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Smart meter business case scenario for Denmark

Developed for **The Danish Energy Association,**

by the **Capgemini Utility Strategy Lab,** representing the

Global Centre of Excellence for Utility Transformation Service

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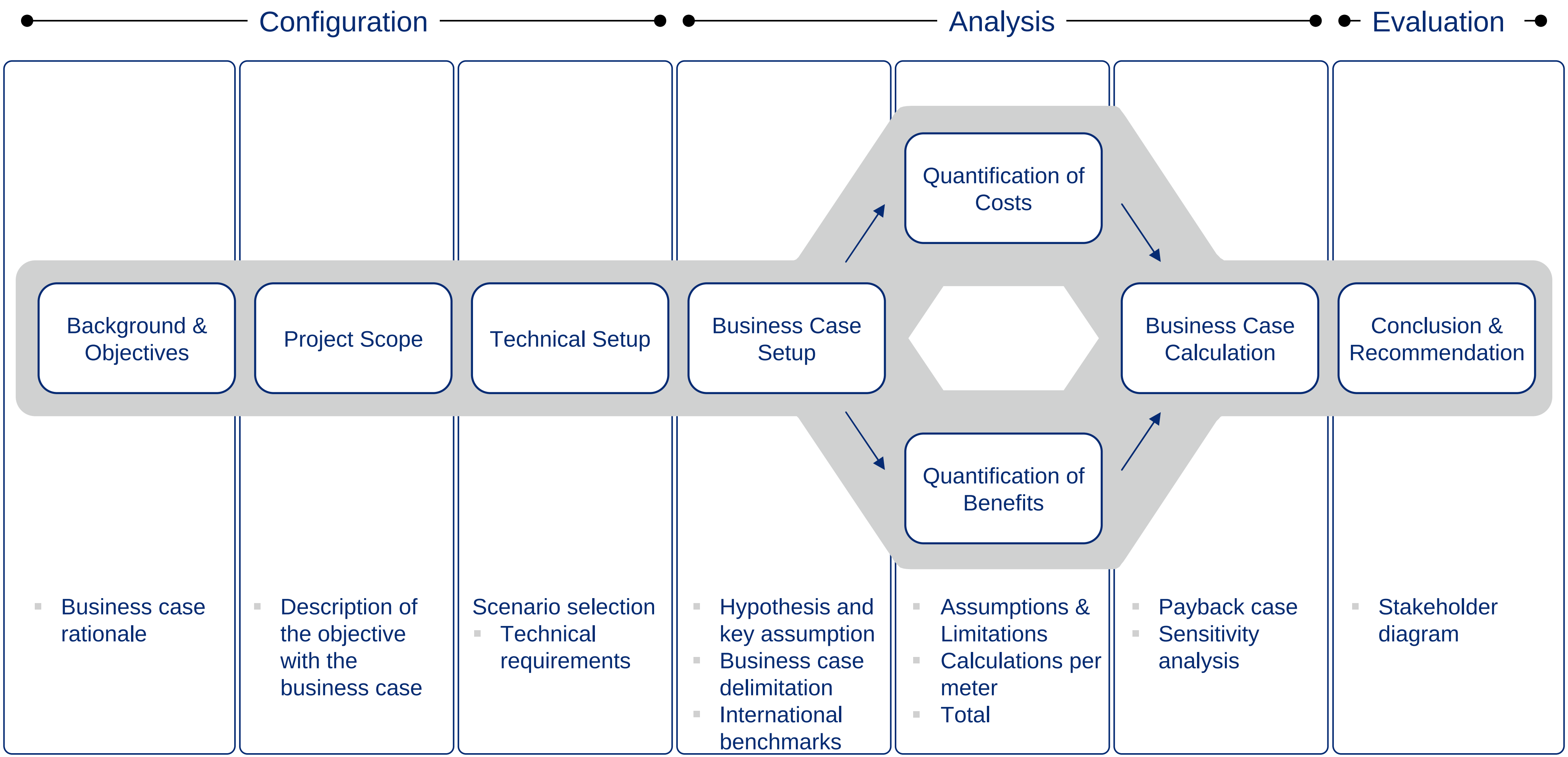
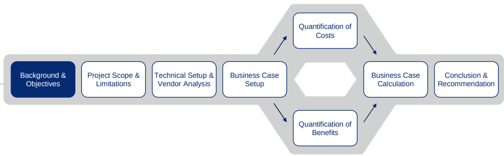
Executive summary

- Smart meters have the potential to provide new opportunities, which will improve the way electricity is distributed and consumed.
- Smart meters have the potential to generate value for all participants in the electrical energy market (incl. generators, TSOs, DNOs, energy supplier, consumers, governmental institutions). In Denmark the participants are currently discussing solutions and scenarios for a sustainable smart meter market solution, where one of the central questions is “who is going to pay for the smart meters, and the installation and maintenance of the smart meters”. One scenario is that the DNO is to pay for all this.
- This business case analyse, from a Danish DNO perspective, the feasibility of a smart meter system implementation, and examine all relevant cost and benefits over a 20 years period. The business case is developed for a virtual Danish DNO, with 100.000 meter points, that has a typical business and technology setup. The scenario is that the DNO will covert all the old meters with new smart meters over a period of three years.
- The business objectives with the installation and integration of the 100.000 smart meters are to measure ’15 minutes consumption data and communicate this data to an IT back-end system, to market players as basis for retail billing, and as EDIEL messaging.
- The cost of the project result in a negative NPV of € -23,6 mill. due to benefits offset by running costs by € -17,1 mill. and investment cost of € -17,8 mill. The main reason for the negative NPV is that the DNO’s smart metering running costs are clearly higher than the running benefits. The running costs are € -16,5 per meter and the running benefits are € 11 per meter. The investment cost results in € -182 per meter.
- Sensitivity analyses show that installation costs are unlikely to decrease in the near future unless the price of the new meters becomes significantly lower. The analysis furthermore show that both running costs and benefits have an elasticity of around 10, which indicates that there are significant NPV improvements to be realised through focus on integrated improvement programs and/or wider strategic focus. This emphasises that it is not enough to invest in the most basic smart meter solutions.
- One needs to think in wider strategic solutions that can unleash more value potential. To get full ROI, a solution has to be considered and designed across the whole utility value chain, including e.g. strategic alliance partners.

A structured and common approach towards setting up the business case has been undertaken reflecting the requirements set out by the Danish Energy Association





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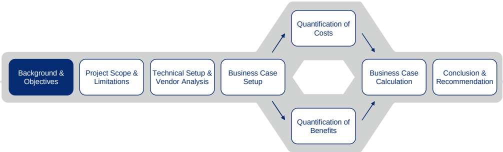
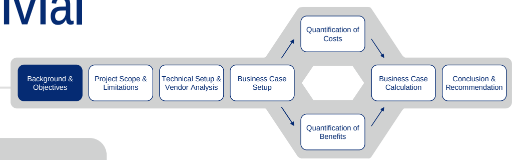
From electromechanical infrastructure towards a digital intelligent infrastructure



- Historically, the compliance-based industry in which utilities operate, have not offered enough incentive for consumers, regulators or utilities to take the difficult steps necessary to make electrical energy markets operate efficiently.
- Since the ‘recent’ inception of electricity deregulation and market driven pricing around the world, government regulators have been looking for ways to match consumption with generation.
- Traditional electrical meters only measure total consumption and as such provide no information of when the energy was consumed.
- Smart meters on the other hand, will change this and provide new opportunities which will improve the way electricity is distributed and consumed. A smart metering system is allowing two-way communication between the distributor, energy suppliers and energy consumers on the one hand, and the energy meter on the other.
- When looking beyond the meter-to-cash process, smart meters have the potential to generate value for all participants in the electrical energy market (including generators, system operators, DNOs, retailers, consumers and governmental institutions).
- This potential will be fully realised when applying a wider strategic mindset to smart metering programs, by considering the investment as the foundation of smart grid or intelligent network initiatives.

One thing is certain; doing nothing about the electrical infrastructure is not an option. The current state of the electrical infrastructure in Europe is not sustainable.

If smart meters provide many new business opportunities, why have they not yet been implemented everywhere? – this is because the business case is not trivial



The owners of the meters in DK are the DNOs, who also are the natural investors of the smart meters, though the other beneficiaries of the smart meters are the generators, system operations, consumers, the retail companies and the government.

The complexity is multiplied because the potential value of the smart meters is not necessarily being paid back to the investor, but unequally distributed between other beneficiaries.

It is complex to measure the ROI, including possible new meter functionalities/potential benefits, various data transmission systems, integration with existing systems as well as the maintenance.

The smart meter business case is not trivial

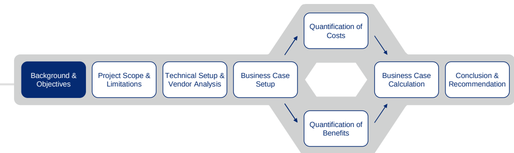
As the utility companies gets partly and fully unbundled retail and distribution businesses, it becomes unclear how the DNOs can justify their investments in smart meters.

In the traditional ownership model, all the utility functions had a single owner and benefits that crossed multiple business segments (e.g. distribution, transmission, generation for electricity) could be paid for by the single owner of the utility.

How much of the cost has to come from internal savings? How much of the cost is considered new capital or new operations and maintenance (O&M)? In the end of course the customer will ultimately pay the cost, they always do.

As the utility value chain continues to be pulled apart, the answer to the "who will pay" gets more complex

Smart metering objectives of the regulatory bodies in the EU are often three fold



Regulatory objectives	Description
Improve the functioning of the electricity market, in particular in the interest of consumers	The benefits sought include informing consumers about their consumption, the frequency and quality of billing (actual data), access to metering data by the players, the introduction of new supply and service offers, the fluidity, speed and reliability of market processes (actual registers for change of supplier, remote operation of the meter for commissioning or cancellation), correction of random variations of the flow reconstitution mechanism (reading made more reliable and systematic, evaluation of losses by calculation, increased reading frequency, larger number of interval data).
Minimize network management costs while maintaining the quality of supply and service	The benefits sought include reading costs (planning of rounds, wasted travel, sharing of gas meter reading costs), the costs of particular operations (cut-off, reconnection, recommissioning, cancellation, change of authorized maximum power, reprogramming of the meter), the cost of the change of supplier to the network manager, the cost of fraud, the costs of processing billing complaints (questioning of estimate), the tracking of quality of supply, the fact that the customer's presence is not necessary for simple operations
Demand Response: demand side management and easier insertion of micro-generation	Through better consumer information and new peak/off peak offers, the demand of energy can be better managed, and may help to reach ambitious objectives of energy savings. With smart metering systems, microgeneration (such as solar, wind, micro-hydro, etc.) can be better included in the global power system and therefore encouraged.

However, these objectives are not necessarily compliant with objectives of the individual market players

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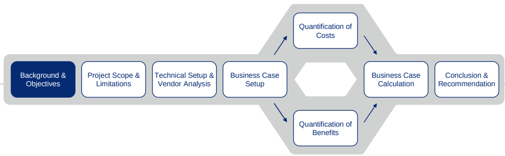
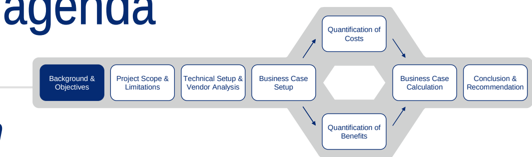
Even though the regulatory bodies often agree on general objectives with smart metering, there are no two similar answers to incentives and legal frameworks



- *Legal framework and main orientations of smart metering experience in selected countries, source Capgemini 2007*

Countries	Legal framework	Institution involved	Main orientation
Sweden	None (not mandated by law)	Parliament	June 03: monthly billing on basis of actual data from July '09 DNOs to inform cust. of power outage & to indemnify them Deployment to all cust. needs to complete prior to July '09
The Netherlands	Draft bill of February 2006	Ministry of Economy	All LV customers will have smart meters incl. communication and connection to AMM on commercial option Smart meters mandatory for all new electricity contracts
Italy	Deliberation 292/06	AEEG (Regulator)	Directives for the installation of smart meters on the LV electricity network
Germany	No specific legislation	VDN (Association of Electrical operators)	Smart metering working groups that created the eHZ program
United Kingdom	No specific legislation	OFGEM	Business case demonstrating the absence of economically viable solutions
California	Energy Action Plan I & II	CPUC (Regulator)	All DNOs required to submit business cases Financial aid for deployment Goal is completion of a 20 mill. deployment prior to end 2012
Ontario	Directive (conversion of meters) Deployment plan Energy conservation responsibility plan	Government OEB (Regulator) Parliament	Schedule for conversion of LV meters (2007-2010) Deployment of 5 mill. meters prior to 2011 Creation of a smart meter entity to drive integration of the smart meters and data collection systems

It's no surprise that Denmark faces similar challenges to those described so far, and the issue of who should pay for the smart meter investment is on the top of the agenda



- *An example of how cost and benefits are varying between stakeholders depending on where in the value chain they belong.*

	Generation	DNOs	Energy suppliers	Customers
Investments		- Meters, Equipment - Meters, Installation - Meters, Customer Service - Concentrator, Equipment - Concentrators, Installation - Metering Information Systems	- IS frontend	
Costs incurred		- Costs incurred		
Operating costs		- Meters, Maintenance - Meters, Communication - Concentrators, Maintenance - Concentrators, Communication - Maintenance IS - Operations IS	- Operations IS - Operations, Services	
Investments avoided	+ Generation	+ Network Optimisation		
Operating benefits	+ CO2	+ Particular operations + Malfunctions and recommissioning + Reduction of NT Losses + Reduction of Technical Losses	+ Customer Service, Reading + Customer Service, Part. Op. + Service Customer, Malfunctions + Reduction of NT losses + Peak smoothing, Sourcing + Pre-payment: unpaid bills	+ Change of supplier easier + Customer presence not necessary + Control of consumption

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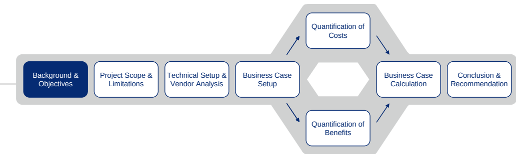
Unfortunately, discussions often seem to boil down to only one or two parties and the potential costs & benefits they face in the case of a smart meter roll out



The first pitfall is that if one party is going to pay the whole cost, they may choose a less costly system with fewer benefits for the whole value chain than if everyone either shared the costs together or the costs were allocated such that the installing party got paid directly by the customer for the other benefits that they hopefully will ultimately benefit from.

While it might be a necessary discussion to have –
it has its pitfalls when it is limited to few parties

The second pitfall is that if too much cost savings is pushed at the installing party, they may choose to stall the installation as long as possible or they may end up with an incomplete system that does not really get all the benefits – the meters are installed, but the systems and staffing to support the operations may get short changed.

Current political energy & climate objectives in Denmark suggest that investments in a smart meter infrastructure would be beneficial and in line with the EU 3x20 vision

Current relevant political energy & climate objectives in Denmark include*:

- Reduced consumption of energy and increased efficiency of energy utilisation
- Increase the development and usage of renewable energy sources (RES)
- Development, demonstration and focus on new energy -and climate efficient technologies
  - This specifically includes technologies which promotes reduction in energy consumption and increase the efficiency of energy production and distribution, as well as advance the usage of renewable energy sources.

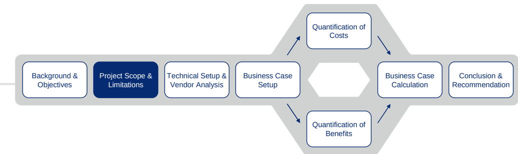
- Strategic implementation and development of a smart meter infrastructure in Denmark would have the potential to enable true “Demand Response” and have a positive impact on all the objectives stated above:
  - “Demand Response” (DR) relates to any program which communicates with the end-customer concerning price changes in the market and/or their own energy use and encourages them to reduce or shift their consumption (*demand*) of energy. The active participation of the end customers is a *response* to factors such as incentive pricing, new tariffs schemes, greater awareness and an increased sense of responsibility.
    - DR programs include at least one of the following:
      - *Peak shifting or clipping:* reduced maximum capacity required at critical time periods
      - *Electricity savings:* decreased over-all electricity consumption throughout the year
  - DR would have an increasing effect in the years to come as the price for electricity in Europe is expected to continue rising rapidly as member states commit to replacing cheap and CO_2 intensive fossil fuel generation with low emissions or renewable alternatives, and as prices for fuel continue to increase. Peak pricing is especially serious as peak demand reaches even higher levels.
  - As mentioned earlier in this section, when applying a wider strategic mindset to smart metering programs, by considering the investment as the foundation of smart grid or intelligent network initiatives, the objective of including increased amounts of RES in Denmark would also be supported:
    - The intermittent (irregular) RES will be easier to integrate in a smart grid due to new technologies and improved grid management opportunities. Distribution grids as they are today might slow down RES integration and development.

*Klima- og energiministerens energipolitiske redegørelse 2008

A step towards a smart meter infrastructure in Denmark

"In Denmark the stakeholders are currently discussing different solutions and scenarios in relation to the many challenges described in this section.

The following analysis will explore one scenario, where costs and benefits of a potential smart meter implementation from a Danish DNO perspective is investigated."



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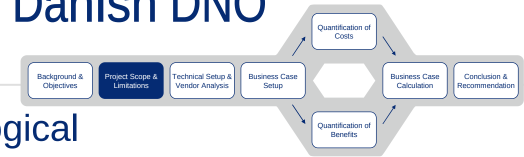
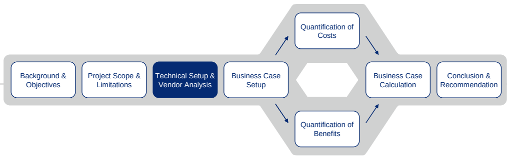
The Danish Energy Association has asked Capgemini to build a smart meter project valuation model, that can be used to address the costs and benefits for a typical Danish DNO



- The scope of this business case is, from a DNO's perspective, to address the technological framework for a roll out of smart meters in Denmark, as well as the associated costs and benefits.

Assignment	Description
Technology framework	▪ The technological framework will assess the expected level of functionality requirements, described by the Danish Energy Association. ▪ Deliverables: • Assessment of the functionality requirements from the Danish Energy Association
Cost/benefit analysis	▪ The cost/benefit analysis will be based on the functionality requirements set by the Danish Energy Association. Capgemini will analyse and describe the cost of implementation, as well as the benefits of smart meters based on Capgemini's benchmarks and best practises from Germany, France, Netherlands, Italy, Spain and US. ▪ Deliverables: • As-is cost structure of smart meter implementation and conclusions for Denmark, based on Capgemini's benchmarks and best practices. • Potential benefits for distributed network operators (DNOs), based on Capgemini's benchmarks and best practices.



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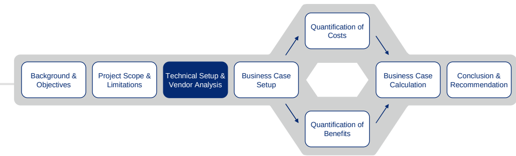
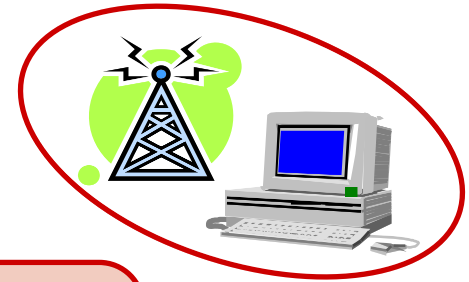
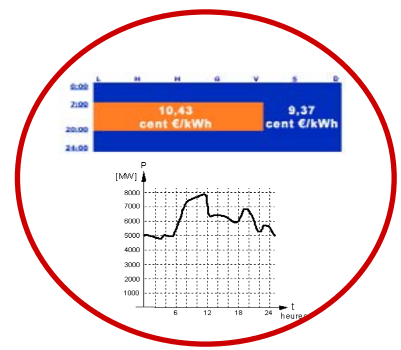
The basic smart meter set-up (requirements)



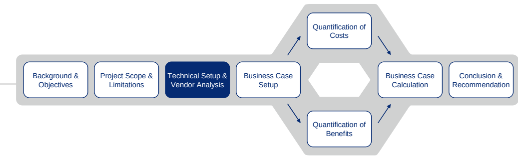
- The requirements set by the Danish Energy Association is compliant with the large smart meter vendors' standard smart meter functionalities

Functionality	Description
Meter reading	Remote
Meter reading (load curve)	1 / week
Data collection and sampling	Data is collected to the DNO every 15th min.
Disconnect	Remote
Advanced meter mgmt.	Yes – incl. remote updating, data pull on demand
Communication with external devices	1 two-way local interface (open standard)
Acquisition and storage	Consumption and delivery quality
Meter resolution	1 W
Future functionalities	Support new flexible tariffs and offers



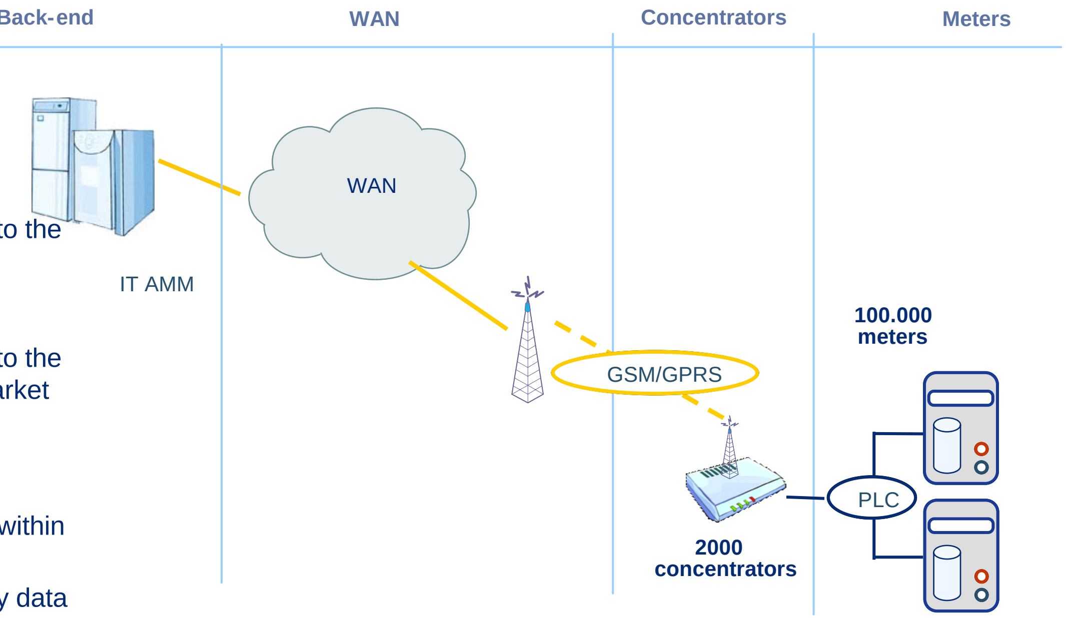


The chosen system architecture is a typical three tier smart meter system architecture



- The system architecture consist of a smart meters, concentrators and a receiving advanced meter management system that is integrated with the backend IT systems

Functionality	Description
System availability = 99,9% within 24h	99,9 % within 24 hours
Registration of disconnection and load quality	
Web access for consumers	Data is communicated to the consumers through the Internet
EDIEL messaging	Data is communicated to the market players after market standards
	Meter data for small consumers are to be forwarded by the DNO within 10-14 days
	Large customers' hourly data are communicated by the DNO within 3 days



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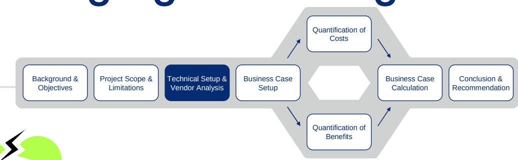
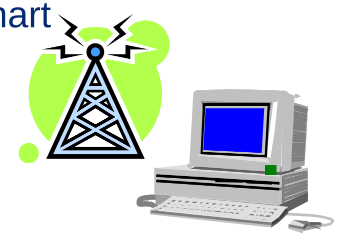
The smart meter system that has been chosen has to be prepared for emerging technologies



- The system has to include open standards (e.g. MBUS) to communicate with smart boxes, household appliances etc.

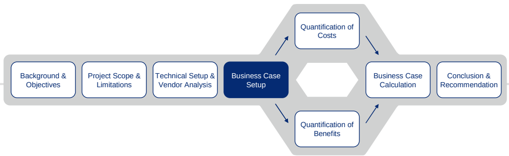


Future functionality

- External display
- Automatic interruption of household devices
- Transfer of legal / certified data
- Support for AMM type commands
- Dual or multi utility meters

Description

Access to consumption, historical data, information from retailer, prices and tariffs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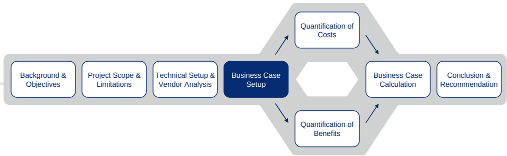
Project Scope & Limitations
Technical Setup & Vendor Analysis
Business Case Setup
Quantification of Costs
Quantification of Benefits
Business Case Calculation
Conclusion & Recommendation

The business case is based on a virtual Danish DNO with a typical Danish business and technology setup



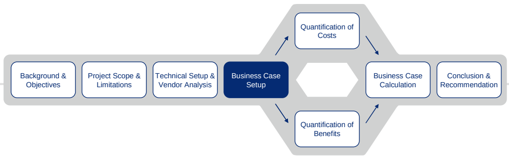
- The virtual Danish reference DNO has 100.000 meter points

General business case assumptions

Assumptions

- The business case is made only for the DNOs perspective:
  - Generally infrastructure costs are associated with DNO's activities as well as shared service (incl. billing services)
  - There exists additional benefits for retailers and society in general, which are excluded in the calculation
- The business case has been calculated for one scenario:
  - A "virtual" DNO responsible for delivering electricity to 100.000 consumers
  - 3-level solution architecture (incl. concentrators)
  - High population density (90% of meters are placed in urban areas)
- Cost/benefit assumptions
  - Costs includes installation, maintenance and running costs
  - Benefits includes only running benefits
  - Shared services cost/benefit spit is included regarding billing and call centre
- Baseline assumption
  - Costs and benefits period 20 years
  - Deployment period is 3 years
  - The main investment is made during the first 3 years
  - Full costs and benefits are realized after smart meters are installed
  - Discount factor of 6%

Delimitation in the business case

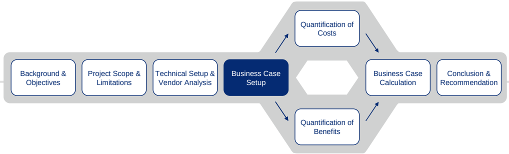


General business case delimitations

Delimitations

- The cost and benefit calculation does not include economics of scale regarding supplier bargain, shared assets (IT systems, hubs, multi utility meters)
- It is assumed that each DNO will have to manage a dedicated smart metering project without sharing any project component with other DNOs except the global architecture of the solution (see separate figure)
- Financial cost/benefits are not included, e.g. after tax benefits (write down of old meters), cash flow cost/benefits due to change of billing cycles
- The business case does not include extra costs nor benefits regarding new billing cycles
- The market data is not to be forwarded as quickly as the rule for hourly measured large costumers. A faster forwarding of data is expensive, and the many small consumers consumption is limited and does not rectify the same forwarding speed as for large customers.

The virtual Danish DNO is accountable for 80-90% of shared service cost and benefits related to customer services in the same utility corporation



- In typical utility corporation, the experience is that the DNO accounts for 80-90 % of the shared services (call centre & billing)

DNO

- The DNO is accountable for:
  - 100% network and infrastructure costs
  - 100% metering and collection of meter data
  - 100% of meter data validation and processing
  - 100 % of EDIEL messaging
  - 100% of billing distribution services
  - 80% of billing consumption cost and benefit
  - 90% of call centre benefits

Network & infrastructure → Metering → Collection of meter data → Data validation and processing

Information (consumption) →

Retailer

Shared service centre

Billing DNO services ↔ Billing

80% cost/benefit split

20% cost/benefit split

Call centre ↔ Call centre

90% cost/benefit split

10% cost/benefit split

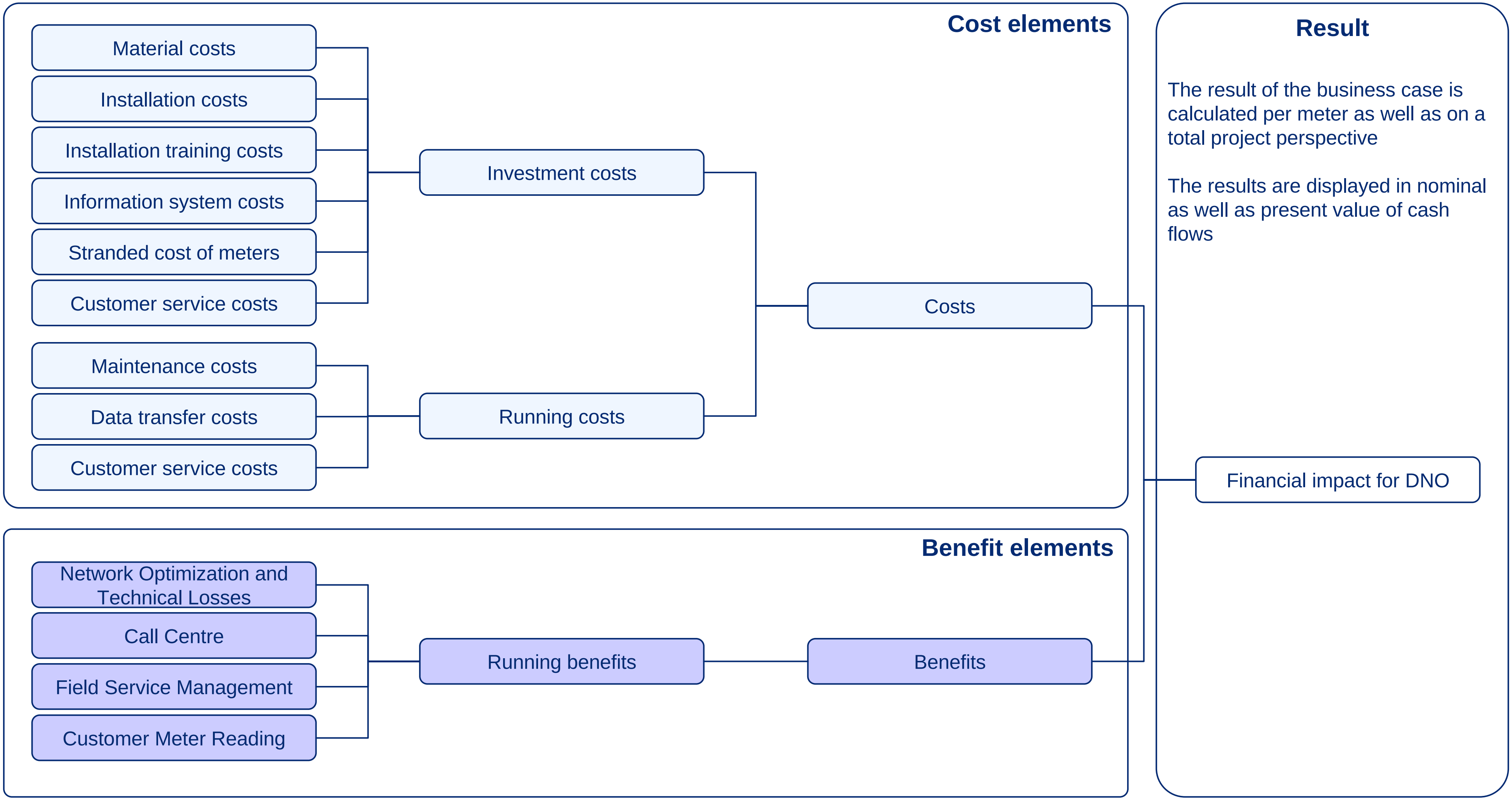
Market obligations

EDIEL messaging

100% ownership

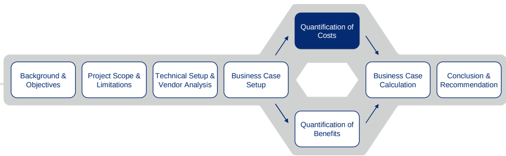
Overview of the cost and benefit split, which illustrates which DNO cost and benefits that are calculated in the business case

The business case logic summarises the elements of the business case leading to the resulting financial impact for the DNO



The result of the business case is calculated per meter as well as on a total project perspective

The results are displayed in nominal as well as present value of cash flows



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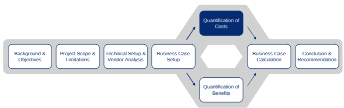
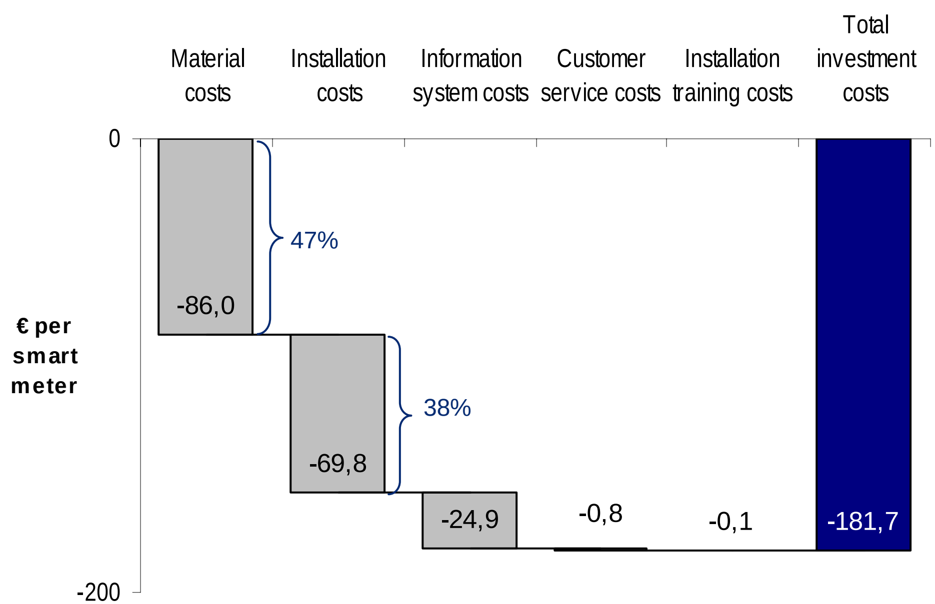
Material costs account for 47% and installation costs for 38% of the overall investment costs



Average total investment cost amount to € -181,7 per smart meter

Breakdown of investment cost per smart meter



3 years installation program

Material costs are calculated for

- Average price of smart meters of € 74 for 90% three phase (€ 75) and 10% mono phase (€ 65)
- Average price of concentrators of € 12 per meter

Installation assumes that an average of

- 10 meters could be replaced in urban zones
- 4 meters could be replaced in rural zones

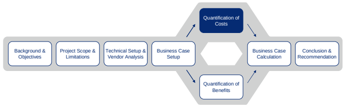
Roughly 20 installers are needed for the 3 year period

67% of meters are placed i house – appointment and customer presence required for the replacement

Well defined replacement processes / logistics and customer acceptance are key success factors to limit the cost of installation. Some lessons learned from previous smart meter implementations:

- Invest in customer communication and marketing
- Provide customer assistance through call centre for both outbound and inbound calls
- Consider 15-25% missed first appointments

Overall investment cost per meter are below the € 200 threshold



Cost element – Investment costs	Costs per meter [€]	Total costs for 100 K meters [€ mill.]
Material Costs	**86,00**	**8,60**
Smart meter	74,00	7,40
Concentrator	12,00	1,20
Installation Costs	**69,81**	**6,98**
Meter Installation	63,98	6,40
Concentrator installation	5,78	0,58
Modem installation	0,05	0,00
Information system costs	**24,91**	**2,49**
Backend IT integration (Incl. internal and external resources)	15,83	1,58
IT Servers	4,68	0,47
MDMS software and installation	4,40	0,44
Customer Service Costs	**0,84**	**0,08**
Installation Training Costs	**0,15**	**0,02**
TOTAL COSTS	**181,72**	**18,17**[1]

1 "cash out view" simply calculated by multiplying cost per meter and total number of meters

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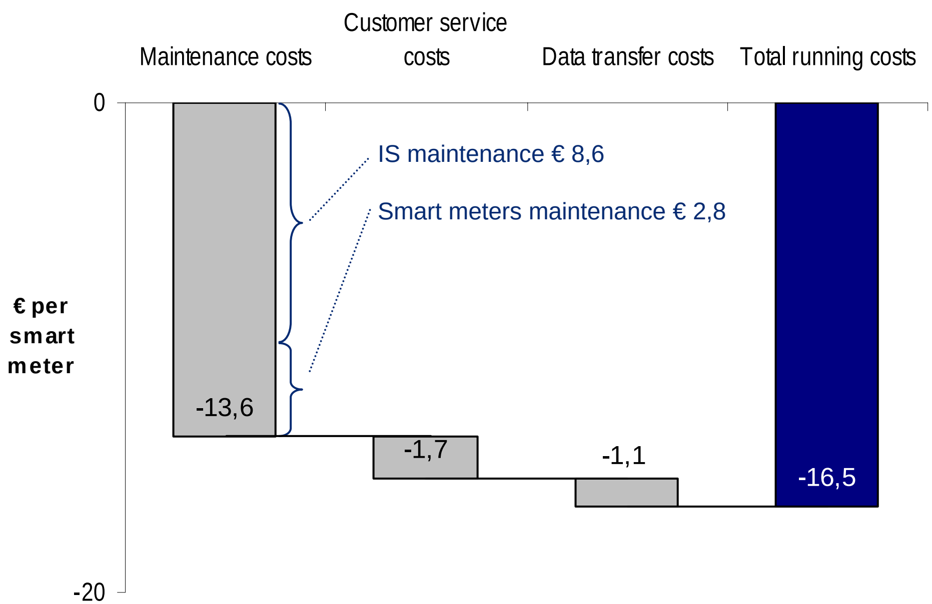
IS and meter maintenance drives the running costs

Average total running costs amount to € -16,5 per smart meter per year

Breakdown of running cost per smart meter



Maintenance costs

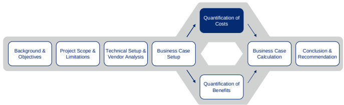
Maintenance of information systems is the primary driver of the running cost amounting to € 8,6 per meter:

- 7 FTEs are dedicated to IS maintenance
- Total cost of an IS employee of € 123.200 per year including 100% overhead

Maintenance of smart meters amount to an average of € 2,8 per meter. Maintenance costs are based on the assumption that:

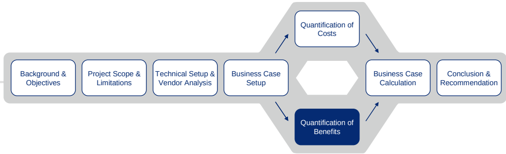
- Annual replacement of 1,5% of smart meters
- 7 meters urban zones and 4 meters in rural zones could be replaced per day per FTE

IS and meter maintenance drive the running costs



Cost element – Running costs	Costs p.a. per meter [€]	Total costs p.a. for 100 K meters [€ mill.]
Maintenance costs	**13,64**	**1,36**
IS maintenance cost	8,62	0,86
Smart meter maintenance	2,82	0,28
Concentrator maintenance	0,20	0,02
Cost of licenses	2,00	0,20
Customer service costs	**1,69**	**0,17**
Data transfer costs	**1,12**	**0,11**
Cost of data transfer per year with GPRS	0,79	0,08
Subscription cost per year	0,34	0,03
TOTAL COSTS	**16,45**	**1,65**[1]

1 "cash out view" simply calculated by multiplying cost per meter and total number of meters



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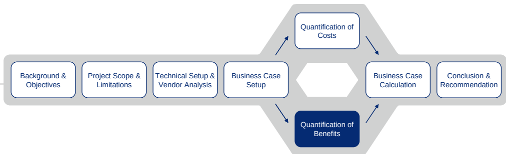
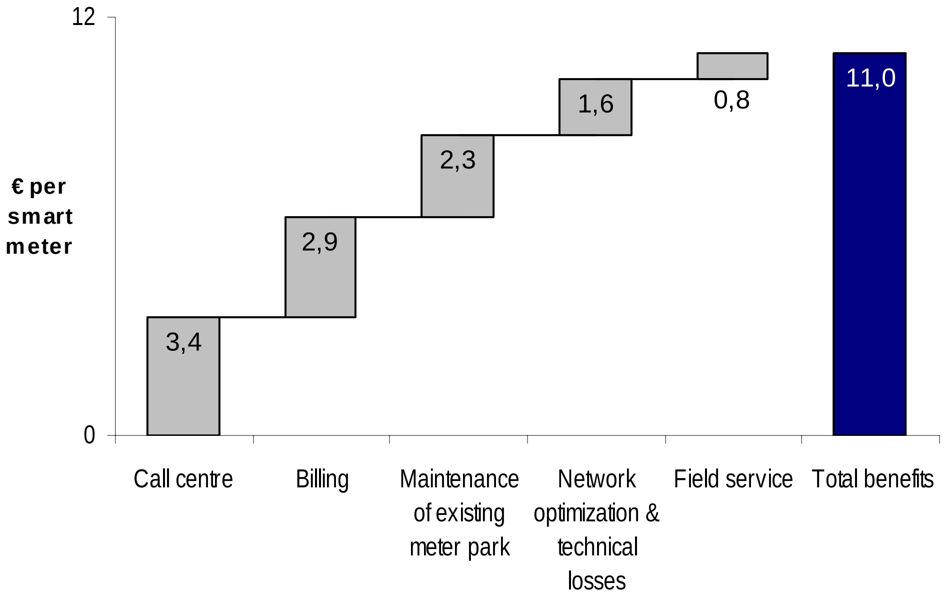
Benefits of € 11 per smart meter per year are estimated



Average total benefits amount to € 11 per smart meter per year

Breakdown of benefits per smart meter



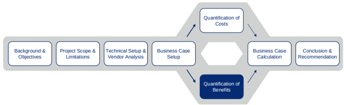
Description

Call centre benefits of € 3,4 are caused by improved meter data leading to reduced number of calls and complaints.

Please note that call centre benefits are partly offset by running customer service costs caused by an increase in the number of calls regarding hourly consumption and rates of € 1,7 per meter per year

Maintenance of existing meter park represent the avoided cost of replacing old defective meters
- Annual replacement of 2% existing meters
- 10 meters urban zones and 6 meters in rural zones could be replaced per day per FTE

Total benefits amount to € 11 per meter per year



Benefits	Benefits p.a. per meter [€]	Total benefits p.a. for 100 K meters [€ mill.]
Call Centre	**3,38**	**0,34**
Reduced # of calls due to improved meter data	1,69	0,17
Reduced # of complaints due to improved meter data	1,69	0,17
Billing	**2,88**	**0,29**
Maintenance of existing meter park	**2,34**	**0,23**
Network Optimization and Technical Losses	**1,58**	**0,16**
Non-technical losses	0,79	0,08
Technical Losses	0,59	0,06
Avoiding oversizing of network	0,20	0,02
Field Service Management	**0,77**	**0,08**
Savings regarding manual readings	0,47	0,05
Meter maintenance - remote prob. identification	0,18	0,02
Remote disconnect regarding debt collection	0,12	0,01
TOTAL COSTS	**10,96**	**1,10[1]**

1 "cash out view" simply calculated by multiplying cost per meter and total number of meters

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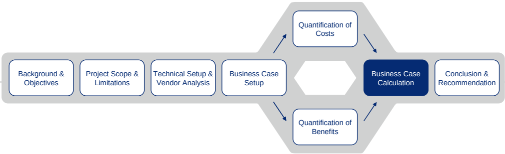

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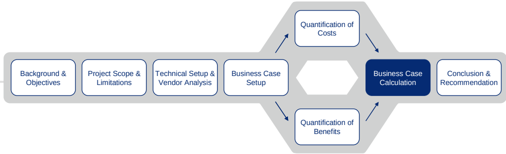
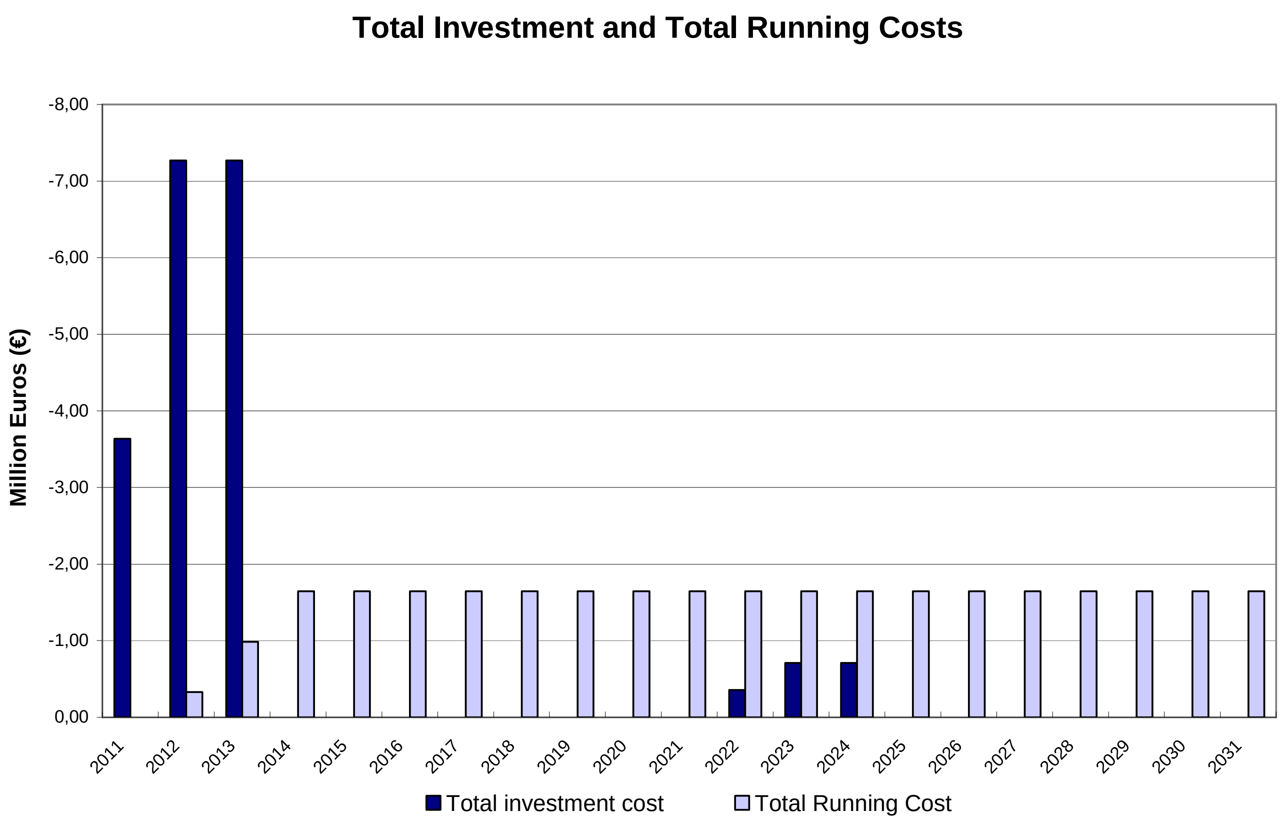
The costs incurred during the implementation period account for 50% of the projects total costs at present value



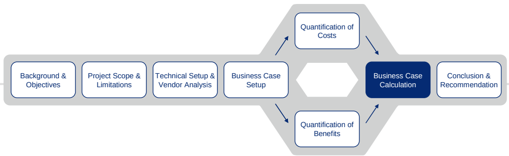
Distribution of total costs over the investment horizon



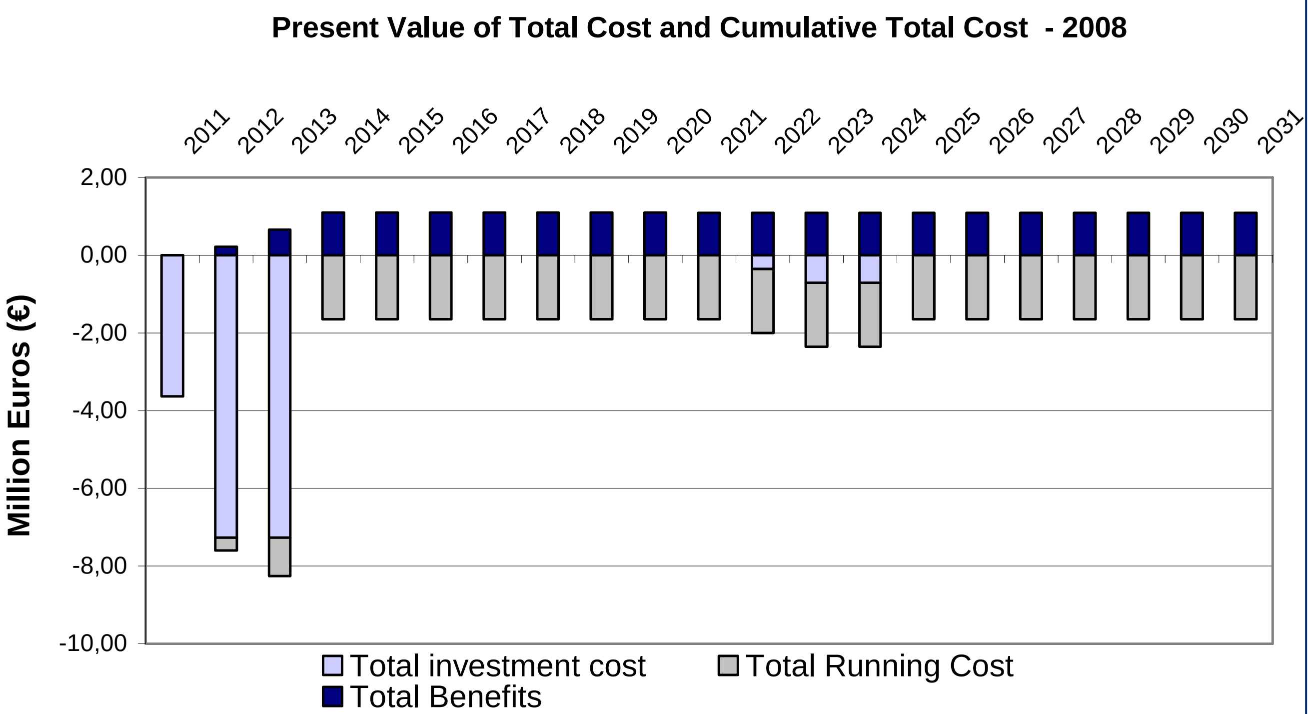
Costs are mainly incurred during the implementation period

The present value of the projects total cost amount to € -34,9 mill.
During the implementation period total costs of € -17,8 mill. at present value are incurred. This correspond to 50% of the present value of the projects total cost

Investment costs are incurred during the first 3 years while full running costs and benefits are realized from year 4



20 year investment cash flow



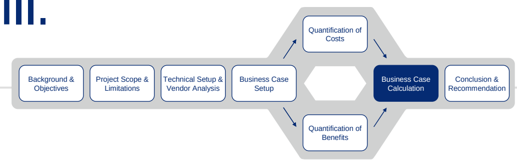
Cash flows are calculated for a 20 year investment horizon

Investment costs of € -17,8 mill. are incurred during the 3 year implementation period
- 20% in 2011
- 40% in 2012 and 2013
- Replacement of concentrators in year 2022 to 2024 (€ 1,8 mill.)

Running costs of € -1,65 mill. per year are incurred after full implementation
- € 0,33 mill. (20%) incurred in 2012
- € 0,99 mill. (60%) incurred in 2013
- Full running costs from 2014

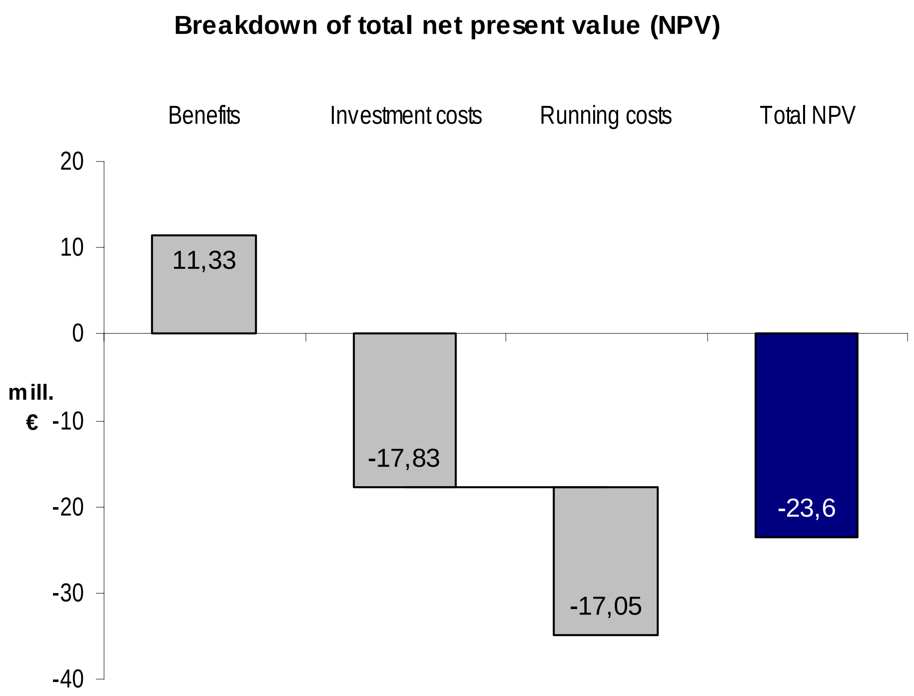
Running benefits of € 1,1 mill. per year are realized after full implementation
- € 0,2 mill. (20%) realized in 2012
- € 0,7 mill. (60%) realized in 2013
- Full running benefits from 2014

The business case result in a negative NPV of € -23,6 mill. due to benefits (€ 11,3 mill.) being offset by running costs of € -17,1 mill. and investment cost of € -17,8 mill.



Total net present value is negative and amount to € -23,6 mill.

Breakdown of total net present value (NPV)



The benefits do not outweigh the costs

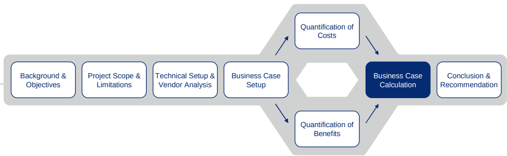
The total NPV is negative and amount to € -23,6 mill.

This is mainly due to the fact that the running benefits of € 11,3 mill. are offset by the major running costs of € -17,1 mill.. This causes a negative net effect of the running costs and benefits of € -5,7 mill..

The present value of the investment costs amount to € -17,8 mill..

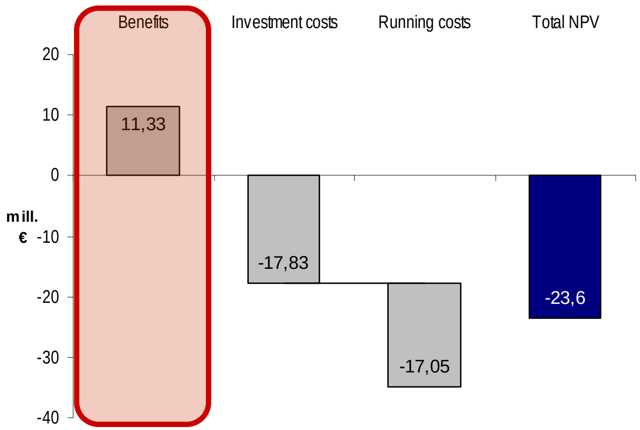
The NPV per smart meter is € -235,5. Calculated at a discount rate of 6% this is equivalent to a annuity payment of € -20,5.

The total present value of benefits amount to € 11,3 mill. and is mainly realized due to call centre and billing services

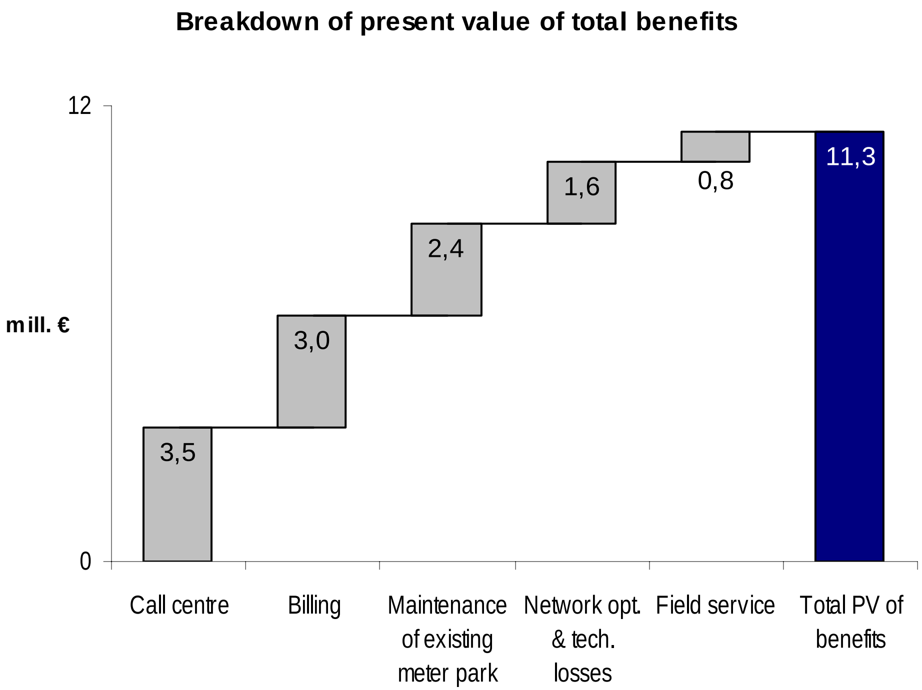


Total present value of benefits amount to € 11,3 mill.

Breakdown of total NPV



Main benefit elements



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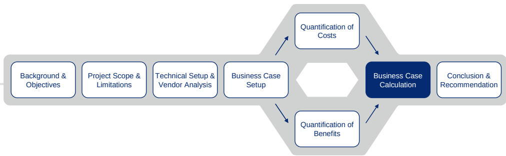
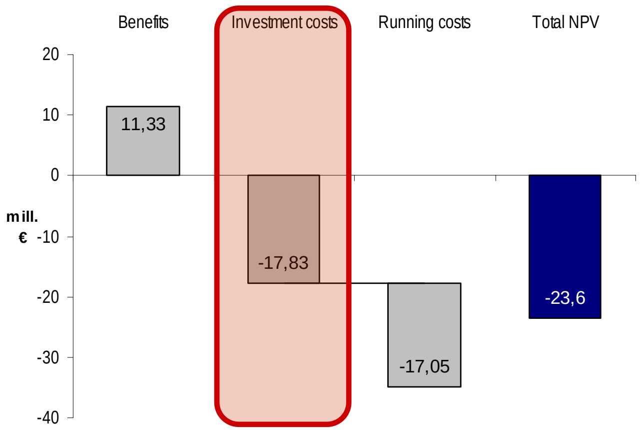
The total present value of investment costs amount to € -17,8 mill., which is primarily composed of material and installation costs

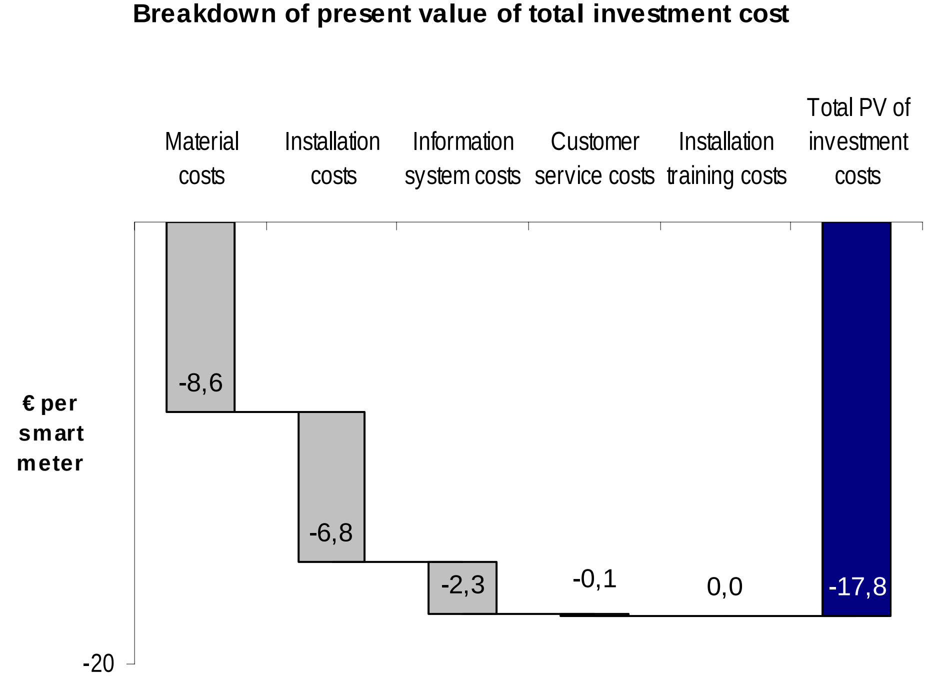


Total present value of investment costs amount to € -17,8 mill.

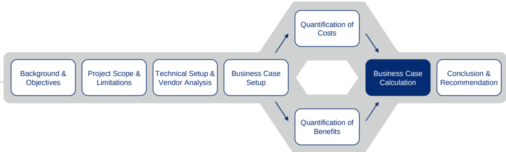
Breakdown of total NPV



Main investment cost elements

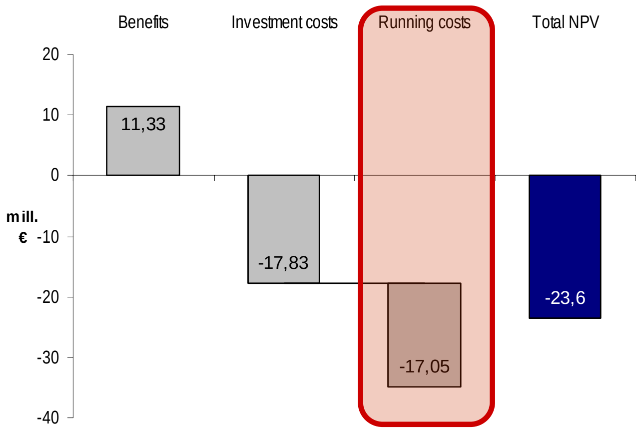


Total present value of running costs amount to € -17,1 mill. mainly due to maintenance costs

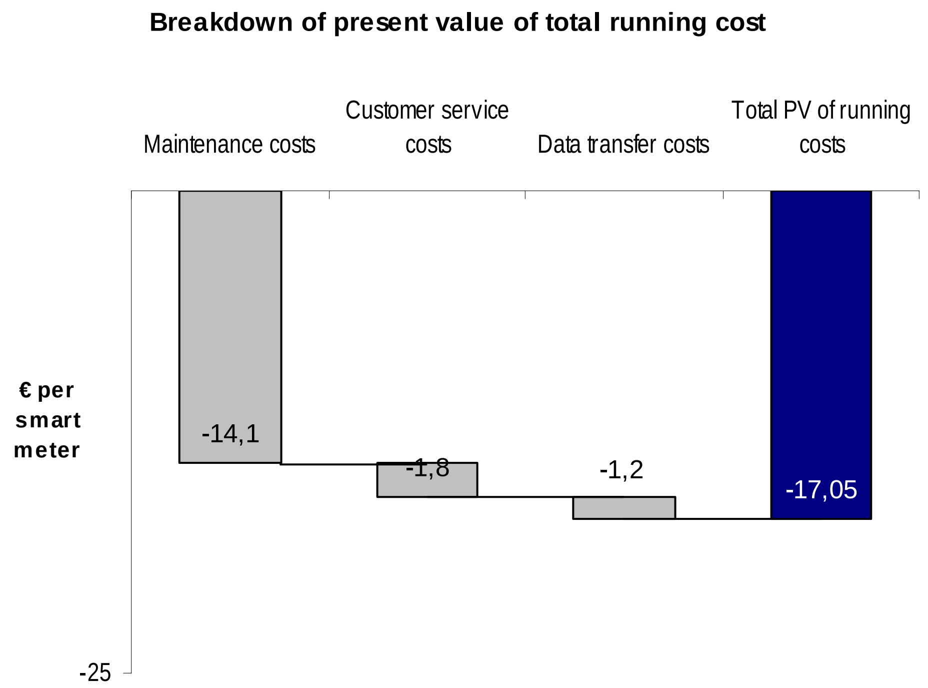


Total present value of running costs amount to € -17,1 mill.

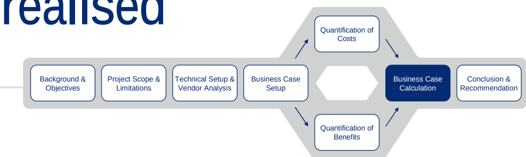
Breakdown of total NPV

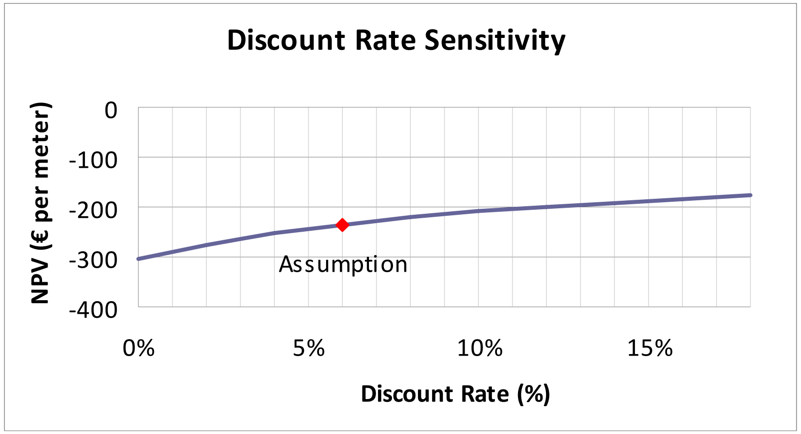


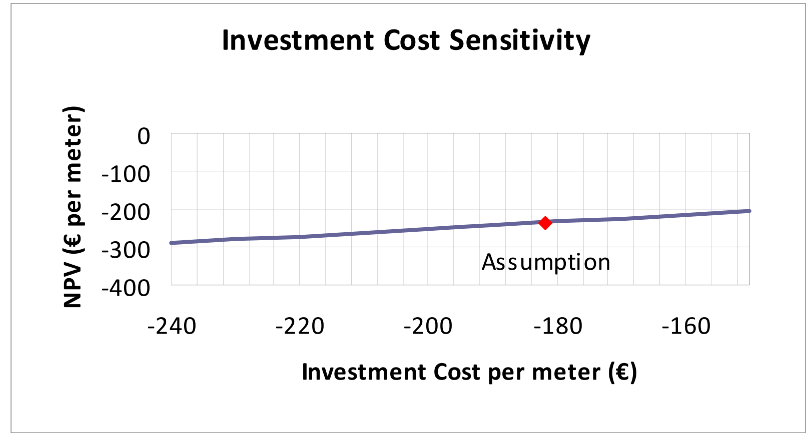
Main running cost elements

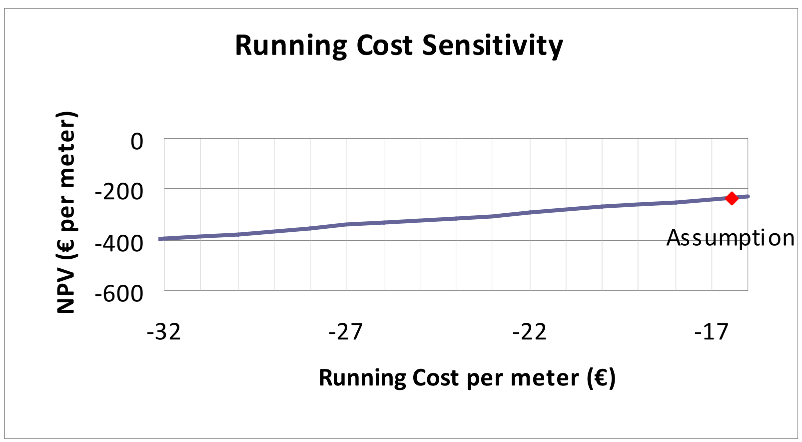


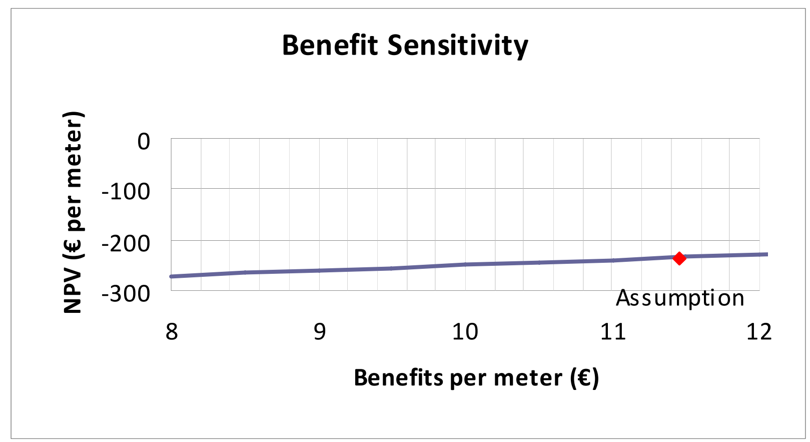
The sensitivity analysis shows that both running costs and benefits have an elasticity of around 10, which indicates that there are significant NPV improvements to be realised



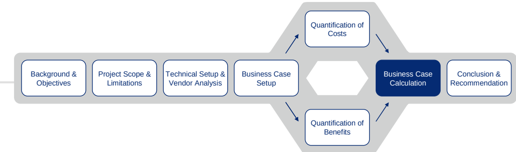


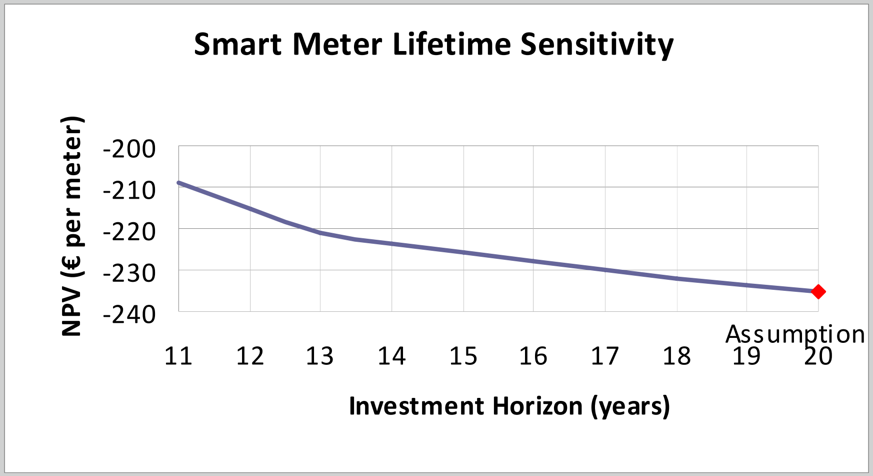




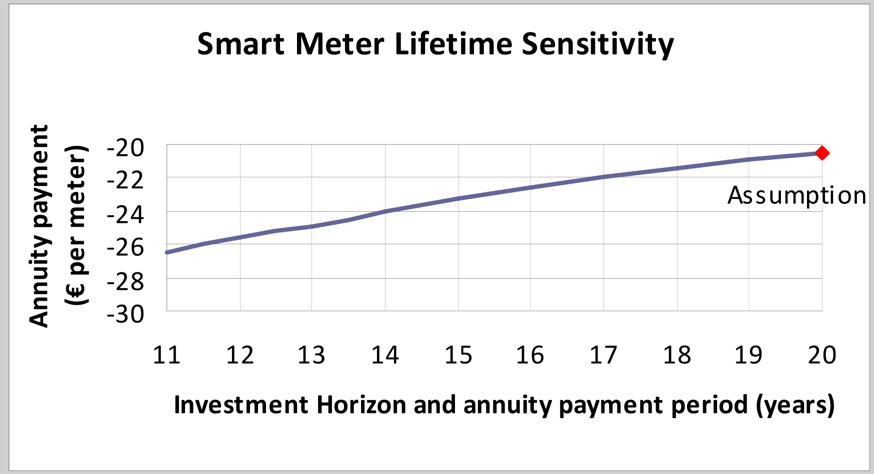


Due to the running costs outweighing the running benefits a shorter investment horizon will result in a higher NPV using the current business case setup



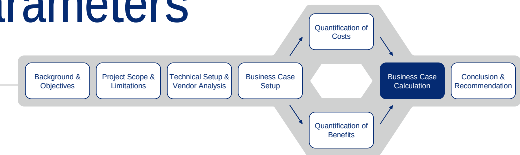


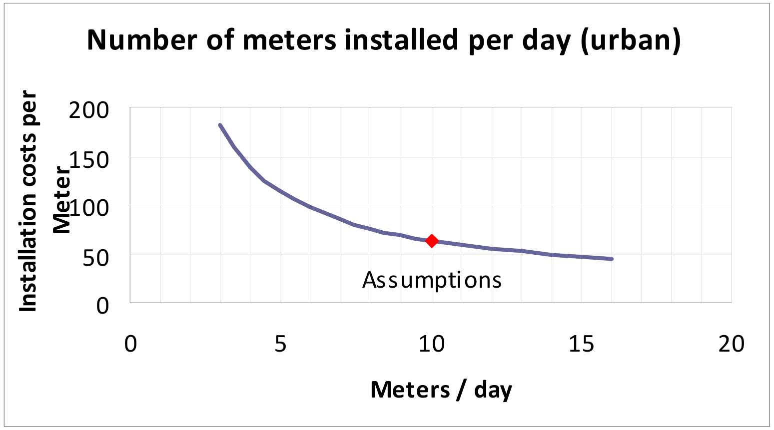
- The smart meter lifetime sensitivity reflects the business case setup
- Due to the running costs outweighing the running benefits a shorter investment horizon will result in a higher NPV
- A significantly shorter life time of smart meters than what is estimated in the business case could be reflected in the business case setup by introducing concurrent re-investment of all meters.
- In such a scenario the short lifetime of meters would increase the importance of replacement cost and strategy

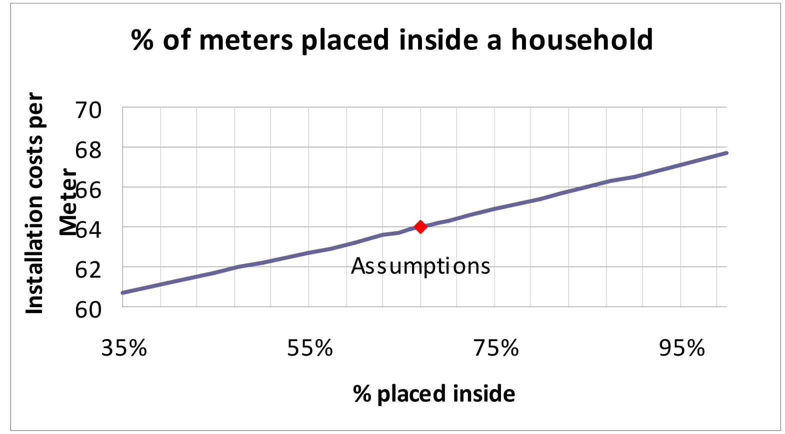


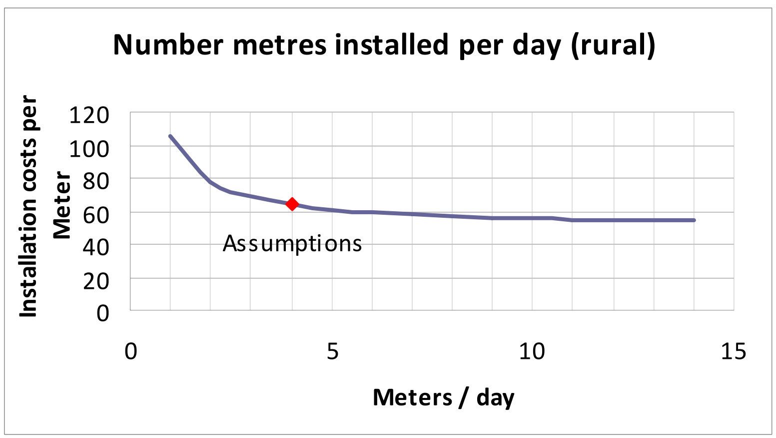
- A shorter lifetime of smart meters are reflected in a shorter investment horizon and a correspondingly shorter annuity payment period
- The shorter investment horizon lead to a higher NPV
- This is offset by the shorter annuity payment horizon leading to a net result of higher annuity payments

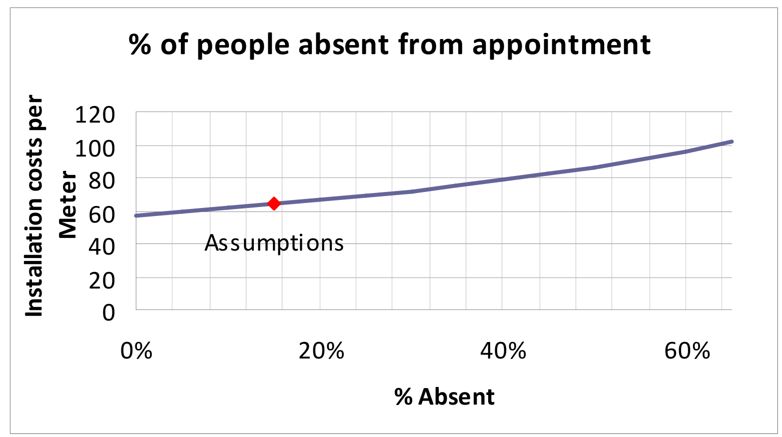
The sensitivity analysis for the installation cost per meter does not show any signs that the installation cost could be significant lower by adjusting the variable parameters











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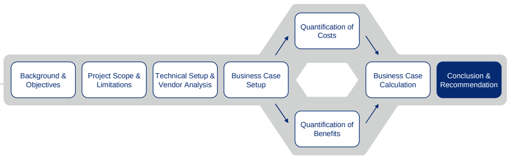

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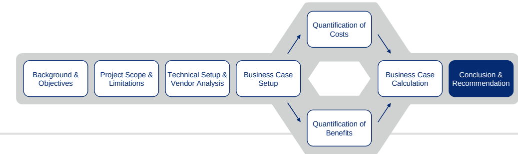
Conclusion



- The business case is made for a DNO perspective only. A virtual Danish DNO, with 100.000 meter points, is used as the scenario.

- This case assumes that the DNO will covert all the old meters with new smart meters over a period of three years. The smart meters have an assumed life time of 20 years. Seen from the large European smart meter vendors' perspective, the proposed smart meter system has standard functionality.

- The cost of the conversion to smart meters result in a negative NPV of € -23,6 mill. due to benefits offset by running costs by € -17,1 mill. and investment cost of € -17,8 mill.

- The main reason for the negative NPV is that the running costs are clearly higher than the running benefits:
  - Running cost of € 16,5 per meter (maintenance costs 83%)
  - Running benefits € 11 per meter (call centre 30% and billing 26%)
  - Investment cost of € 181,7 per meter (material costs 47%, installation costs 38% and IS costs 14%)

- The sensitivity analysis for the investment cost per meter do not show any signs that the installation cost could become significantly lower by adjusting the variable parameters.
  - It is unlikely that the installation costs will decrease in the future unless the material costs will become significantly lower.

- The sensitivity analysis shows that both running costs and running benefits have an elasticity of around 10, which indicates that there are significant NPV improvements to be realised through focus on improvement programs and/or wider strategic focus.
  - By earning € 1 on efficiency the DNO will gain € 10 on the NPV.
  - This emphasises that it is not enough that the DNO simply invest in the most basic smart meters, but rather needs to think in wider strategic mindset, which will unleash the true potential of the smart meter infrastructure.
  - To get the full ROI a solution should be considered across the whole utility value chain, including e.g. strategic alliances.

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Looking at political objectives in Denmark regarding energy and climate, it is important to consider the conclusions of the business case in a broader perspective

- It is commonly argued that these political objectives are ambitious and requires radical changes in energy infrastructure and consumption

Description

EU political drivers

- In Europe, electricity is key to find solutions for meeting 3x20 objectives (reduce energy consumption, reduce GHG emissions, increase use of renewable)
  - Energy savings: slow down electricity growth (+2% CAGR for 2002-2005)
  - GHG emissions: electricity generation produces 56% of CO2 emissions (ETS – 2006)
  - Renewable energy sources (RES): by 2020, 2/3 of new generation power will rely on non schedulable sources (solar, wind)
- EU Directive on Energy End-Use Efficiency and Energy Services requires new solutions for supplying customers with accurate data (e.g. bills based on real consumption, information on consumption profiles, historical data)
- With vertically integrated Utilities, project costs and benefits crossing multiple business segments (e.g. T&D), are simply allocated to the (single) owner. With EU unbundling, the question becomes more complex (even if, the customers will ultimately pay the costs)

Danish objectives includes

- Reduced consumption of energy and increased efficiency of energy utilisation
- Increase the development and usage of renewable energy sources (RES)
- Development, demonstration and focus on new energy -and climate efficient technologies

In order to meet the demanding energy and climate objectives, a strategic mindset must be applied by the stakeholders when considering future sustainable infrastructure investments

Smart Meter VS Smart Grid

Description

- Smart metering technology needs to be used and considered at a strategic level by both utility companies and consumers, if one see this as simply a cheaper way to read meters, it is very difficult to build a business case for the investment.
- Many utilities today are starting down the road of smart metering, as a first step, towards a vision of developing a more intelligent electricity infrastructure as a whole (smart grid), from generation to end-consumers.
- Utilities are advised to start this journey by designing a secure, robust, scalable and extendable integration infrastructure.

Short term potential VS long term potential

- While basic smart metering technology has been available for a number of years, it has now evolved to the point where it has the potential to empower consumers and enable them to see and manage consumption patterns and energy bills, achieving the 'holy grail' of demand side management (Demand response).
- However, in addition to this, smart meters are also part of even bigger potentials when combined with intelligent distribution and transmission grid components making up a digital smart grid system.
- Smart grid investments will pay -in the long run –dividends to utilities, shareholders, customers and society at large.
- The smart grid serves an important role in facilitating energy efficiency programs and distributed/renewable energy integration: both key trends that will help ensure improved environmental outcomes for the future.
- However, the capital costs and operations and maintenance costs are substantial and this level of effort is very challenging to a utility especially considering other significant projects in progress.
- Each initial technology investments (e.g. smart meters) will require a ROI, but the stakeholders must remember that these initial investments build the smart grid infrastructure that will position them for larger future ROI for smaller incremental investments.
- Current projects that can be positioned for regulatory rate relief (i.e. smart metering) should be considered in light of the long term advantage as well as the immediate return.

"While the long term potential of smart meters and a smart grid might seem convincing, one should not forget the stakeholder part of the equation."

Having considered the strategic perspective of a smart meter rollout, it is important to recognise that several stakeholder groups are affected by such an investment

- A fair distribution of benefits and costs in relation to smart meter investments is not easy to define, but it seems reasonable that stakeholders who benefit from the investments should somehow contribute to the cost side as well

Stakeholders

Description

- In today's multi-stakeholder, balance scorecard world, business cases are no longer pure numbers games. Planners and analysts constantly struggle attempting to put Euro values on non-economic political, societal, environmental costs and benefits.
- There is no one-size-fits-all recipe for utilities to develop a smart metering business case and a roadmap, each utility must take stock of its current efforts, strategy, infrastructure, and regulatory circumstances while tailoring smart grid technology road map and business case to meet particular circumstances.
- Several stakeholder groups will be affected by benefits and/or costs of a smart meter rollout and an eventual realisation of a digital smart grid electricity infrastructure.
- Major decision makers (e.g. utilities) and influencing parties (e.g. the government) must recognise that when considering infrastructure development projects, there are potential for uneven distribution of costs and benefits among several independent stakeholder groups both in the short run and long run.
- While there has been a few attempts to shed light on what a smart meter and smart grid multi stakeholder business case could look like, there is no 'universal recipe' on how to affect a fair distribution of the costs & benefits among the stakeholders.

Generators | Grid owners | Grid operators | Energy suppliers | Customers

Regulator

Government

Society

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..and you are welcome to read our international smart metering reports:

- (double-click on the report to open)

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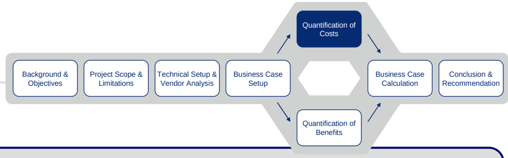
Explanation of investment cost elements



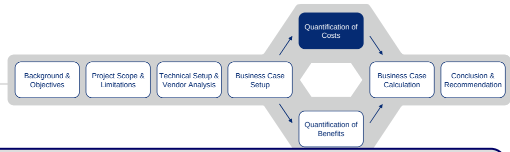
Cost element	Explanation

Meter material	• Costs for meters are based on the following assumptions
	  • 90% three phase meters and 10% mono phase meters
	  • Meter costs
	    • Three phase smart meter € 75
	    • Mono phase smart meter € 65

Meter installation	• Total labour costs of € 52.800 per installer + 100% other costs (transport, administration, office)
	• Number of meters per day and installer incl. travel
	  • Urban and semi urban (90%): 10
	  • Rural (10%): 4
	• 67% of meters placed inside the house requiring appointment
	• 15% of costumers absent from a meter replacement appointment

Customer assistance	• Costs for customer inbound calls to answer questions about the installation and Smart Metering in general
Customer communication and marketing	• Costs for customer outbound calls to set-up the appointment for the installation and additional marketing material e.g. flyers

Explanation of investment cost elements (cont.)



Cost element	Explanation
Concentrator material	• Costs per concentrator of 600 (inside a transformer box)

Concentrator installation	• Total labour costs of € 52.800 per installer + 100% other costs (transport, administration, office)
	• 2 installer needed per concentrator installation
	• Number of concentrators per day and 2 installers incl. travel
	    • Urban and semi urban (90%): 4
	    • Rural (10%): 3

Modem installation	• Installation charge per modem of € 2,7

IS installation investment	• Costs included are
	    • License cost for meter data management
	    • Integration cost for meter data management (Incl. internal and external resources)
	    • IT server costs
	• Costs derived must partially be seen as rough estimations – precise calculations would require a detailed analysis of current and to-be IT landscape

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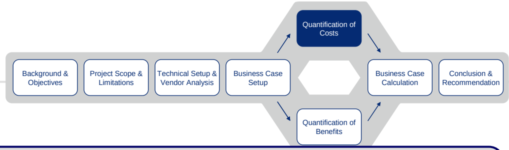
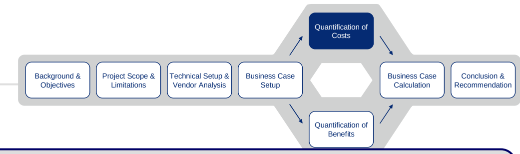
Explanation of investment cost elements (cont.)



Cost element	Explanation
Training costs	• Costs for training of installers, IT staff, etc. of € 600 per FTE

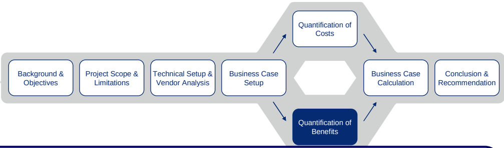
Stranded costs	• Depreciation for replaced meters
	  • Cost per meter € 35
	  • Depreciation life span of 25 years
	  • Average age of 20 years
	  • 60% of meters older than depreciation life span

Explanation of running cost elements (cont.)



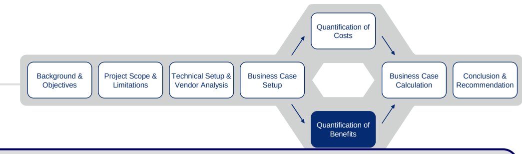
Cost element	Explanation
Smart meter maintenance	• 1,5% of smart meters which need to be changed per year due to a defect
Concentrator maintenance	• 1,0% of concentrators which need to be replaced per year due to a defect
Cost of licences	• License fee represents the average license fee costs derived from three representative DNO's from Denmark
IS maintenance cost	• Number of staff dedicated to the maintenance of IS 7 FTE • Total cost per IS maintenance employee € 61.600 + 100% other costs (transport, administration, office)

Explanation of benefit elements
Network optimization and technical losses



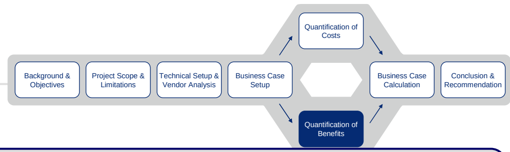
Benefit element	Explanation
Avoiding oversizing of network (assets)	Annual network investments for households € 0,4 mill. • Security factor for capacity/investments 20% • Security factor for investments with smart metering 15%
Technical losses	Total volume of low voltage distribution 0,4 TWh • Technical losses of 3% • 5% reduction of technical losses due to implementation of smart meters • Price for losses compensation € 99 mill. per TWh (wholesale market)
Non-technical losses	0,1% of consumption which is measured but not paid for 75% reduction of non-technical losses due to implementation of smart meters Price used on retail market € 263 mill. per TWh

Explanation of benefit elements
Call centre



Benefit element	Explanation
Reduced # of calls due to improved meter data	50% of customers call regarding meter reading and complaints on bills • Average handling time of 0,1 hour • 50% Saving potential regarding meter reading and complaints on bills • Cost per hour € 75,1 based on total labour costs of € 44.000 per call centre agent + 100% other costs (transport, administration, office) • 90% of total share of call centre costs coved by the DNO
Reduced # of complaints due to improved meter data	10% of customers result in an escalated complaints due to bad meter data • Average handling time 0,5 hour • 50% Saving potential regarding claims (%) • Cost per hour € 75,1 based on total labour costs of € 44.000 per call centre agent + 100% other costs (transport, administration, office) • 90% of total share of call centre costs coved by the DNO

Explanation of benefit elements
Field service



Benefit element	Explanation
Savings regarding manual readings	Forced manual reading are required for 1% of customers per year • 12 meters read per day • Cost of an effective working day € 667 based on total labour costs of € 52.800 per installer + 100% other costs (transport, administration, office) • 85% reduced manual reading due to smart meters
Meter maintenance - remote problem identification	Outage claims of 4% of clients per year • 10% of claims result in technical visits • 33% reduction of technical visits per year • 5 visits per technician per day • Cost of an effective working day € 667 based on total labour costs of € 52.800 per installer + 100% other costs (transport, administration, office)
Remote disconnect regarding debt collection	Disconnect regarding debt collection for 0,03% of meters • 90% reduced technical visits due to disconnects per year • 6 visits per technician per day • 2 service technicians per visit • Cost of an effective working day € 667 based on total labour costs of € 52.800 per installer + 100% other costs (transport, administration, office)

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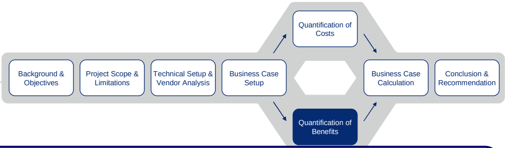
Explanation of benefit elements
Customer meter reading



Benefit element	Explanation
Handling of template customers	1,5 FTE handling template customers • 100% reduction in handling of template customers • Total cost per of € 52.000 per billing employee + 100% other costs (transport, administration, office) • 80% of total share of billing costs coved by the DNO
Handling of customer meter readings	Customer meter readings are handled for 99% of customers • Average cost of handling customer meter reading of € 1,25 per meter
Handling of debt collection	2,5% of meters resulting in debt collection cases • Average cost of a debt collection case € 33 • 60% reduction in handling of debt collection • 80% of total share of billing costs coved by the DNO