanted to add some summer school programs.

What about the Mobility2Grid Conference Lab2Reality? It took place in the Future Mobility Week. Can you tell me more about this initiative or is it more related to TF 1?

The Lab2Reality Conference was part of the general research application of the whole project. Each of the Topic Fields 1 to 7 had to write their own application but we also had to design a paper to show that the TF work together and have certain common goals. In that altogether research application, we stated that we wanted to host two conferences, as a complete project. One conference would be at half of the project time and the other one would be at the end. I helped organizing the Lab2Reality Conference in my other job as the coordinator or the Research Campus.

That was about all the Topic Fields, but TF 5 also participated with a workshop. In the afternoon, we had different workshops for discussing and going into detail of some different questions. TF 5 (Education and Knowledge Transfer) and TF 7 (Operation and Commercialization) organized together a workshop for business models that connected energy and mobility. That's how TF 5 was part of the organization of the conference, but it's not connected to the master programs or to our general tasks.

I also read that the *Tagesspiegel* was present. They are not partners of the Research Campus but were there to transfer what was said in the Conference.

Yes, it was meant to be both directions. On the one hand we, of course, get more knowledge about other projects and about developments in other countries, and developments, new researches and results in the rest of Germany or the rest of Europe, but then we also wanted to use the conference for extending our work and showing that we actually do something here, that we obtain results.

There were also students involved because they made scientific posters and we also had some students as visitors but we didn't talk about future master programs.

Can you tell me more about the introduction of the master programs called "Building Sustainability Management Methods for Energy Efficiency" and "Sustainable Mobility Management"?

Regarding the first one (Building Sustainability Management). We already had a program in 2012 in German, which it was rather technical (not an MBA). It was sort of the foundation of all the Programs that followed. Not many people studied it, so we decided to redesign it into an MBA, more focused on economics. It was introduced in October 2016 with a first batch of 20 students out of 30 places available, quite a good quota. This year we are receiving many applications so we will probably end up having 30 students in the program. It is quite demanded.

The Sustainable Mobility Management was developed afterwards, it started in 2017. It was quite interesting for us because we know that there were different universities and actors that tried to set up programs like this in the past, but most of them didn't manage to get them running for different reasons. It is often said that there is demand for people who can do sustainable urban planning, within the public administration, etc. However, many people don't want to study it because the career expectations are not quite clear. They can work in consulting but maybe it's different than the Energy Management Program as well, because with it you can also go into large energy corporations. That is different for the Mobility Sector because there are not many large mobility corporations other than car manufacturers, who don't need mobility planners.

We are excited to see if it works. The first year we've had around 15 students, which is still good, and now we have more applications so we will probable get over 20 students in the second year. 15 is kind of threshold: we cannot do more than two years below 15 students, but 20 is good for us.

The content in the Mobility Management masters is considerably varied. We have some technological foundations because it's important to have some basic understanding but we also have some economics, of course. There is also "future research", so that one gets an idea of how to do prognosis and planning not only for traffic systems that existed 5 years ago, but to future existing systems as well. Instead of only *reacting* to that, one will be able to *act*, because of the knowledge regarding the way it will most likely develop in the future. I had a series of lectures with people from industries or politics to work on this idea.

Do people from the companies that are in the Research Campus also get involved there?

There are no large corporations in this sector, so it is a bit different regarding this master. We have actors innoZ (*Innovationszentrum für Mobilität und gesellschaftlichen Wandel* or Innovation Center for Mobility and Societal Change in English), which is somewhat between a company and a research institute but in this master, it's more about people from politics or administrations. If you do urban planning, traffic planning or mobility planning, you will most likely end up in administration or politics.

I have one question regarding the Mobility2Grid Proposal of 2015. What is exactly the *Elektromobilitätswerkstatt?* Is it a new initiative?

The idea was to have this *Elektromobilitätswerkstatt* as a place for our trainings, addressed to people who are not working in management but who actually have to fix and maintain electric vehicles. And they could do it here, somewhere on Campus. But the problem was that we didn't really have space for it, because the EUREF Campus area is limited. Also, the owner of the area is keener on having offices, because they give more revenue than having a workshop.

The fix we had that was that we got into the ZeeMo.Base, basically a showroom for e-mobility and the smart grid in Campus. It was one of the places where we thought that we could have the electromobility workshop (*Werkstatt*). The deal was that we couldn't use it for trainings, but you can still learn a lot of things. It's more about the energy grid and less about electric vehicles but there are also these small electric cars that can help us show the way an electric vehicle works.

It's not a workshop where you can develop new cars and work with normal size cars, as the original idea suggested, but you can still show the functioning. For example, where do we need to be cautious because of the high voltage?

This was also mentioned in the said proposal. How does the TF 5 get groups from outside the EUREF Campus to be interested in the topics that are dealt with here? For example, the civil society or small companies from the area.

It usually works through our network. For instance, one of the lecturers from the Sustainability Masters works for *Messe Berlin*, the trade and fair organization of Berlin, and they were interested in doing one of the training that we offer.

Another approach was possible thanks my colleague Birgit Böhm, who also works for TF 5. We were on a scientific conference in April where we showed some posters, and people approached us asking if they could visit the Campus, because they found it interesting and wanted to know more about our trainings. It's mostly about networking and conferences.

The first target group we had in mind were companies who are part of Mobility2Grid because we need to evaluate the programs and the trainings, which is always easier testing them with people that we know, companies that we trust and know well. They can give us some feedback, we can make use of it and then continue towards other interesting companies and stakeholders.

What about the small companies like startups? Do they have the same degree of involvement as bigger corporations on the Campus? Their goal is creating revenue streams but they have to work on understanding the user in a different way than bigger companies. How does this affect their work on Campus?

We are interested in having startups in our trainings. The problem is that they mostly have to focus on the business model until they make money. We have Emmy, the e-Scooter sharing company, on Campus. They are currently not being active because they have a competitor, Coup[2], so right now they must fight to survive in the market. It's really hard to get some feedback from them. We wanted to use some of their scooters for an image video, and they were interested. But in the end, it couldn't happen because they are too busy. It would be nice including them more but it's difficult because they don't have the resources. Startups are really focused on their business model and not that focused on promoting research.

It's also difficult to get startups as partners in the consortium because the Ministry for Education and Research, where we get funding from, is not willing to fund startups if it is unclear that they will still exist in two, three or five years. Companies that are supposed to receive funding need to have existed for a certain time and need to show some financial safety. If companies or startups don't receive funding it's harder for them to present results. At this point, it really depends on their interest in the project and whether it helps them or not.

[2] Coup GmbH: New Bosch subsidiary, a company under 25 associates. Bosch's first e-mobility business venture with end customers.

It's hard for me to understand this way of working that you have on Campus. There are big companies, there are small companies, the academia… Actors learn from each other and it's very positive for them to be together in this area. But, for instance, how involved are big companies such as BMW? They obviously have other goals. Are they here just to profit from the research from other companies, or do they contribute with venture (they can afford it, not like startups) because it's cheaper for them than investing in other projects?

BMW is a complicated case because they are not very active in M2G. I think they have interest because they realized that their business model regarding the petrol cars (vehicles) will not be as successful in the future as it was in the past. They try to obtain an overview about the research that takes place in the area of alternative fuels and alternative fuel vehicles. And I can just assume, this might be the motivation for getting involved in such a project.

More or less the same happens with other companies like Siemens, which is also a large corporation. A very small branch of Siemens is active, but they *are very* active in M2G. There is some funding but they also are quite involved, even though it's always just a small team working from big companies.

Siemens was part of the new electric bus charging station that was set up on the Campus. They developed the charging pole (Figure 15) that was formally opened during the conference and Siemens sent three people from the P&A department.

Figure 15: Innovative quick charging station for electric buses.

Picture: André Beckersjürgen / M2G

That shows that they are interested in finding new business areas and cooperate closely with universities and academia in order to get access to research results. But, at the same time, the idea of the whole research campus is that the university and academic partners work not on very basic research but on some research with results that can be applied to business.

I understand. Looks like a quite complex relationship network.

I already interviewed another researcher from TU Berlin, one from TF 1, and they told me that there are going to be more Research Campus like this one, in Essen or China. That shows that this idea is working and people are interested. Is there going to be any kind of Transfer of Knowledge between this area and these coming ones? Are you going to be responsible to transferring what has been learnt here to the new Campus?

Yes, indirectly. But I think I need to clarify this a bit.

The Research Campus Mobility2Grid is a network of actors that are located at the EUREF Campus. The EUREF Campus is the physical location and the Research Campus M2G is one actor in this area. What is going to be transferred to Essen and China is the EUREF Campus, not Mobility2Grid. It's a different thing because it's the EUREF AG company the investor who develops these other places. However we hope that some of the projects on which we, as research campus in Mobility2Grid, work on the EUREF Campus, will be transferred though EUREF to the other areas. Some of our results make a lot of sense to the EUREF company and they want to apply them elsewhere as well, but it's basically not under our control.

So the EUREF Company is the one that owns this place and they decided to apply this concept in other places.

Yes. And the daughter company of EUREF AG is called EUREF Consulting, and they are members of the Research Campus again. We have the connection, we talk to each other and work together, and they are very interested in finding viable mobility solutions, and connecting mobility and energy here on campus and on the future campus as well.

But specially, when it comes to company partners, and that's not only regarding the EUREF partners but all the business partners, sometimes it's hard to differentiate what the company does anyway and what it does for the research campus. They are part of the Research Campus if it makes sense for them and if it's not completely far of their general lines of work.

So you could say that some parts are probably transferable, but is it because they would have done it anyway, and then it is part of the research campus; or maybe it wouldn't be part of the Research Campus but they would have done it anyway if the campus didn't exist.

Yes, I guess it has to do with open innovation. The way it was before regarding patents for example, companies wouldn't share their knowledge, but later they started working together without putting aside the fact that they were still competing for a position in the market.

Next question is quite wide, but I'm curious to know about any major changes that have taken place since the beginning of the project. From 2015, this field of Educations and Knowledge Transfer.

The biggest change for me and regarding the master programs what actually a structural and organizational change, because when we started back in 2015 and also in the prophase, the master programs were run by a company or institute that was directed by one of the three professors active in TF 5. He also had a scientific company which run the master programs. However, the TU Berlin got some feedback about this structure because this structure might be problematic in the future, regarding some regulations. Therefore, the master program's organization and administration were transferred to another company, with no connection to the Technical University.

That was the biggest change for me because now it is far more difficult for us to access the master programs, and their organization. I still have good connection with some colleagues, so I can still ask them to send evaluations to the students and to organize tours around the campus and adding contents about the project into the programs but it's definitely more difficult than before.

My thesis focuses on the roles of the stakeholders involved on the Research Campus M2G. The four helices present in the Living Lab are the government, the business, the TU Berlin and the civil society. Would you say that the role of the government, apart from funding the project to a certain extent, includes these regulations you mentioned? I'm sure that a lot of things could go faster if stipulated laws were defined beforehand. In other words, I don't see the role of the government as clear as I see the role of the other stakeholders.

In TF 5 it doesn't play a major role, but for the general project it plays an indirect role. The government can influence regulations and laws, which we need to function: specially in QF 7, whose job is finding business models.

As far as I know, they struggle because this is a technology which isn't widely used yet, so there are no regulations with reference to who gets paid when an electric vehicle sends energy back to the grid: is it the owner of the car? The owner of the battery? The person who produced the energy in the first place? The person who owns the grid? The distributer? The car manufacturer? That would be an example where we need regulations.

In other cases, regulations can also be problematic, for instance when it comes to the planning of the area. That's more problematic for the EUREF AG than for us. But for us it also means some restrictions. The district of Tempelhof - Schöneberg has certain regulations that do not always mean an agreement with EUREF and the district and they don't allow us to perform like we would want. We can talk and try to find solutions but sometimes it's just negative responses.

We are writing the application for the second main phase now, and all topic fields agree that we need public administration as part of the main project, so that we have some sort of official structure to talk to them.

My last question is related to the work here in the EUREF Campus. Is it very different than working in the University Campus, even if it's also as a TU researcher for the Mobility2Grid Campus?

I think that the difference here (and this is also one of the goals of the ministry, and a reason why they are funding the project), is that it's a very limited area with a network of people. So when I come here I usually see people that I know, many of them connected to Mobility2Grid in one way or another. It's much easier to exchange ideas in informal ways (specially reminders, etc).

On the other hand, you can see that this office is quite empty compared to the space it has. It was meant for people who worked in the project to come here and work in a flexible way. This wasn't such a success as we thought it would be, because people prefer staying in their offices, where they already have the infrastructure they need for research, they have their other colleagues... We are thinking about finding a way In the second phase to make people come here in a regular basis to work together, because that is the core of the project, to exchange ideas between the actors on the Campus. There are a lot who are already here, but also many who aren't.

I'm sure that's one of the many difficulties about this kind of project. This area is so big, and with so many different partners from a lot of companies and projects involved. It surely takes a lot of effort to make it work.

Sometimes it's incredible that it works, but it's still fun. It's based on a topic that makes sense but what we know that it's not going to be the future of energy and mobility, but it's going to be a part of that solution and it's great that we have so many people working on it.

8.3 ANNEX 3. CITIZEN SURVEY ABOUT THE SUSTAINABLE ENERGY TRANSITION

Sex:

- Female
- Male
- Prefer not to say

Age:

- 18 – 25
- 26 – 45
- 46 – 65
- 66+

Current (job) occupation:

Level of studies:

City of residence:

Country:

a) Questions about sustainability awareness.

1. **Did you know that more than 400 000 people are estimated to die prematurely each year in the EU from air pollution? (source: EU Commission)**
   - Yes
   - No

2. **Did you know that 60 % of people in the EU live in areas with a population greater than 10 000 inhabitants and that this percentage is expected to increase to 80 % in 2050? (source: EU Commission)**
   - Yes
   - No

3. **Regarding CO_2 emissions and air pollutants caused by transport, cities are responsible for 40 % of CO_2 emissions and 70 % of other pollutants. Were you aware of this fact? (source: EU Commission):**
   - Yes
   - No

b) Questions about personal preferences regarding future urban mobility and smart grids.

1. **Which of the following measures would you say is most important in the future urban mobility scenario?**
   - Strengthen general pedestrian and bicycle traffic
   - Develop a private Car-Sharing network to reduce the number of private vehicles
   - Develop company-managed Car-Sharing networks (e.g. Car2Go, etc.)
   - Grow the public transport network with shorter waiting times and more available destinations
   - Other

2. **If you had to choose now an alternative to diesel/petrol powered cars, what kind of transport would you prefer?**
   - Hybrid vehicles
   - Natural gas vehicles (powered by liquefied natural gas)
   - Electric vehicles
   - Hydrogen vehicles
   - Other

3. **Which of the following conditions is, in your opinion, the most important to purchase an electric vehicle in the future?**
   - Low acquisition and exploitation costs
   - Autonomy greater than 500 km
   - That it's powered by electricity from only renewable energy sources
   - Availability of charging stations
   - I would never buy and electric vehicle
   - Other

4. **What would encourage you to buy an electric car?**
   - Ecological benefits
   - Financial reasons
   - Fashionable design
   - I will have to do it at some point due to regulations
   - Nothing, I have no interest in buying an electric vehicle

5. **Which charging technology do you consider the most convenient for an electric vehicle?**
   - Fast charging (higher power and changes in household infrastructures could be required)
   - Inductive charging
   - Slow charging (e.g. domestic charge)
   - Battery exchange stations
   - Other

6. **How often do you use Car-Sharing?**
    - Minimum once a week
    - Once a month
    - Once a year
    - Never

7. **Which of the following aspects do you find the most important regarding Car-Sharing?**
    - Privileges when parking
    - Lower prices than private vehicles or taxis
    - Fare depending on distance and not time
    - That it's powered by energy from renewable energy sources
    - It covers a large area, not only city center but also suburbs
    - Other

8. **Would you install clean power generation systems (solar panels, wind mills…) in your property for your own consumption?**
    - Yes, and I would like to connect them to the grid to sell energy too
    - No, regulations are too complicated
    - Yes, but only if there's some kind of subvention
    - Yes, but only if investment costs are amortized over less than 5 years
    - Yes, for ecological reasons regardless of the cost
    - Other

9. **Would you belong to an energy cooperative in your neighborhood, that obtains (and shares via micro smart grid) energy from renewable sources and is not connected to the main grid?**
    - Yes, if price is lower than the electric rate by 5 %
    - Yes, for ecological reasons, even if the price remains the same
    - Yes, for ecological reasons, even if the electric rate is 10 % more expensive
    - No, there will always be a small supply risk
    - Other