Innovation Journey in Energy for Smart Cities 2017-2018

09-Motivating Citizens to Contribute Towards Sustainable Energy Use by Using the Information Generated by "Smart Meter"

IMEC, Belgium

WPO- Feasibility study

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Executive Summary

The need to contribute to sustainability energy use is very real, the technologies that enable these contributions are in place. But the end users are not leveraging the possibilities. Our project specifically deals with the information generated by smart meters and its lack of impact on consumer behavior of energy utilization. We propose a solution that provides a pathway for energy consumers towards sustainability usage and getting incentivized based on their behavior. Our proposed solution gathers information from smart meters and using machine learning algorithms to provide personalized insights to consume energy efficiently. Our platform also provides a service to share smart appliances so the overall energy consumption is reduced. For the incentives, since the solution is for the smart zone of Antwerp and most of the people are already possess an Antwerp card. The incentives can be integrated into the same existing infrastructure with IMEC and the municipality of Antwerp collaborating with each other. The rewards and incentives can range from discounts at a local coffee shops or planting a tree with the users name in the Antwerp Park thus encouraging the other members of the community to adapt the same behavior and creating a sense of shared ownership. We extend this concept to a gamification strategy where the participants that exhibit environment friendly behavior are acknowledged on smart screens spread across the smart zone to enable continuous and ongoing improvement of the community.

Introduction to Challenge

Firm	IMEC VZW
Website	https://www.imec-int.com/en/home https://www.imec-int.com/en/cityofthings
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Challenge Summary	How to motivate citizens to contribute towards sustainable energy use by using the information generated by 'smart meters'
Category	Internet of Things (IoT)

IMEC

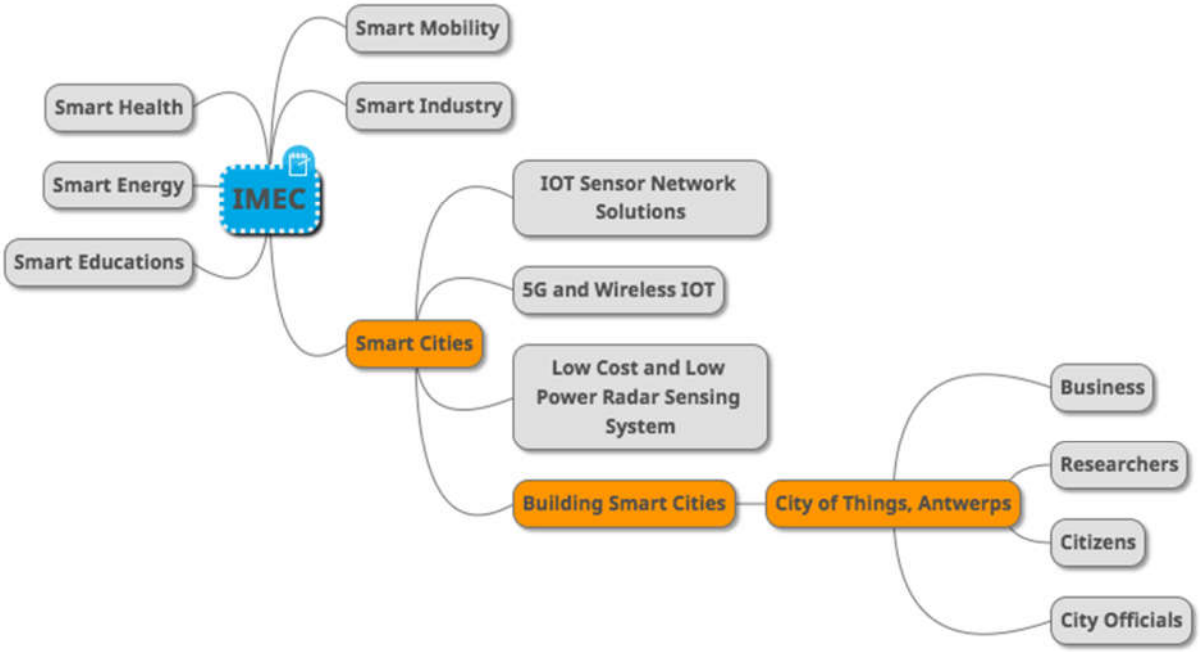
IMEC is one of the leading organizations for R&D in nanoelectronics and digital technologies. The institute employs around 3,500 researchers from more than 75 countries and has numerous facilities dedicated to research and development around the world, including 12,000 square meters of cleanroom capacity for semiconductor processing.

In 1982 the Flemish Government set up a program in the field of microelectronics with the goal to strengthen the microelectronics industry in Flanders. The decision was inspired by the strategic importance of microelectronics for the industry, and by the major investments required to keep up with developments in this field.

This program included setting up a laboratory for advanced research in microelectronics (IMEC), a semiconductor foundry (former Alcatel Microelectronics, now STMicroelectronics and AMI Semiconductor), and a training program for VLSI design engineers. The latter is now fully integrated in the IMEC activities.

IMEC was founded in 1984 as a non-profit organization led by Prof. Roger Baron Van Overstraeten. It is supervised by a Board of Directors, which includes delegates from industry, Flemish universities and the Flemish Government. Since 1984, IMEC has been led by Roger Van Overstraeten, Gilbert Declerck (as of June 1999), and Luc Van den hove (as of July 2009).

IMEC's business vertical is as follows:



IMEC's presence are mentioned below:

- Leuven, Flanders, Belgium
- Eindhoven, Netherlands
- Hsinchu, Taiwan
- Shanghai, China
- Bangalore, India
- San Francisco, California, United States
- Kissimmee, Florida, United States
- Tokyo, Japan
- Osaka, Japan

Main problem to solve

The problem is that citizens don't see a clear advantage or profit for themselves of the information gathered by smart meters that are being deployed, which are visualized as only Utilities' convenience and interest.
In the Smart Zone, several buildings already have a 'smart meter' that monitors the use of gas, electricity and/or water. Through the commercial app that goes with it, inhabitants already have an idea about their personal consumption. Such apps typically refer to 'average use' or 'similar families'. We want to go beyond this personal insight, and show people how their consumption compares to the actual neighborhood. This consolidated view should create a 'shared ownership' and responsibility so that they, as a 'shareholder' of the neighborhood can improve the overall consumption pattern. This data can be visualized in real-time on the info screens that are spread across the Smart Zone.

The challenge

Our challenge is to co-create a solution which is technically, societally and economically feasible and sustainable and that addresses following questions:
1) How can the current commercial approach be improved to empower each individual citizen and a neighbourhood to achieve such 'shared ownership', and to contribute to the wider city energy and climate objectives?

2) How can 'behavioural nudging', receiving cues to adapt consumption behaviour of energy, water and waste, be applied in the most effective way? Which incentives and rewards would be effective and feasible for all parties involved? What approach should be used?

3) How can the actual data that is captured be transformed, analyzed, so as to generate new meaningful data,that can contribute new insights to the Smart Zone?

4) How can dataflows of all resources (via smart meters for energy, water, waste) be integrated? What are societal, legal and technical hurdles, technical approaches, standards...? What are missing components that need further definition or technical solutions, (clarified in a basic architecture)?

5) What could be a sustainable business model for all parties involved building on the topics above?

1.1 What problem does your product/service solve?

With the increase in the surge of smart meters in the commercial and household usage, there is a need to engage communities and neighborhoods in utilizing the insight provided by these devices to contribute towards sustainability and development. The problem exists that people don't see a clear benefit for themselves in using these devices. Part of the problem is that people are unable or not proficient in handling the information and utilizing them for their own and community's advantage.

Our service eliminates the need for the user to manipulate the information and takes away the number crunching from the user and provides customized recommendations/suggestions on a periodic basis with the help of which the users can adapt and change their behaviors accordingly. After successful implementation of the recommendations/suggestions through our service/platform. The users shall receive virtual rewards depending on the adaptability of the prescribed recommendations. The reward system shall inculcate a healthy competitive environment and the users shall be able to compare their performance with that of their neighbors. This shall solve the problem of unengaged communities and also pave way for sustainability through cooperation.

1.2 Which customer need does it satisfy?

There is a need for the consumers to comprehend and utilize the data from the smart meters to their own advantage. The smart meters currently are regarded only as Utilities convenience and are not helping in engaging masses. The service makes the data easy to understand and eliminates the processing of data but instead provides easy to follow recommendations to follow that can be used to reduce the energy bills.

Macro Environmental Analysis

This report provide an interim update on the given macro environmental factors on the challenge. It provide preliminary, incomprehensive analysis of our results. A further analysis will be provided as it progresses.
We foresee the solution will be developed around the main product (i.e. the smart meter) to create a relatable business vertical for the firm. At this stage, the analysis mainly focus on the main product (i.e. the smart meter).

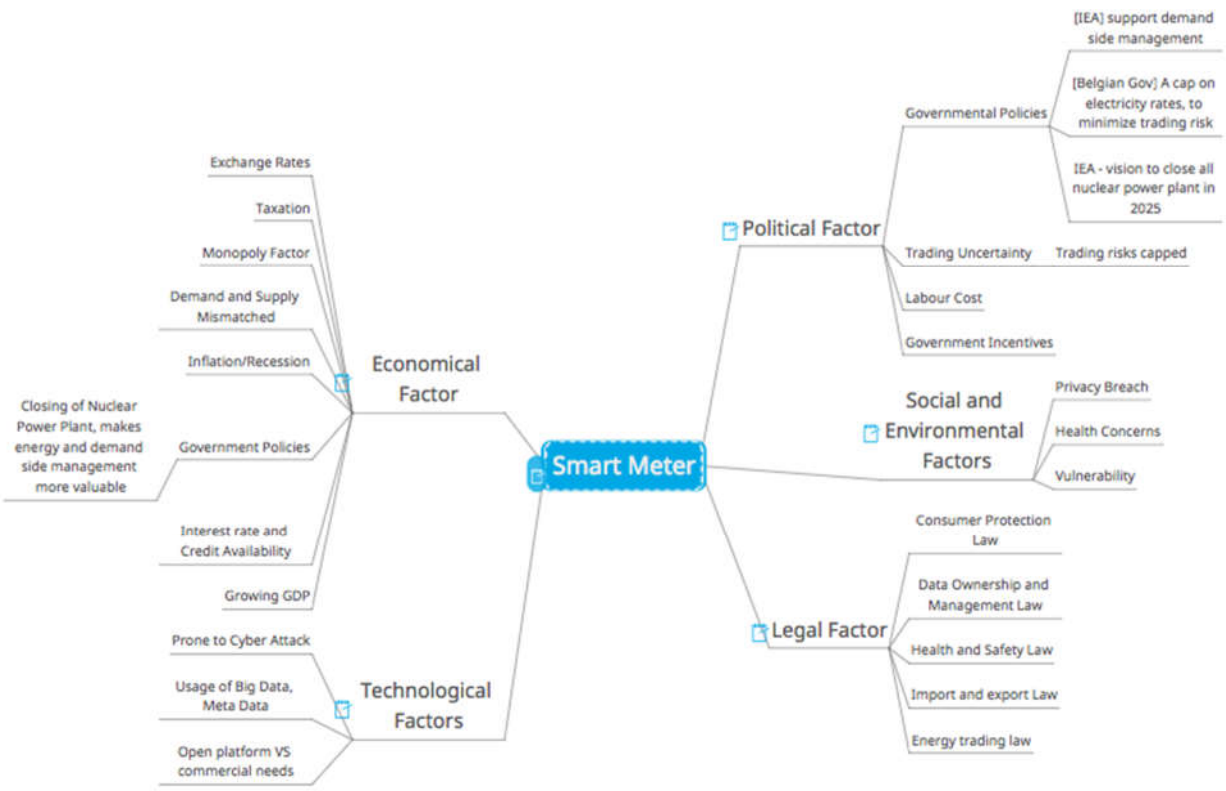


Figure (1) Overview of the Macro-Environmental Analysis

2.1 Political

The political factors here defined as external constraints that impact the business/firm function on day-to-day activities. These constraints could be implied by actions of government creating a favourable/unfavourable political condition in the location where the business conducts day to day activities.

The macro environmental factors are elaborated as follow:

1. ***Government policies****:* Changes in the policies based on low carbon emission consideration may affect the performance of the company. If the new policies are in line with the novel products design, then there will be a greater possibility to increase the profits of the company. On the other hand, if a new policy allows more FDI(foreign direct investment) it may affect the performance of the locally manufacturing company.

2. ***Trading uncertainty****:* Changes in the international trading agreement between supply-demand countries may affect the overall production cost. Suppose the government impose new trading policies between countries which lowers the customs duty then the cost of procurement for the company will reduce. Based on bilateral trade agreement, duty on exporting final product may reduced which may boost the company's profit.

3. ***Labour cost****:* Changes in labour law may affect the income of the workers in the manufacturing unit. If the minimum labour pay limit is increased by the government officials through new policies then cost to the company may increase.

4. ***Government Incentives****:* Incentivising smart energy meters by governmental policies due to reduction in overall CO2 emission may increase the overall profit of the company.

2.2 Economic

Here we will look into the factors that will define the consumer buying power. Economic factors mainly connected with goods, services and finance.
Following are the possible influential factors in macro-economic-environmental analysis for our product.

1. ***Exchange Rate**:* Suppose in smart meter production, some of the modules of electronic board (silicon chips, modem, etc.) are imported from other countries. Then the fluctuations in currency exchange rate will affect the cash flow of the company. Further, the cost escalation resulting from imported raw material and new capital goods due to currency exchange rate fluctuation may drastically affect company's performance.

2. ***Taxation:*** If employing smart meters by citizen reduces energy consumption it may attract governmental incentives for climate control. These monetary incentives may relax import and inventory taxes involved in production/establishment/refurbishment which in turn may reduce cost to the company.

3. ***Monopoly factor**:* If the company became monopolistic then based on technology and demand it may increase the profit by boosting cost of the product.

4. ***Demand-supply mismatch/economic stability:*** Insufficient supply for the growing demand may leads to possible switching of customer to other suppliers/competitors leading to greater losses and loss of market space.

5. ***Inflation/Recession:*** During inflation, customers would not have sufficient revenue to buy high cost energy efficient components, they may opt for cheaper solutions which will adversely affect the company's cost-balance score card. Also during inflation, company needs to spend a higher amount to buy the same inventory/raw materials.

6. ***Government policies:*** If the product is efficient and promotes low carbon emission, it may attract some changes in the policies which may prove to be beneficial for the company's output. On the other hand, if a new policy allows more FDI (Foreign Direct Investment) it may affect the performance of the locally manufacturing company.

7. ***Interest rate and credit availability:*** Low credits and increasing bank interest rate for the inventory, commodities and capital goods will prove to be bad for company's cash flow thereby affecting company's performance.

8. ***Growing GDP**:* Increasing GDP is directly related with the spending of the people/ government. Inflated spending creates demand in the system which may develop high profits for the product over long term prospects.

2.3 Social and Environmental

Social Factors

One of the key challenges in efficient utilization of resources via smart meters is the human resistance to adaptability of change which serves as the main bottleneck in our case. People don't see a clear advantage or profit for themselves of the information gathered by the smart meters and are viewed as only a means for the utilities convenience or interest.
Many social factors influence the customer psychology to resist the adaptation of Smart meters, some of which are:

1. ***Privacy Breach***: This by far seems to be the most important factor that people adhere to while advocating the so called harmful aspects of smart meters. People are concerned that the energy companies might be able to track their daily routines through their energy consumptions and can ultimately sell that data to advert companies in exchange for a huge sum of cash.

2. ***Health Concerns:*** People fail to understand the exact working of smart meters and their transmission protocols like GSM and Wi-fi, misguided by the mass propaganda are of the view that these meters radiate harmful electromagnetic radiations and are supposedly harmful for the human body.

3. ***Vulnerability:*** People have a notion that smart meters can be hacked or controlled and can be used for automatic switching of appliances. More than three quarters of Britons are fearful of the concept of a 'smart home,' according to a study by MoneySupermarket.com

Environmental

Professionals and experts are on the same page when it comes to the positive effects of smart meters and automation on the environment. As per the smart 2020 report by the Climate change group, a closer look at the buildings in North America indicates that building automation of electricity could save 15% of North America's buildings emissions. Globally, smart building technologies would enable 1.68 GtCO2 of emissions savings, worth € 216 billion ($340.8 billion). Reducing T and D losses in India's power sector by 30 % is possible through better monitoring and management of electricity grids, first with smart meters and then by integrating more advanced ICTs into the so called energy internet. Smart grid technologies were the largest opportunity found in the study and could globally reduce 2.03Gt CO2 emissions, worth € 79 billion ($ 124.6 billion).

2.4 Technological

Impact of technological advancements: As these days our world is moving towards green energy and people are motivated to use new technologies for preserving the environment, the energy sector is tending more towards the use of smart grids for the sake of better energy management and to control the energy use in a smart manner. Smart meters are an essential part of the concept of smart grids and they'll help in smart energy management, so these technological advancements will help our business to grow.

The Technology of Smart Meters: Nowadays AMI technology is being used in smart meters in which time-based pricing and demand response actions are taken by the smart grid through two-way communication. The following figure shows the communication layers of smart grids.

Figure (2): Two way communication

Associated Risks: People are reluctant to use smart meters as they are afraid of cyber attacks through which their personal information may be stolen and from blackouts which can happen as a result of these attacks. People are also reluctant to share their data with the utilities because they want to keep their personal usage private. These risks may cause damage to our business, but on the other hand, firm steps have been taken to standardize the technology used in smart meters and make sure of the foolproof security of the communication links and users personal data.

To ensure the success of technology implementation, it has to be able to served benefits for variant buying power of consumer. Hence, multiple technology/platform should be available. However, data standardization is required, to ensure synchronization in the market place and everyone has access to the same benefits.

2.5 Legal

The legal factor in here, defined as external factors which refer to how the law affects the way firm operate and consumers behave or reacting.

Below are the few laws we could look at that could further affect the macro-environmental factors:

1. ***Consumer law****:* Consumers perceive that the data may contain confidential information and could be misused by third parties for their own benefits without legal consent. The challenge lies in unclarity of the compulsory legality of smart meter installation. Consumer has to be properly educated on the legal requirement of smart meter ownership, resulting data ownership and management of data. This should be addressed by the local government where the implementation takes place. The government has to identify and define the law of data ownership and management.

2. ***Data management law:*** the ownership of the data and equipment clearly defined. If there does not exist any clear law that could protect the consumer, this might hinder the consumer from participating in the activities.

3. ***Health and Safety laws****:* Concerns such as radiation activities that could impact health and safety for consumer should be catered for..

4. ***Import/Export laws:*** Import and export boundaries across Europe and around the globe should be looked into. This will define the way the firm distributes the product/.

5. ***Energy trading laws:*** This will impact the variety of choice the consumer could have. More choices means more competition and might cost energy to be more economical for the consumer.

Value Chain Analysis

Overview

As per United Nations World Populations Prospects 2017 every year, the world's population is expanding by 83 million people. Right now, there are around 7.6 billion people in the world. By 2050, there will be just short of 10 billion. Today, half of the world's population lives in cities, a number that is expected to increase to 75% by 2050. But as urban populations grow, so do urban challenges – such as mobility, safety, environmental concerns, or urban planning issues.
In this section we will elaborate on the value chain analysis of the smart meter production in the current electricity market. The figure below indicates the position of smart meter and relevant technologies in the electricity market industry. Smart meters serve to provide data between the end users and the grid operators.

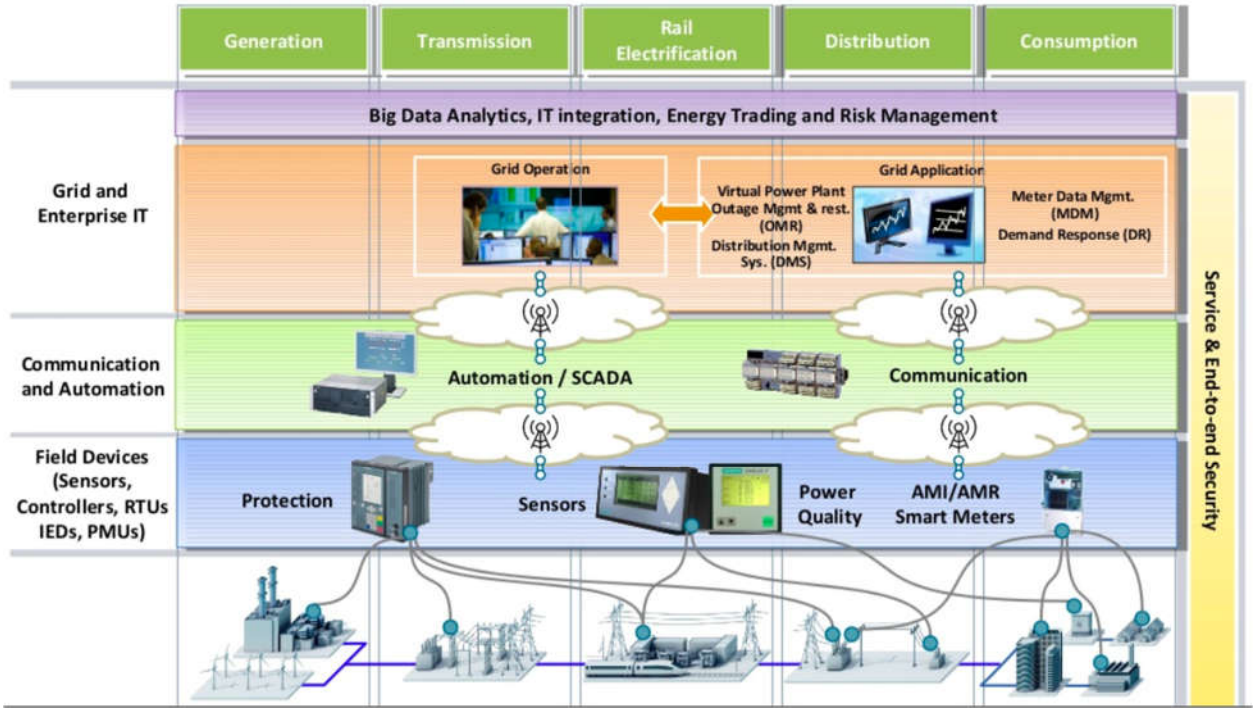


Figure (3): Smart Meters in Electricity Market

Ref: https://www.slideshare.net/antoniomorenom/sepic-ieee-isie-2010

This value could be further added due to the recent changes in the energy grid trends to become a smart grid and call to improve or optimise the electricity production to reduce the carbon emission factor. In an ideal world, the utility companies and governments would like to produce energy in a demand and supply prospect for maximised renewable energy production, minimised storage and carbon based fuel electricity production.

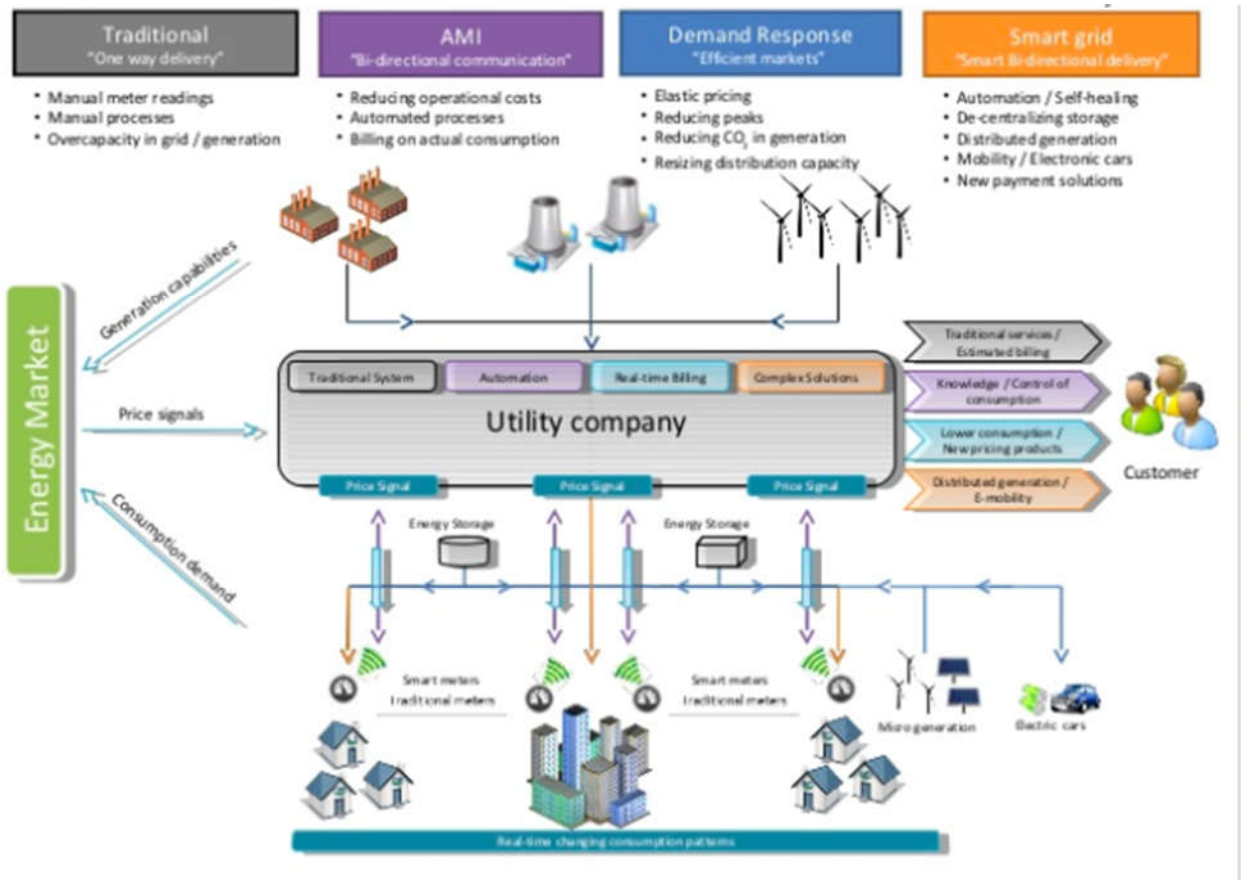


Figure (4): Energy Market

Ref: https://www.slideshare.net/antoniomorenom/sepic-ieee-isie-2010

Demand side management and demand response has become a model that presume to improved sustainability index.

IMEC is a commercial research and development company with focus on emerging chip design. Hence, the value chain analysis will focus on improving profit margin and innovative solution.

The standard value chain analysis uses Porter's value chain analysis template to evaluate a company's business model. However, as we focus on disruptive innovative product, Porter's value chain has been argued not to fit the model [4].

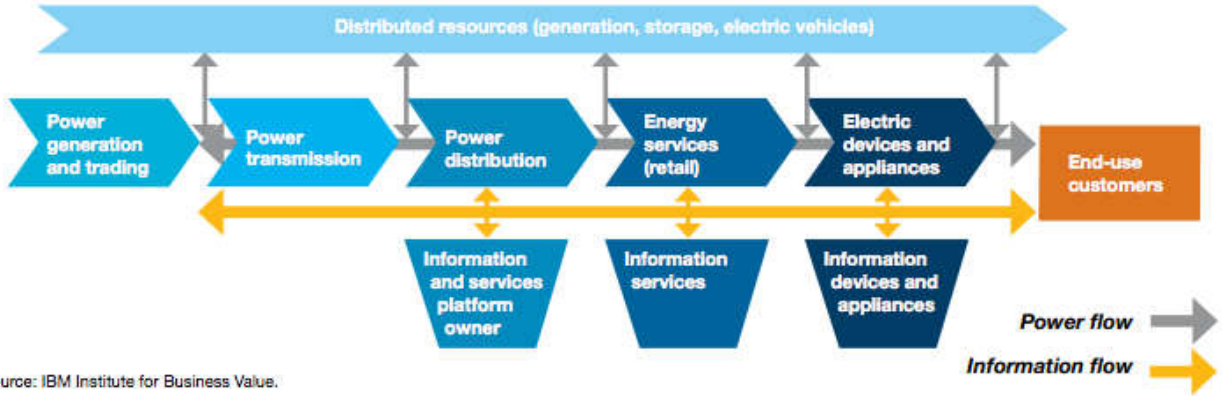
We start by elaborating our objective: To improve the profit margin. We feel the company profit on smart meter and smart meter related products could be improved when the consumer uses the value brought by smart meters and related products more often. The value of the family of product is gauged as:

a. More participation from the end users.
b. Creating availability of energy consumption data on demand and real time.
c. Ability to control equipment in the house on real time and on demand.
d. Improved consumer sustainability index.
e. Reduce end-user consumer spending on energy bill.
f. Optimised production of energy for generator company.
g. Optimised trading for energy retailers.

As there isn't clear regulation on the compulsory nature of smart meter installation world-wide for various retail consumers, the smart meter manufacturer should take into consideration a larger range of consumer based. Hence, the consumer here is being defined as:

1. Energy retailers(in Belgium) but not limited to:
    a. Comfort Energy
    b. Ebem
    c. Ecopower
    d. Elegant
    e. Eneco
    f. Energie2030
    g. Energy People
    h. Engie-Electrable
    i. Eni
    j. Essent
    k. Lampiris
    l. Luminus
    m. Mega
    n. Octa+
    o. Poweo
    p. Wase Wind
    q. What Z
2. Generation companies
3. End users:
    a. Residential
    b. Commercial

Emerging electricity value chain



Source: IBM Institute for Business Value.

According to IBM institute for business value, the emerging electricity value is described as above. The smart meter could be adding value in the following area, but not limited to:

1. End users
2. Electric devices and appliances
3. Information devices and appliance
4. Energy services
5. Information services

Year	Average delivered volume per access point	Delivered volume (MWh) household access points	Delivered household access points
2016	3,468 kWh / year	9,548,037.53	2,753,028
2015	3,514 kWh / year	9,628,688.90	2,739,937
2014	3,561 kWh / year	9,692,449.31	2,721,502
2013	3,895 kWh / year	10,521,437.02	2,701,333
2012	3,932 kWh / year	10,578,422.02	2,690,214
2011	3,967 kWh / year	10,677,365.10	2,678,142
2010	4,339 kWh / year	11,569,438,34	2,666,112
2009	4,288 kWh / year	11,372,169.11	2,651,905

Ref: http://www.vreg.be/nl/elektriciteitsverbruik-van-een-gezin

Consumer	Annual consumption meter in kWh	Annual consumption night meter in kWh	Annual consumption only night meter in kWh
Small consumer with 1 meter	600	/	/
Relatively small consumer with 1 meter	1,200	/	/
Average consumption of a family with 2 meters	1,600	1,900	/
Average consumption of a family by one meter	3,500	/	/
Relatively large consumer with 2 meters	3,600	3,900	/
Large consumer with 2 meters + accumulation heating and / or electric boiler	3,600	3,900	12,500
Large consumer, with 1 meter + accumulation heating and / or electric boiler	7,500	/	12,500

End User demographic

The table below indicate the smart meter consumer interest in Belgium.

	Interesse slimme meter	
	Ja	Nee
n=	371	166
Leeftijd		
18-34	21%	14%
35-54	37%	29%
55-64	19%	23%
65+	24%	34%
Opleidingsniveau		
Lager + lager secundair	14%	14%
hoger secundair	41%	39%
hoger + universiteit	45%	47%
Provincie		
Antwerpen	29%	29%
Vlaams-Brabant	17%	17%
West-Vlaanderen	20%	19%
Oost-Vlaanderen	21%	23%
Limburg	14%	12%
Actief / Niet-actief		
Actief	60%	45%
Niet actief	40%	55%
Eigenaar/huurder		
Eigenaar	81%	80%
Huurder	19%	20%
Distributienetbeheerder		
Zuiver	25%	21%
Gemengd	75%	79%

Ref: http://www.vreg.be/sites/default/files/rapporten/rapp-2012-11.pdf

Manufacturing of the smart meter and relationship to consumer are further elaborated below:
Following are the value chain we think is related to our product i.e. smart meter. The various process and factors which are responsible/affecting the utilisation of the Smart Meter are described below.

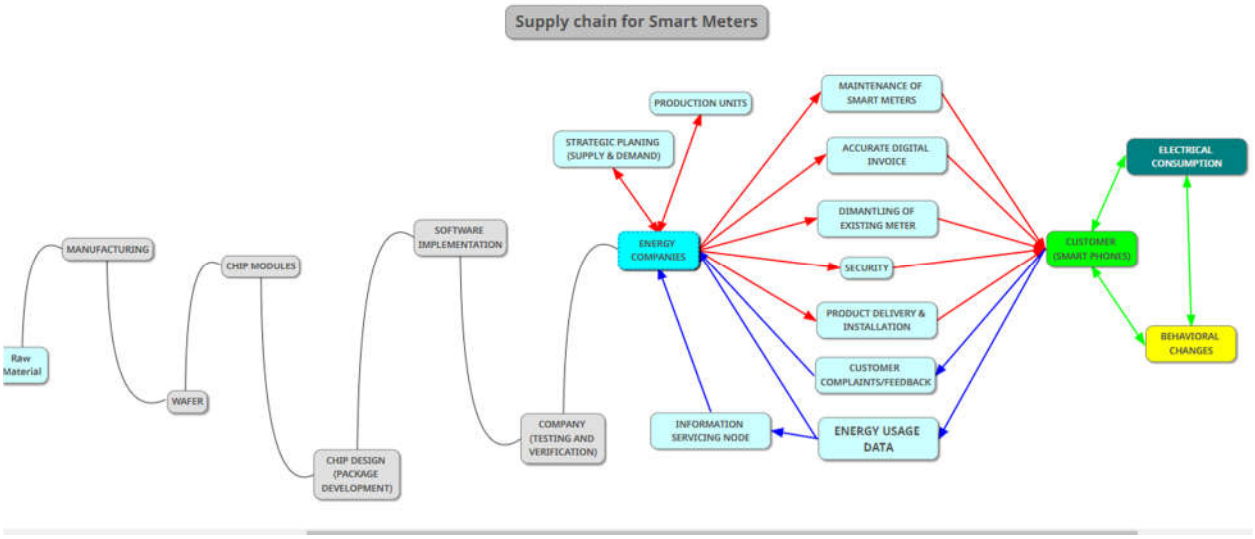


Figure (5): Overall Value/supply Chain for Smart Meter

For better understanding of the product-Smart meter, we can segregate the value/supply chain into two phase viz,

a). Production phase:
In this phase, we have the sequence of different processes which are playing an important role for manufacturing of our product. The pictorial depiction of the various actors available in production phase value chain are shown below.

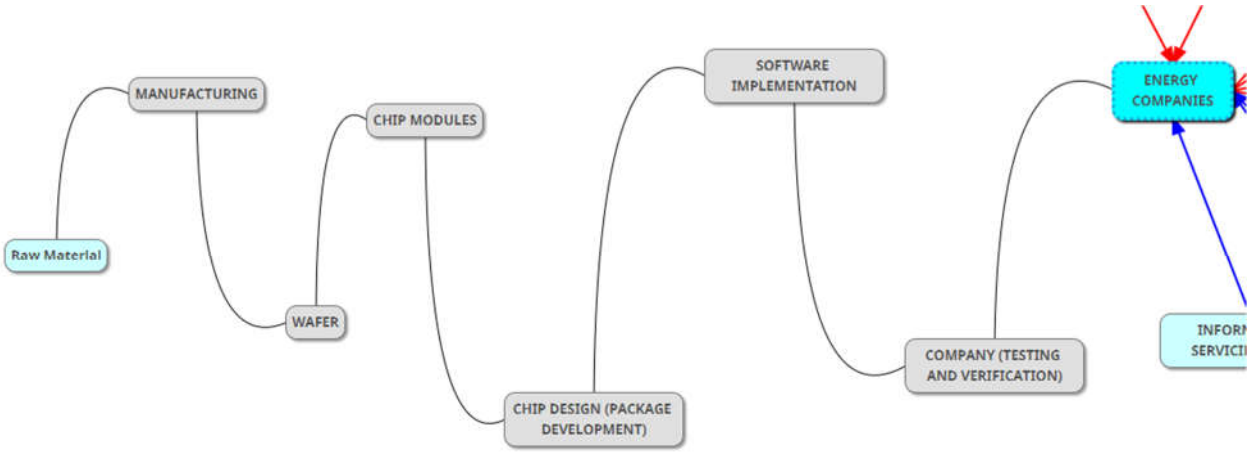


Figure (6): Value Chain for Smart Meter (Production Phase)

As shown in above figure, we can see that all the major factors relating to fabrication of the smart meter starting from procuring raw material and ending with the delivery of teh product to the energy companies for successfully deployment of the product to customer. The brief description concerning major factors for value chain (for production) are listed below:

Raw Material: Procuring of the raw material required for manufacturing of smart grid plays a major role. Here we need to procure high grade silicon material which is the base material for fabricating chips.

Manufacturing: After procuring raw materials, we need to process it by heat to extract silicon from it in grain form.

Wafering (Fabrication): This process is use to process our silicon particles to form wafer in a laboratory environment. Doping our wafer with other materials like germanium, vanadium will be done here to make it suitable for operations.

Chip Modules: Here we need to make each module (SMPS, Instrument, sensors, etc.) by implanting and connecting various semiconductor devices into it. This is done based on the functionality requirement of the smart meter.

Chip design (Package Development): Here integration of all components with diverse functionality are done.

Software implementation: Certain microprocessor and microcontrollers which are required for proper operation of the Smart Meter are assembled here.

Testing: Following assembling and manufacturing all elements, testing is performed to verify the operation from modules level to whole product level before marketing.

Energy Company: After successfully testing and verify the product, Smart meter are shipped to the various energy companies so that it will be marked, programmed and deployed to the concern customer.

Based on the problem statement we can infer that the IMAC can successfully produced the Smart Meters based on their expertise in nanotechnology. However, because of lack of information regarding usage and advantages of Smart meter, dispatching and installation of these devices becomes difficult in Antwerp. Based on our preliminary study we come up with some of the factors/services which needs to be consider while deploying and successful operation of Smart Meters in Antwerp. The Value chain concerning the service phase of Smart Meter is shown below.

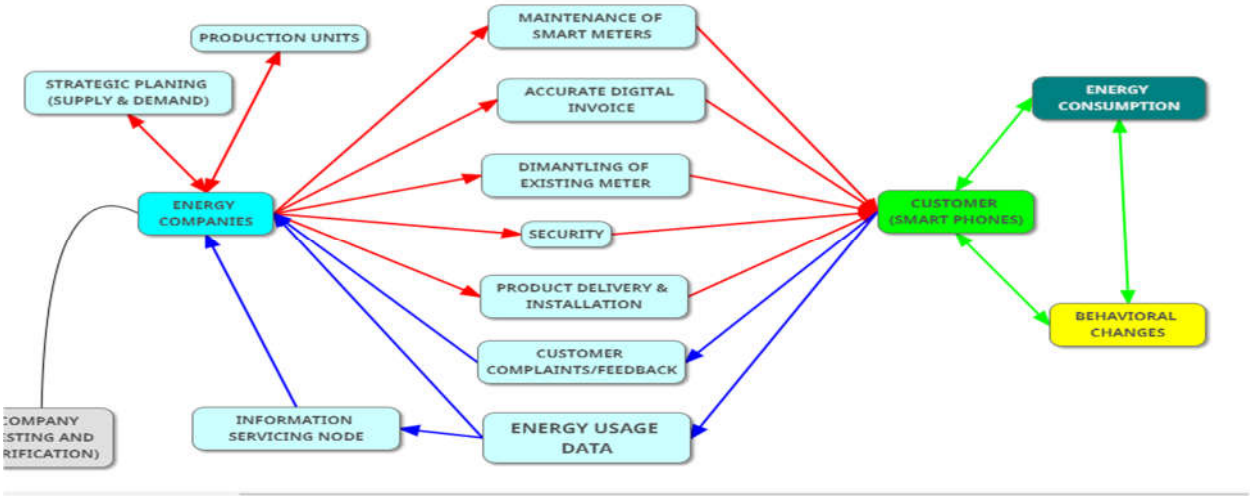


Figure (7): Value Chain for Smart Meter (Service Phase)

We can infer from above figure that the most important element/factor for servicing of Smart Meter is to convince the Antwerp dwellers to install this product. The advantages and environmental benefits by the usage of the smart meter needs to be properly conveyed to locals so they can understand its importance and accordingly install it. The installation of smart meter
can improve their behavior based on the feedback from the device for their own real time energy usage compared to neighbours.
The past forecasted data from smart meters can also assist Antwerp's smart zone people to change the behavior and switch their activities towards time when energy rates are less this can in turn reduce their spending. Following are the brief description for Smart Meter Service side supply chain,

Product Delivery and Installation: First and foremost activity while providing servicing through smart meters is to convince the local people to installing the Smart meter in their houses. For installing smart meters it needs to be dispatched to customer from energy companies with proper assigned IP address so that it can be monitored online.

Dismantling of existing energy meter: Replacement of existing meter by smart meters requires it to get dismantled and send it back to the owner i.e. energy companies
Maintenance of Smart Meter: Once installed, these smart meter need maintenance at the regular interval to avoid any unpredictable outcomes. Replacement of the damaged components or updation of the softwares should be done to improve the overall performance of our energy system.

Security for meter: Because these meters are the property of energy companies, they need make sure that the product is secure. Any tampering with the product may provide bad outcomes.

Customer feedback/complaints: This factor plays an important role in servicing of smart meters. Any problems related to the product which is experienced by the customer needs to be send to energy companies so that they can take necessary actions to foster quick solutions.

Energy Usage data: This factor in smart meter plays a very vital role. As the people in Antwerp consumed energy in their houses, the smart meter send those data to the people of those house and energy companies through information servicing node. These data are used to change the behaviour of the people by showing their various energy consumption compared with their neighbours. The information regarding real time energy usage by the customer helps him/her to take essential actions which has the potential to curb the carbon emission.

Digital Invoice: In this process, the payment slip for the monthly energy consumption is send via digitally to the customer. Smart meter eradicate the usage of paper based predictive invoicing which was done earlier by energy companies by sending person to each and every houses to record the reading manually.

Production Units: These are represented by all the energy producing/distributing companies which are providing electricity, gas, hot-water, etc. to our customer (households) in Antwerp. Real time information sharing between energy companies and energy production unit plays a vital role for reducing emission by optimising the system operation.
Information Servicing Node: This processing unit analyses the data collected by all the houses in the Smart city region and send it to the energy company which can further examine these data for monitoring supply and demand of electricity, gas, hot-water, etc.

Strategic Planning: This factor is performed by the energy companies based on supply and demand. The optimised solution concerning reduced emission is analysed here.
Customer: Customers utilize these Smart meter in their houses to realised the real time energy consumption data and checked their consumption with comparison to their neighbours.

This activity can further change the behaviour these customer to reduce their consumption or switch their activity to some other time when energy rates are low.

Energy consumption:The real time data regarding electricity and other energy consumption is provided to the customer along with their neighbours performance so that he can realise his performance in the society and try to improve the consumption.

Behavioural changes: Behavior change is also need to be considered as one of the main factor which affect the servicing of the smart meter. People can mitigate the energy consumption by changing their behavior to reduce the emission or save money. Low cost can be an essential driving factor for people to change their behavior.

Gap Analysis

Despite the tremendous potential of smart meter and its role for smart cities, end users still holds a key role in improving participation and sustainability index of residential household in smart cities.

The challenges could be described as below, but not limited to:

1. Broad range of demographic consumer (i.e. age, buying power, language, household structure, culture) based may require a complex or multiple solution to address consumer interest for participation.
2. Consumer perception and objective of sustainability are varied
3. Unclear business-profit model

Market Analysis

3.1 Current market size and growth in next 5 years

As recommended by European Commission science and knowledge service, over 70% of the European consumer should installed smart meters in their houses by 2020 to reduce their energy bills. These meters are found out to be very effective in recording actual energy consumption rather than the traditional meters. However, for our predefined geographical system boundary i.e., smart zone, it is found that there are 100% penetration of smart meters in the houses built in this region. So, from meter deployment point of view, the market already achieved its task with the help of IMEC initiatives in City of Things in Antwerp.
https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters

With the installation of Smart meters in Smart Zone, it can be extrapolated that around 9% of annual household energy consumption can be reduced by 2020. The aim is to reduce the energy consumption further by 20% which is possible by implementing feedbacks and targeting mechanism in the prescribed area (xxx). Moreover, with the contribution of the inhabitants for

optimized energy consumption by changing their behavior, the overall energy profile for the inhabitants is found out to be more effective and beneficial.

3.2 Market structure and market share (%)

This project deals with the product: Smart meter utilization by the Smart Zone dweller for effectively optimized their energy consumption. In Smart Zone, the installation of Smart Meters is already being done fully in smart zone area by IMEC as a part of its City of Things initiatives. It has 100% market share in the prescribed area.

3.3 Market trends (5 years period) and % of growth (by technology and geography)

The current global market of smart meters is worth $12.79 billion and is expected to increase by 9.34 percent CAGR annually over the next five years.
https://www.marketsandmarkets.com/Market-Reports/smart-meter-366.html
In terms of shipments, the market is expected to grow from 119.27 million units in 2016 to 130.28 million by the year 2022.
https://www.mordorintelligence.com/industry-reports/global-smart-meters-market-industry
In 2016, around 63 percent of all meters installed including smart metering technologies,
https://www.freedoniagroup.com/industry-study/smart-meters-2844.htm
reaching a figure of approximately 700 million units installed globally – around half (52 to 58 percent) of the devices were deployed in China. Over the next five years, EU utilities will

contribute the largest shift in investment trends, aiming to spend $37.8 billion. This investment will enable the utility companies to comply with a recent EU legislation that necessitates deployment of smart meters among at least 70 percent of the customers. Japan following the trends with $16.6 billion of additional investments through to the year 2020, taking the marketshare to 45.2 percent (CAGR growth).
https://www.metering.com/magazine_articles/global-trends-in-smart-metering/
http://www.strategyr.com/pressMCP-7018.asp
https://ec.europa.eu/energy/en/topics/markets-and-consumers/smart-grids-and-meters

3.4 How large will be the Total Addressable Market (TAM) be in the following 5 years?

TAM is an estimate of how much IMEC company would make in sales per year if there were no other competitor.
Because the deployment of smart-meters in smart zone is already been done by IMEC itself, there are no competitors in terms of market share from product point of view. However, it should be noted that the system boundary has huge potential of plausible benefits in terms of CO2 emission reduction if people of smart zone try to change their behavior for optimized energy consumption.

Segmentation-Targeting

3.5 Who are your customers and what are their characteristics? Customer analysis

Competitive analysis

Our target customers include utility companies that have already invested or plan to invest in smart metering technologies, as well as the end-users. The utility companies are financially motivated to encourage end-users to leverage insightful information generated by smart meters to facilitate a positive impact in their energy consumption habits. Since the EU legislation requires all utility companies to invest in the smart metering technology and deploy the devices across at least 70 percent of their customer base, our customers in terms of technology providers would include all EU utility service providers. Further, any technology partner involved in developing and maintaining the metering devices may also be a direct custom of our solutions.
In terms of end-users, primarily every household impacts energy consumption figures and naturally plays a role in facilitating the purpose of our solutions to reduce energy consumption malpractices. However, the most contributing end-user such as individuals involved in performing the daily chores at home – washing, cooking, cleaning – may be our primary targets. In business settings, our end-users will include all employees, specifically the individuals incharge of maintaining technology operations such as lighting, heating and cooling, among others.

3.6 Which are their needs in relation to the product/service? How are they currently covered?

It can be noticed that utility companies suffer a heavy loss during peak hour time of the day as majority of the consumers consumes heavy energy during this period. In these instances, the grid also experienced instability which may prove to be fatal for utility companies. To minimize these risks of heavy load and instability, utility companies are motivated to encourage inhabitants to alter their energy consumption behavior based on their energy profile. Currently these customers are actively participating to encourage citizens by sharing their energy consumption along with their neighbors to create a sense of belongingness.
From end-user perspective, the continuing encouragement with lucrative benefits are not available. Currently the citizens of smart zones are not able to understand the difference between their own energy usage amongst their neighbors instead they are relating their consumption with the average consumption of the locality. This comparison is not presented in an effective manner for inhabitants to understand the possible ways to reduce their own usage to optimize the energy consumption.

3.7 Which market segments do you identify?

For the given problem, the market segmentation is considered to be done by customer. Because the smart meter is already being deployed in the smart zone, the customer segmentation proves to be very vital in determining the effective utilization of this product for optimized energy usage. It is found that for some inhabitants, the user interface platform was not intuitive enough to provide sufficient inspiration for them to act towards lower energy consumption.

3.8 Which market segments do you target?

The citizens of smart zones are the major market segment we are going to address with our product and services because they are the key factors to influence their energy demand based on the lifestyle for optimized energy consumption.

3.9 Are there similar products in the market? Please specify your competitive advantage?

We offer a unique value proposition of involving our end-users directly into leveraging the information generated by smart meters. Currently there is no adequate solution in place to enable this goal. Our key competitive differentiation is the inspiration to inhabitants by portraying individual energy profile within their neighborhood and encourage them by fostering certain rewards for changing the energy consumption behavior for every individual customers. Further, we think that the collaboration with other services like Antwerp card, will also boost public involvement and strengthen the social gathering.

Competitive Analysis

3.10. Which are the key players (competitors) in the different market segments?

The following are the major companies present in Belgium which are also providing the smart energy meters to the citizens.
a) Eandis (DGO): meters mainly manufactured By Itron and uses Elster (Honeywell group) AMI.
b) Atrias: A joint initiative of the five most important distribution grid operators in Belgium: Sibelga, Infrax, ORES, RESA and EANDIS.
c) landis+gyr in collaboration with ORES.
d) Engie with Sigfox network (1,000 smart water meters will be installed in homes in Antwerp) :
Water-link company : (install 205,000 smart meters covering every household in Antwerp over the coming years.) (ENGIE Fabricom and Hydroko will be responsible for the meters).
Although these competitors provides the same kind of the meters as compared to IMEC which is dominated the smart zone region, the main challenge of motivating citizens for sustainable energy use lies with all the players. All the companies experiencing the same tough task of convincing citizens to change their behavior so that the overall energy consumption will be less and sustainable in nature. The association with Antwerp Card through Antwerp Municipality can prove to be effective way to utilize the already existing rewards/points service to encourage people of Antwerp.

3.11. Comparison of the competitors' key products by characteristics

Product-wise, all the smart meters are same and effective in nature by each company. However, it should be noted that some of the meters provider concentrate with one particular aspects like ENGIE with collaboration of some companies in Belgium focus only for water supply and usage.

The product Smart-Meter is same for all manufacturers. Also, the performance-wise most of the meters have same kind of outcomes and have similar kind of characteristics of life-time, size, cost of manufacturing, etc. In fact, in Antwerp the implementation and integration of smart meters by IMEC under initiatives of City of Things, with IOT goes one step further by sharing visuals of real-time energy consumption on info-screen throughout Smart-Zone with deployment of automated metering infrastructure for smart city application.

In general, the Cost: ~$25, Lifetime: 5-7 years, Size: < (300x 250x 150).

3.12. Define the positioning mapping according to the variables that differentiate yourself from competitors and that are valuable for your customers

We know that, deployment of smart meters already curbed the energy consumption of the user compared with traditional meters by providing accurate energy consumption. With the implementation of the proposed solution, the individual consumption will further reduced to the optimum level. Although the smart meters have been supplied by energy companies, it is possible to integrate the data generated by this device to the reward mechanics such as discount coupons to entice the citizens of smart zone. In early stage, IMEC with the assistance of major energy producers may have to invest marginally in rewards which will be gifted for the best performer to encourage citizens. However, It can be envisioned that the reduction in energy consumption over time should surpass this investment cost incurred initially.

Figure (8): Position mapping for the recommendation on Smart Meter servicing

The increase in cost by the given recommendation can be due to slight modifications on smart meter data sharing platform which needs to be incorporated with attractive and effective informative visualization details screen and energy consumption guiding expenses. As IMEC already finalized to install information/advertising screen in smart zone, the cost of erection, installation and commissioning of these screen are not be considered here. These screen along with its original information/details will also be used to encourage inhabitants to reduce energy usage by showing best performer in their locality.

3.13. Threat of substitute products/ services. Threat of new entrants. Are you aware about other similar products under development?

Smart Meter is the only device which integrate the basic needs of the people with the energy suppliers /producers in the real-time platform. Till now there is no other product which can replace the smart-meter and provide the same functionality to consumer and producers. It is because of this reason, there should not be any threat of substitute product in near future. Regarding services provided by smart meter, it is considered as the latest technology to provide all the information concerning energy usage. From the view point of the reward mechanism such as planting trees, discount coupons, etc., several substitutions will indirectly lure inhabitants as it foster more options for them to choose and keep interested.

Value Proposition for Customer

4.1 Why will the customer buy your solution and what will he sacrifice?

The user attains the following advantages on using our services:

1. Customized recommendations for energy optimization.
2. Reduction in energy/electricity bills.
3. Ease of adaptation.
4. Compare the results with the communities to compete for social rewards

The user shall have to sacrifice on sharing their consumption data with the service providers.

4.2 Quantify the impact of your product/service for the customer?

According to the finding of International VaasaETT and of an energy efficiency study conducted by Trilations that covers 470 households in Flanders. The average savings per household from the practical utilization of the information by smart meters is around 4.5 %. Generalized to Flemish population this means an average of gain of 2.6 % of electricity.

Considering an average household of four people, the average electricity costs alone according to luminous standards is 1440 euros. A saving of 4.5 % of energy would translate to a saving of 65 euros per household per annum.

Product/Service Definition:

We propose the solution to our challenge as a consultancy service together IMEC and it's partners in which we will provide technical comparative analysis of the user's Smart meter information with the optimal usage behaviour and will provide recommendations accordingly.

5.1. Characteristics and attributes of the Product/Service to be developed

Our solution mainly comprises of a Service and following are its main attributes and characteristics:
Our team of experts will get the User's Smart meter data with their consent, then these experts will analyse this data and by looking at the consumption behaviour of the users will deduct an optimal usage pattern for them. Then we will present out report to the user in the form of comparative analysis and recommend them the changes they require to do in their behaviour in order to reduce their energy consumption and contribute in the transition towards Renewable energy.
Our team of experts will further keep on analysing the users behaviour periodically and monitor the changes. In order to develop a sense of responsibility among communities we, together with IMEC and its partners can provide some awards and Green certificates to the houses and communities with the best energy consumption patterns.

5.2. Innovative and Differentiative features

Following are our innovative and differentiating features of our service:

- Providing a comparative analysis to the users to aware them of their actual energy consumption pattern.

- Make them realize what they can actually achieve by changing a little bit of their behaviour.
- Motivate them by giving them awards and green certificates.

- Bring the sense of responsibility among all the citizens and the communities to contribute towards the climate change issue.

5.3. What we need to achieve by the end of this project

By the end of this project we need to have a fully working business plan for our service as we foresee a business opportunity in this market area and we want to utilize this projects working time analyzing this business area. Our main goal will be to provide a viable solution to the IMEC's challenge through our business plan.

5.4. Proposed technology for the Product/Service

The technology which we propose for our solution is already present with IMEC as they are using 5G technology and IOT for their products like smart meters. We need to have enough information about smart meters like what can be the minimal amount of energy that a user can use without wasting energy and by changing their behaviour. We need to know how to predict by looking at the consumption pattern that how can they change their behaviour to consume energy in an efficient manner.

IPR Protection

6.2. How do you intend to protect foreground IP developed in your project?

Since the project is at its initial development stages, a formal background IP does not exist. The proposed solution is aims to build upon existing knowledgebase and open source technologies. Following successful implementation of the project, the data captured using smart meters, consumer-facing mobile apps and online platforms used as part of the solution will be anonymized. The insights developed using that information will be subject to copyrights when published. Ongoing data processing will allow us to establish meaningful knowledge that could be protected as an Intellectual Property for our company.

Initial Business Model

7.1. Exploitation strategy definition

Exploitation strategy refers to the deliberate use of the available knowledge for commercial purposes. In the case of our business proposal, we intend to use the data available from smart meters and deliver useful insights to end-users such that their energy consumption behavior changes in favor of positive environmental impact. The data itself will remain as a property of respective owners and will be made available through formal consent for our project to process, deliver mobile app services and other relevant technology solutions toward sustainable energy efficient user behavior.

7.1. Initial Business Model

Our target is to maintain a minimal threshold for our customers to leverage our services. A freemium model is in consideration in addition to a low-cost subscription based pricing model for individuals that prefer not to enroll in the freemium service model. The pricing will be comparable and competitive to other solutions available in the industry. However, we also aim to complement our solution with additional services that may involve transaction fees based on the unique services toward energy efficiency improvement offered to individual users. Both the freemium and subscription based pricing model could be combined in a tiered structure to allow the consumers the flexibility to choose based on service requirement and budget. The subscription cost will not exceed 15 percent of the average monthly utility bill for single family households.

Investment and Financial Returns

8.1. Initial Business Model

The initial financial investments required are evaluated below:

- Mobile app development: EUR 15.000 to 20.000 CapEx
- Advertisement and marketing: EUR 5000 for the first 12 months
- Team building and employee payroll: EUR 250.000 for the first 12 months
- IT infrastructure expense: EUR 30.000 for the first 12 months

The expected operating investment for the first year are expected to reach EUR 350.000

Annexure

Smart Cities Week Barcelona (Nov 2017)

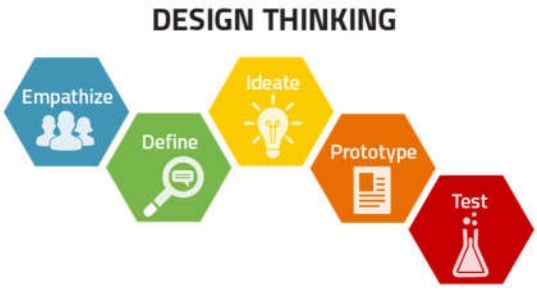
A. Application of SIT Innovation Methodology

B.

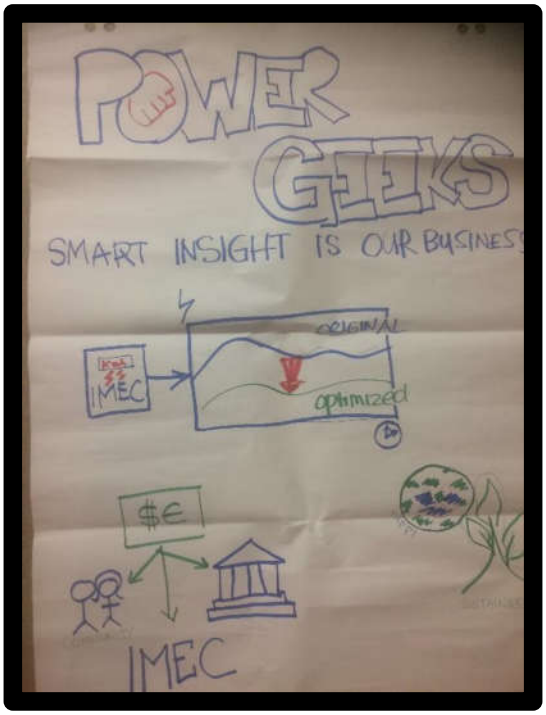
The first workshop on Monday was given bby Alex Katz where the team learnt an important too in Systematic Incentive Thinking namely the elimination method. The elimination method involves listing down of different key components of your products and then taking it away and building a scenario/product/service in the absence of the key element. This tool was quite powerful and not easy to wrap our heads around but after a sew iterations with this powerful innovation tool we came up with different solutions for motivating citizens and making them more aware of their consumption and behavior.

C. Application of Design Thinking Methodology

Design thinking methodology revolves around understanding the customer well and is solution oriented rather than being problem oriented. The main stages in design thinking methodology involves the following steps:



The technique proved to be quite helpful in understanding better the needs of our customers in specific understanding the needs of the inhabitants of the smart zone in Antwerp, their pain points, problems and desires.



D. Market Research

The market research was mainly conducted during the Smart Cities World Energy Congress 2017 in Barcelona. The team met with a number of companies working in the domain of manufacturing smart meters and also providing user interface design apps that go with these smart meters to make them more user friendly. Since there were not many households and buildings with smart meters and the our problem mainly focused on the smart meters users in Smart Zone, the customer surveys was conducted in Antwerp in the

E. Team Roles and Pitch Presentation

During the team building workshop, the team was tasked with a team building exercise with time constraints and resource inefficiency to depict real life challenges and after the task we were asked to analyze and pick out the positives and negatives, to improve on the negatives and to build on the positives. For the pitch presentation session we finally presented the following solution:

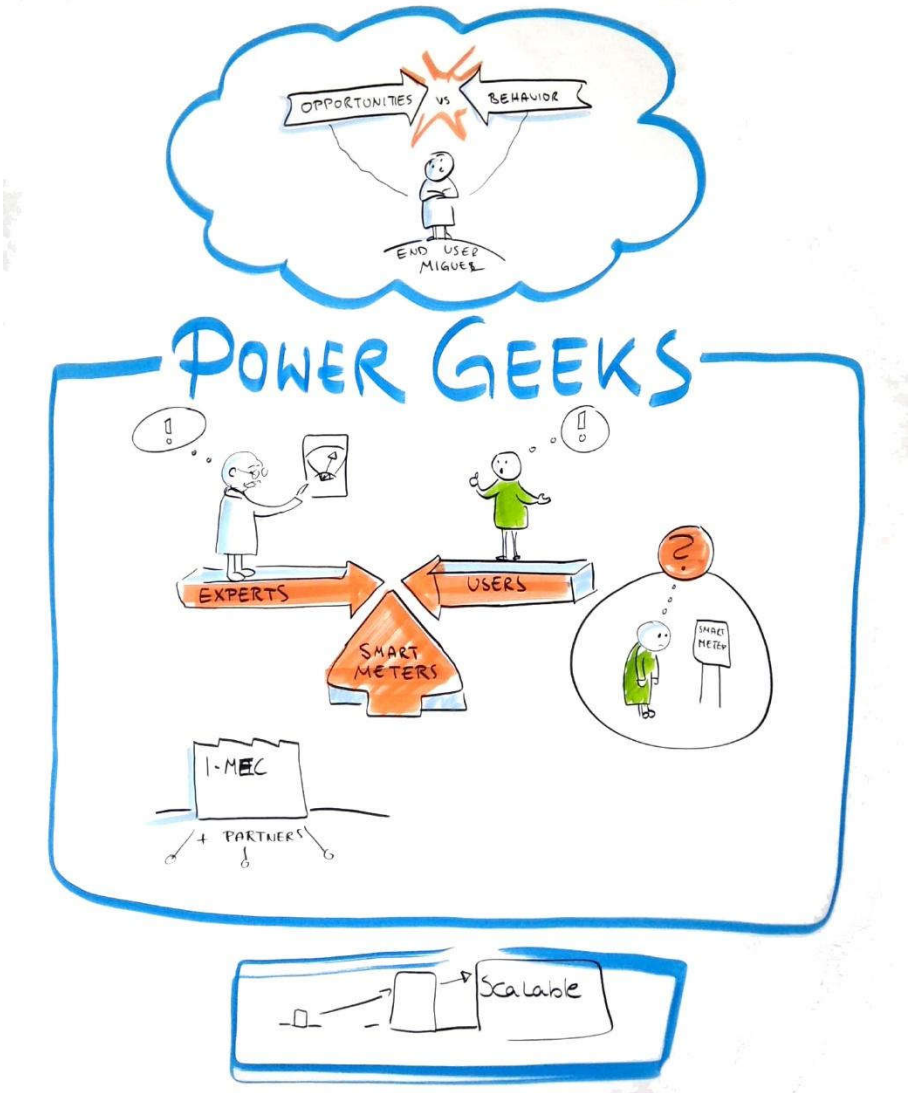
"*We propose our solution of an expertise services model together with the IMEC network of partners to provide an accurate comparative analysis of current consumption behavior versus an optimized energy consumption behavior, both at an individual and collective level.*

Through minimal participation of end-users, and by leveraging the existing and available knowledgebase pertaining to energy consumption in conjunction with the real-time data generated by the smart meters, the Experts will be able to:

-Identify and visualize current utility service usage pattern.
-Identify the malpractices that lead to energy wastage and cause unnecessary consumption during peak hours unique to each end user and also look possibility of deploying intelligent agents such as those that would automate the process of contributing toward sustainable energy usage. Well, think smart lighting!

All of these changes will enable an optimized utility service consumption pattern, which we can quantify, visualize and compare with the current usage pattern.

Consumers that proceed with execution of the proposed recommend, will see the rewards channel back to them in terms of fulfilling the objective to contribute, viably leverage the latest technology innovation at a cost model that's subsidized by all beneficiary. Stakeholders, and acting upon the changes without having to disrupt their routine lifestyle ,additionally we can create rewards and certification mechanism that acknowledges their contributions on an individual and aggregated level to enable continuous and ongoing improvement of the community."


OPPORTUNITIES
VS
BEHAVIOR
END USER
MIGUEL
POWER GEEKS
EXPERTS
USERS
SMART METERS
SMART METER
I-MEC
+ PARTNERS
Scalable

Antwerp Bizboot Camp (March 2018)

A. Business Model Workshop

On the first day of training workshops the team was coached by Kris Vander Velpen, an expert in business modeling strategies from Flanders Business School. The workshop focused mainly on the three head challenges that any startup might face in business model development.

First Challenge: Choosing the most important customer and building around them
Second Challenge: Identifying our Value Proposition
Third Challenge: Startup and Scalability.

Based on the guidance by the coach and with the help of Mar and Xavier we re-iterated with our business model canvas.

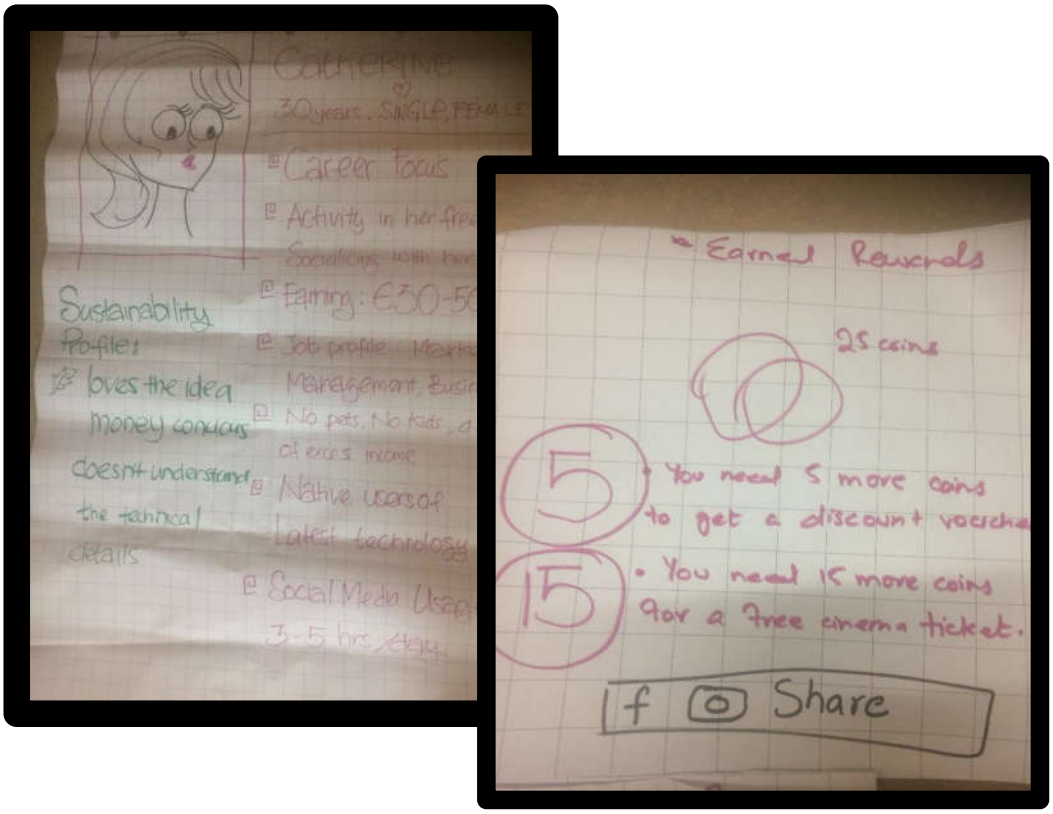
B. Application of New Innovation Tools

The second coaching session was by Alex Katz, where our team was introduced to different methods of innovation mainly Task Unification. In task unification we were taught to identify a closed world and list down all the internal and external components of the closed world. After identifying different components we assign additional tasks to these components and identify the product. After different combinations the products/services are filtered through a feasibility analysis to see the realistic implementation. As an example we tested this method

On bike rental services and came up with different solutions to avoid vandalism by irresponsible citizens, like making the bike modular so that the person with the correct pass code can take off two modules of the bike and clip them together. Another one was to implement the lights and such critical components within the hard frame thus assigning an additional task to one of the components. After practicing with this tool, we took it on to apply it to our task of motivating citizens towards the use of smart meters and came up with interesting combinations which proved to be quite helpful in coming up with the current solution that we now provide.

C. Prototype

For the prototype development workshop we were coached by Dr. Robin De Croon a Post doc at KU Leuven University. We learnt the importance of user interface design and the importance of paper prototyping. Development of different personas for customers and classifying their personas into categories was pretty helpful. After the coaching in the room we went on to create our own prototype, first on paper and then on user friendly online interfaces like proto.io. We tested our smart meters app with different people that were unaware of the idea to have as little interference and based on the feedback were able to improve the final application prototype for the final pitch session.



D. Intellectual Property Applications

The intellectual property session was given by Daniel Closa from the European Patent Office. The workshop was mainly in two parts, for the first part we were taught about how the European Patent Office works, the processes and timelines associated with patent filing and the significance of a patent especially for a product based startup. The second part of the workshop handled more of the tricky domain of computer implemented Inventions followed by a series of QA session.

E. Work Plan and Next Steps

For the next step in this project we shall focus on the business model of the companies like Airbnb, Uber and Tinder and how these companies make use of the already available passive resources creating shared ownership. We plan to build further on the idea of shared smart appliances whilst minimizing energy consumption and also utilizing smart meters to identify the costs associated with renting and sharing these smart devices.

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