Study on cost benefit analysis of

Smart Metering Systems in EU Member States

FINAL REPORT / ANNEX:

Review of Member State Cost Benefit Analyses (additional material)

Institute of Communication & Computer Systems of the National Technical University of Athens ICCS-NTUA

AF-MERCADOS EMI

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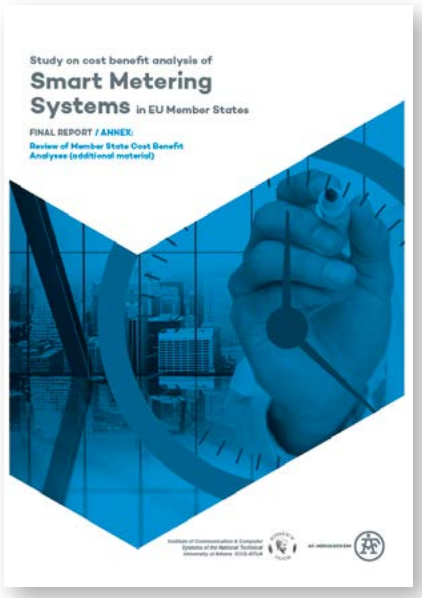

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1. Great Britain

1.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below:

TABLE 1

GREAT BRITAIN - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Consumer	FA: Provide readings directly to consumer or 3rd party	In-home display (IHD) provides customer information on meter balance, instantaneous power in kW, cumulative consumption on a daily, weekly and monthly basis. Ability to transfer real time data on pricing and consumption to a customer access device, or third party subject to customer consent	Exceeds minimum requirement, in particular use of IHD and data provided to customer
	FB: Update reading frequently enough to use energy saving schemes	10 second update to customer, for billing purposes maximum frequency of 30 minutes where customer has provided consent.	Compliant
Metering operator	FC: Allow remote reading	Facilitated through use of DCC system (communications service provider, data services provider)	Compliant
	FD: Provide 2-way communication for maintenance and control	Facilitated through use of DCC system (communications service provider, data services provider)	Compliant
	FE: Allow frequent enough readings for network planning	Capability to report outages, restoration of supply, measure maximum demand	Exceeds minimum requirements due to functionality for operational purposes (real time monitoring of outages, recording minutes off supply) as well as planning purposes

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Commercial aspects of supply	FF: Support advanced tariff system	Capability of applying Time-of-use Pricing or Time-of-use with Block Pricing - capability of recording consumption to up to 48 registers and accumulating consumption into 8 time of use bands. Capability to support pre-payment mode.	Exceeds requirements due to high level of tariff-related functionality
	FG: Remote ON/ OFF control supply and/or flow or power limitation	Capability for load limiting and disconnection. Capability to support pre-payment mode.	Compliant
Security – data protection	FH: Provide secure data communication	DCC subject to various licence conditions regarding data security. Implements end-to-end security model through the use of Smart Meter Key Infrastructure	Compliant
	FI: Fraud prevention and detection	Use of security log system on meter to detect improper use	Compliant
Distributed generation	FJ: Provide import/ export and reactive metering	Capable of recording import/ export and reactive power	Compliant

The functionalities as a whole comply with the minimum requirements of 2012/148/EU, and in some cases are in excess of these requirements. This is the case for the data provided to customers, the amount of data that can be collected where the consumer has provided consent, and the use of metering data for network operational purposes. These additional functionalities are largely software driven and are unlikely to have a significant cost impact.

However, a key distinguishing feature of the Great Britain system is the use of the Data Communications Company (DCC) to provide communication services between smart meters and the business systems of energy suppliers, network operators and other authorised service users. The DCC is to put in place the shared data and communications infrastructure necessary for smart meters to:[1]

- Operate consistently for all consumers regardless of their energy supplier.
- Provide smart metering data to network operators in support of smart grids.
- Permit authorised third parties to provide services to consumers once they have granted permission to use their data, offering new routes for consumers to receive energy services and advice on how to reduce their energy usage.

1 *http://www.smartdcc.co.uk/about-us/*

The use of the DCC is an example of a "hub model" where a central communications body is responsible for providing access to data to third parties. The proposed models of the Czech Republic and the Slovak Republic considered in this report share features of this approach.

1.2. Approach to cost benefit analysis

Key framework considerations in the CBA are set out in the table below:

TABLE 2

GREAT BRITAIN - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Department of Energy and Climate Change (DECC)
Period of roll out	2012-2020
Proportion of metering points covered	Over 99% by 2020
Roll out alternatives included	None
Counterfactual	Assume that 5% of the consumption reduction applicable to smart meters would be achieved with basic meters due to improved billing and use of clip on displays to monitor usage.
Sensitivity analysis considered	Counterfactual scenario with 20% voluntary roll out of smart meters at average cost and with these customers receiving 30% of benefits considered (reduces NPV by £2 billion).
	Scenarios on key variables, including: Customer energy savings (1.5% to 4%), call centre savings (£1.90 to £2.50), reduced theft (5% to 15%) and reduction in customer minutes lost (2% to 15%)
Modelling period	18 years (2012-30)
Discount rate	3.5%
Asset life of meters	15 years

A key feature of the cost-benefit analysis in Great Britain is that is foreshadows a dual fuel electricity and gas smart meter roll out. A CBA of this nature reflects the fact that the metering market is de-regulated and that many customers use the same metering provider for gas and electricity supplies, and hence in the British supplier-led model there will be strong incentives to replace both electricity and gas meters with smart meters at the same time. This dynamic will not be applicable in all countries, including some that have developed joint gas/electricity cost benefit analyses.

To facilitate analytical comparison with the results of electricity-only CBAs, analysis is undertaken on the costs and benefits to separate out the impact of gas. This should be considered highly indicative in nature. In addition, it should be noted that in this section only those costs and benefits attributed by DECC to domestic customers are considered.

1.3. Costs

A breakdown of key incremental costs related to the introduction of smart meters is set out below under two key cases:

- The dual fuel scenario reported in the January 2014 CBA, and
- An indicative assessment of the impact of removing gas from the roll-out.

The cost impact is set out in the following table:

TABLE 3

GREAT BRITAIN - TOTAL COST BREAKDOWN BY TYPE OF COST (PRESENT VALUE)

Dual fuel			Electricity only	
Cost type	**Total cost (€ million)**	**Average Cost (€/metering point)**	**Total cost (€ million)**	**Average Cost (€/metering point)**
Smart meters	8,661	145.40	4,851	147.28
Information Technology	993	16.66	993	30.31
Communications	2,968	49.82	2,968	90.09
In-home display	*	*	*	*
Generation	-		-	-
Transmission	-		-	-
Distribution	-		-	-
Training costs	-		-	-
Customer care and other (project management etc)	466	7.83	466	14.15
Sunk costs	-	-	-	-
TOTAL	**13,088**	**219.70**	**9,288**	**281.65**

Costs converted using exchange rate of £1=€1.25. Note: the cost of in-home displays is not separately identified from the overall cost of the smart meter.*

Note that these costs, and the corresponding benefits, differ from those in the Commission's Report COM(2014)356 as an updated CBA is considered in this report. A breakdown between capital and operating expenditure is set out in the following table:

TABLE 4

GREAT BRITAIN - COST BREAKDOWN BY CAPEX AND OPEX (PRESENT VALUE)

Dual fuel			Electricity only	
Cost type	**Total cost (€ million)**	**Average Cost (€/metering point)**	**Total cost (€ million)**	**Average Cost (€/metering point)**
CAPEX				
Investment in smart meters	6703	112.51	3446	104.62
Investment in Information Technology	548	9.19	548	16.62
Investment in Communications	2496	41.90	2496	75.78
Investment in In-home display	*	-	*	-
Generation	-	-	-	-
Transmission	-	-	-	-
Distribution	-	-	-	-
TOTAL CAPEX	**9746**	**163.61**	**6490**	**197.02**
OPEX				
IT maintenance costs	445	7.47	445	13.51
Network management and front end costs	-	-	-	-
Communications/data transfer costs	471	7.91	471	14.31
Scenario management costs	-	-	-	-
Replacement/failure of smart meter systems	1959	32.88	1405	42.66
Generation	-	-	-	-
Transmission	-	-	-	-
Distribution	-	-	-	-
Meter reading	-	-	-	-
Call centre/customer care	-	-	-	-
Training costs	-	-	-	-
TOTAL OPEX	**2875**	**48.26**	**2321**	**70.47**
OTHER COSTS				
Customer care	466	7.83	466	14.15
Sunk costs of previously installed meters	-	-	-	-
TOTAL OTHER COSTS	**466**	**7.83**	**466**	**14.15**

Costs converted using exchange rate of £1=€1,25. Note cost of in-home display not separately identified from the overall cost of the smart meter.*

Note that in the above analysis the meter cost is presented as net of the cost of the old meter.

In some areas DECC specifies explicit gas and electricity costs. For example, it states the installation cost of an electricity meter at £29, the installation cost of a gas meter at £49, and dual fuel installation cost of £69 – an efficiency saving of £10 – which applying proportionally suggests that the cost of electricity meter installation falls to £24.74 under dual fuel conditions.

In developing the sensitivity analysis on costs without gas the following assumptions have been applied:

- The cost of an electricity meter plus in-home display (IHD) is similar to a cost of a gas meter, and hence the total cost of metering is reduced by the proportion of gas meters in the total cost (45%)
- Installation costs are reduced by the proportion of electricity to dual fuel costs
- Communications equipment costs and the incremental energy usage of smart meters are unchanged (gas smart meters are battery operated).
- The following capital and operating costs are assumed invariant: DCC costs, IT costs of suppliers, network operators and aggregators.
- Reading inefficiency of existing meters falls by 67% (as there will still be manual gas meter reading)
- All other O&M costs are reduced by the proportion of gas smart meters in the total number of smart meters (45%).
- Customer care costs are unchanged.

Under this scenario average costs per metering point rise by 28% from €219.70 (gas and electricity) to €281.65 (electricity only).

1.4. Benefits

1.4.1. Key assumptions

Key assumptions on benefits are set out in the following table:

TABLE 5

GREAT BRITAIN - KEY ASSUMPTIONS ON BENEFITS (DUAL FUEL)

Variable	Unit	Value
Avoided meter reading costs	€/meter/year	7.50
Call centre cost savings	€/metering point/year	2.75
Reduction in consumption	%	-2.80% (-2% for gas)

Variable	Unit	Value
Reduction in losses (network operator)	€/metering point/year	0.63
Reduction in non-supplied energy	%	10%
Reduction in theft	%	10%
Avoided meter reading costs	€/meter/year	7.50
Call centre cost savings	€/metering point/year	2.75

Note – cost of metering assumes 2 manual reads per year, at cost of £3 per reading.

1.4.2. Total benefits

A breakdown of key benefits by type of benefit is set out in the table below. In addition, the assumed benefits adjusting for the gas component of the CBA is set out.

TABLE 6

GREAT BRITAIN - BENEFITS BY TYPE (PRESENT VALUE)

	Dual fuel		Electricit y only	
Benefit	**Amount (€ million)**	**Amount (€/ metering point)**	**Amount (€ million)**	**Amount (€/electricity metering point)**
Benefits included in 2012/148/EU				
Reduction in meter reading and meter operations	3558	59.72	1186	36.00
Reduction in operational and maintenance costs	6391	107.29	3618	109.82
Deferred/avoided distribution capacity investments	176	2.96	176	5.35
Deferred/avoided transmission capacity investments				
Deferred/avoided generation capacity investments	1004	16.85	1004	30.46
Reduction in technical losses of electricity	513	8.60	384	11.67
Electricity (energy) cost savings	5369	90.13	3236	98.25
Reduction of commercial losses	301	5.06	167	5.06
Reduction of outage times	118	1.97	118	3.57
Reduction of CO_2 emissions	996	16.72	225	6.83
Reduction of air pollution	88	1.47	61	1.86
Benefits not included in 2012/148/EU Avoided investment in standard meters				
TOTAL BENEFITS	**18513**	**310,77**	**10174**	**308.88**

The three key drivers of the benefits in the analysis undertaken by DECC are:

- Electricity consumption savings.
- Reductions in operations and maintenance expenses, for which the following items are most notable: savings in call centre costs, avoided site visits to pre-payment meter customers, better debt management and switching savings.
- Meter reading costs.

In the sensitivity of only considering electricity benefits, a saving of 33% in meter reading costs is adopted, as it is assumed that some gas and electricity meters are currently read concurrently, and hence the introduction of smart meters only for electricity would not change meter reading requirements in all cases. The appropriate value will not be zero as not all electricity customers have a gas supply, not all customers receiving both services have the same supplier, and even in these cases joint meter reading is not necessarily undertaken. Other key adjustments include:

- The following benefits reduce in proportion to the number of electricity meters in the total meters: debt management, remote connection, switching savings and theft.
- Around 60% of consumption benefits would arise reflecting DECCs assumption that electricity consumption would fall by 2.8% and gas (credit meters) by 2%.
- A notional adjustment of 25% is made to account for gas losses.
- 30% of air quality improvements are assumed to be gas-related.
- The benefits of avoided site visits for pre-payment customers are adjusted in proportion to the number of electricity and gas pre-payment meters (assumed as 4 million and 2.8 million respectively).

On the other hand there are various benefits that are only electricity related, including capacity investment and outages, the per-metering point value of which increases in an electricity-only scenario. With these assumptions the reduction in average benefits falls slightly from €310.77/metering point to €308.87/metering point. However, with these high level adjustments in place the net benefit of the project remains positive at €897 million or €27.23/metering point, although significantly lower than in the dual fuel scenario.

1.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA in the form specified:

TABLE 7

GREAT BRITAIN – COMPARISON OF BENEFITS IN CBA AND THOSE IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 2 manual reads per year
Reduced call centre/customer care costs	Yes	Considers savings to supply and network businesses – including fixed costs of call centres. A significant component is avoided site visits to customers with pre-payment meters
Reduced maintenance costs of assets	Yes	Allowance for remote connection included.
Reduced costs of equipment breakdown	Yes	Reduced costs of fixing faults
Deferred distribution capacity investment due to asset remuneration	Yes	Allowance provided in CBA for better investment decisions facilitated by smart meters (which reduces investment needs)
Deferred distribution capacity investment due to asset amortisation	No	However, see above regarding investment decisions
Deferred transmission capacity investment due to asset remuneration	Yes	Some limited benefits to transmission investment arising from ToU tariffs and load shifting are included
Deferred transmission capacity investment due to asset amortisation	No	However, see above regarding investment impacts
Deferred generation for peak load plants	Yes	Also includes benefits from reduction in short run marginal cost
Deferred generation investments for spinning reserve	No	However, see above regarding reduction in short term generation costs
Reduced technical losses of electricity	Yes	Expressed on per meter basis than %
Consumption reduction	Yes	Estimated at 2.8% for electricity (2% for gas)
Peak load transfer	Yes	Included in relation to benefits of micro-generation
Reduced electricity theft	Yes	Assumed at 10%
Recovered revenue related to contract power fraud	No	Not included
Recovered revenue related to incremental 'contracted power'	No	Not included
Reduction of outage times	Yes	10% reduction assumed
Reduced cost of client indemnification	No	Not included

Benefit	Included?	Treatment
Reduced CO_2 due to reduced line losses	No	Different approach to CO_2 applied (see subsequent table)
Reduced CO_2 due to wider spread of low carbon generation sources	No	Different approach to CO_2 applied (see subsequent table)
Reduced CO_2 due to truck rolls of field personnel	No	Different approach to CO_2 applied (see subsequent table)
Reduced air pollutant emissions due to reduced line losses	No	Different approach to air quality applied (see subsequent table)
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	Different approach to air quality applied (see subsequent table)
Reduced air pollutant emissions due to truck rolls of field personnel	No	Different approach to air quality applied (see subsequent table)

Additional benefits are set out in the following table:

TABLE 8

BENEFITS INCLUDED IN CBA BUT NOT IN 2012/148/EU

Benefit	Treatment
Reduced inspection costs and special meter requests	Considered as component in overall benefits of reduced site visit costs
Reduction in CO_2 emission	Instead of the Commission's approach estimates are made of the benefits from reducing consumption and shifting the peak
Improvement in air quality	Instead of the Commission's approach estimates are made of the benefits from reducing consumption and shifting the peak
Improved debt management for the suppliers	It is assumed that smart meters allow the suppliers to better manage customer debt and working capital – a high saving of £2.20/credit meter is assumed
Savings in switching process	A more efficient switching process is envisaged for suppliers due to the new functions performed by the DCC

For comparability purposes there are some unique features of the benefits provided by the Great Britain CBA:

- Switching savings, which comprise more than 10% of the gross benefits and which are attributed to the use of the DCC, a model that is not in use in other Member States
- The large proportion of pre-payment customers, for which a large benefit is attributed for the need to avoid site visits to replace metering equipment upon changes from prepayment to credit payment mode and vice versa.

2. Netherlands

2.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below.

TABLE 9

NETHERLANDS - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Consumer	FA: Provide readings directly to consumer or 3rd party	The metering system allows for this, but the core CBA considers only bi-monthly reading and at the time of moving house or changing suppliers	The proposed metering system is compliant with minimum functionalities, but the core CBA scenario does not invoke all these functionalities. For example, the key scenario is based on indirect feedback.
	FB: Update reading frequently enough to use energy saving schemes	Readings up to 15 minutes are possible, though the CBA is based on bi-monthly information provision	
Metering operator	FC: Allow remote reading	Remote reading is undertaken	Compliant
	FD: Provide 2-way communication for maintenance and control	Control and maintenance of the meter among other things reading of the meter status (battery, alarms, error messages), firmware updates, date and time synchronization and recording changes between the various settings 'administrative off', 'standard reading' and 'detailed reading'	Compliant
	FE: Allow frequent enough readings for network planning	Allows reading of the metering values and the fault register to monitor the quality of the electricity supply	Compliant, though in the scenario in the CBA not all real time benefits may be possible
Commercial aspects of supply	FF: Support advanced tariff system	The meters support advanced tariff options, but these are not included in CBA	Metering system is compliant, core CBA scenario does not include advanced tariff options
	FG: Remote ON/OFF control supply and/or flow or power limitation	The grid operator has the option to centrally control the meter so that it will allow no electricity or only a limited amount of electricity to get through	Technology is compliant though this feature is no longer activated

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Security – data protection	FH: Provide secure data communication	Provided	Compliant
	FI: Fraud prevention and detection	Provided	Compliant
Distributed generation	FJ: Provide import/ export and reactive metering	Facilitated (though not considered in the CBA)	Compliant

The proposed smart metering system in the Netherlands is compliant technically with the minimum functionality of 2012/148/EU. That is the smart meters, communications and IT systems proposed all meet the necessary requirements. However, the Netherlands situation raises two important issues: first, the core scenario for the CBA does not invoke all potential functionality; and second, national legislation permits smart meters to be installed and operated in a manner that also does not activate all potential functionality ("administrative off").

The core situation proposed in the CBA of the Netherlands does not include direct feedback. Instead, bi-monthly readings are provided to customers, with this supplemented by additional information on usage. However, for the purpose of the CBA this approach is likely to be conservative as the full system costs are likely to still be incurred, but with benefits proportionally reduced due to the non-activation of full functionality.

Since the production of the CBAs the Netherlands has announced that the remote shut off functionality will be removed from smart meter roll-out due to security issues. This will affect full compliance with functionality (g) relating to remote on/off control of supply and/or flow or power limitation.

In addition, due to legislative requirements, the CBA considers the option to have the meters set to "administrative off mode". This mode allows smart meters to operate as a conventional meter. The consumer has the right to decide whether to use this mode or not.

2.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 10

NETHERLANDS - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Ministry of Economic Affairs
Period of roll out	2010-2020
Proportion of metering points covered	98% by 2020
Roll out alternatives included	None
Counterfactual	Traditional meters only
Sensitivity analysis considered	20 % meters with IHD 20 % refuse installation 20% administrative off mode
Modelling period	50 years (2010-2060)
Discount rate	7%
Asset life of meters	15 years

The CBA in the Netherlands relates to a joint roll out of gas and electricity meters, although in most cases gas and electricity costs and benefits are separately identified.

A notable feature of the CBA analysis is that the modelling period is much longer than that for many other countries.

2.3. Costs

A breakdown of key incremental costs related to the introduction of smart meters is set out below. The cost and benefit breakdown in the following tables have been extrapolated from the SenterNovem report released in 2005, which summarises the analysis of KEMA at the same time. This approach has been taken due to the high level nature of the results included in the 2010 analysis. The methodology adopted produces slightly different results to those in the Commission's benchmarking report, though the net benefits are similar. In undertaking this approach the following assumptions have been adopted:

- For benefits reported as combined electricity and gas in 2010 the same proportion of electricity and gas benefits in the total is assumed as in 2005.
- Individual cost items are inflated uniformly from the 2005 analysis.
- In the case of costs and benefits that cannot be separated between electricity and gas these are applied 50:50 to each category.

The resulting breakdown of costs is set out below. No distinction between capital expenditure and operating expenditure is provided.

TABLE 11

NETHERLANDS - TOTAL COST BREAKDOWN BY TYPE OF COST (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	549.35	81.99
Information Technology	38.70	5.78
Communications	768.93	117.45
In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
Training costs	-	-
Additional billing	234.90	35.06
Sunk costs	-	-
TOTAL	**1609.88**	**240.28**

The assessment treats additional billing costs as a negative benefit (cost) in the CBA. Bi-monthly paper billing is the current system used in the Netherlands. A monthly paper billing system is proposed once the smart meters are installed, which will increase the billing costs in proportion to the number of bills delivered.

A more detailed breakdown of the capital expenditure is provided below:

TABLE 12

NETHERLANDS - DETAILED COST BREAKDOWN

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters acquisition and installation	549.35	81.99
Information Technology	38.70	5.78
Communications	786.93	117.45
PLC Infrastructure	137.61	20.54
GPRS Infrastructure	380.57	56.80
Cable Infrastructure	94.60	14.12
Data concentrators	174.16	25.99
In-home Display	-	-

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Generation	-	-
Transmission	-	-
Distribution	-	-
Training costs	-	-
Billing costs	234.90	35.06
Sunk costs	-	-
TOTAL	1609.88	240.28

2.4. Benefits

2.4.1. Total benefits

A breakdown of key benefits by type of benefit is set out in the table below:

TABLE 13

NETHERLANDS - BENEFITS BY TYPE (PRESENT VALUE)

Benefit	Amount (€ million)	Amount (€/metering point)
Benefits included in 2012/148/EU		
Reduction in meter reading and meter operations	250.00	37.31
Reduction in operational and maintenance costs	620.00	92.54
Deferred/avoided distribution capacity investments	-	-
Deferred/avoided transmission capacity investments	-	-
Deferred/avoided generation capacity investments	-	-
Reduction in technical losses of electricity	-	-
Electricity cost savings	518.26	80.19
Consumption reduction	373.26	57.71
Peak load shift	145.00	21.64
Reduction of commercial losses	62.00	9.25
Reduction of outage times	32.00	4.78
Reduction of CO_2 emissions	-	-
Reduction of air pollution	-	-
Benefits not included in 2012/148/EU		
Competitiveness	423.68	63.24
TOTAL BENEFITS	**1905.94**	**284.47**

A notable feature of the benefits is the important role of greater competitiveness, where it is assumed that the introduction of smart metering will promote customer switching and competition by inducing innovation, and hence result in lower prices in the market. While a key driver of benefits the allowance provided in 2010 is lower than that included in the 2005 analysis.

2.4.2. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 14

NETHERLANDS - CONSIDERATION OF BENEFITS IN CBA AND THOSE IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 4 manual reads per year
Reduced call centre/customer care costs	Yes	Considers savings to faulty reading, administrative issues, faulty switch and administrative switch
Reduced maintenance costs of assets	No	No benefits to reduced maintenance costs included
Reduced costs of equipment breakdown	Yes	Reduced costs of fixing faults
Deferred distribution capacity investment due to asset remuneration	No	Not included
Deferred distribution capacity investment due to asset amortisation	No	Not included
Deferred transmission capacity investment due to asset remuneration	No	No benefits to transmission included
Deferred transmission capacity investment due to asset amortisation	No	No benefits to transmission included
Deferred generation for peak load plants	No	Not included
Deferred generation investments for spinning reserve	No	Not included
Reduced technical losses of electricity	No	Not included
Consumption reduction	Yes	Estimated at 3.2%
Peak load transfer	Yes	Estimated at 2.5%
Reduced electricity theft	Yes	Reduced 50%
Recovered revenue related to contract power fraud	Yes	€1 per household
Recovered revenue related to incremental 'contracted power'	No	Not included
Reduction of outage times	Yes	10% reduction assumed

Benefit	Included?	Treatment
Reduced cost of client indemnification	Yes	€35 grid administrator, €1 household
Reduced CO_2 due to reduced line losses	Indirectly	Included in consumption savings
Reduced CO_2 due to wider spread of low carbon generation sources	Indirectly	Included in consumption savings
Reduced CO_2 due to truck rolls of field personnel	No	Not included
Reduced air pollutant emissions due to reduced line losses	No	Not included
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	Not included
Reduced air pollutant emissions due to truck rolls of field personnel	No	Not included

Additional benefits are set out in the following table:

TABLE 15

NETHERLANDS - BENEFITS INCLUDED IN CBA BUT NOT IN 2012/148/EU

Benefit	Treatment
Reduction in CO_2 emission	CO_2 costs are included in energy costs.
Competitiveness	Important benefits are the realized energy savings, improved competition because of more consumers switching suppliers

3. Romania

3.1. Functionality

The evaluated model in Romania is designed with a "middleware layer", consisting of data concentrators and balancing meters placed on each substation, with data communication occurring through PLC wiring from the meters to the concentrators and through various communication channels from concentrators to the central application.

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below.

TABLE 16

ROMANIA - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Feature(s)	Evaluation
Consumer	a) Provide readings directly to consumer or 3rd party	Report states the system is compliant	The CBA scenario assumes indirect information provided to customer.
	b) Update reading frequently enough to use energy saving schemes	Report states the system is compliant	
Metering operator	c) Allow remote reading	Included	Compliant
	d) Provide 2-way communication for maintenance and control	Included	Compliant
	e) Allow frequent enough readings for network planning	See below	Compliant
Commercial aspects of supply	f) Support advanced tariff system	The meters can support advance tariff systems	No inclusion for advanced tariff systems in the CBA
	g) Remote ON/OFF control supply and/or flow or power limitation	Included	Not included in CBA
Security – data protection	h) Provide secure data communication	Facilitated by meter and communications technology	Compliant
	i) Fraud prevention and detection	Facilitated by meter and communications technology	Compliant
Distributed generation	j) Provide import/export and reactive metering	Not stated	Unclear

The CBA states that the following additional functionalities have been incorporated into the metering and communications system evaluated:[2]

2 *AT Kearney Final Report, p.55*

- Automated fault identification/grid configuration, reducing outages times.
- Enhance monitoring and control of power flows and voltages.
- Improve monitoring of network assets.
- Identification of technical/non-technical losses by power flow analysis.
- Meter enables use of different technologies providing communication with the Home Area Network (HAN) and other smart meters.
- Meters should transmit to the Central Application information about the status of the device integrity breach sensor
- Advanced Metering Infrastructure (AMI) system central application should store meter data at least for the period relevant for billing, complaint, collection.
- Communication infrastructure should enable expanding the AMI system with additional meters, without the need to replace existing elements
- AMI system should allow integration of at least one balancing meter at every MV/LV station
- Meters should have capability of storage of the data for a sufficient time period
- Time synchronisation
- Remote software update.

The cost impact of these functionalities is not assessed in the CBA.

3.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 17

ROMANIA - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Consultant to EBRD (AT Kearney)
Period of roll out	2012-2022
Proportion of metering points covered	80% by 2020, 100% by 2022
Roll out alternatives included	None
Counterfactual	Continuation of standard meter installation
Sensitivity analysis considered	• Different scenarios on commercial loss reduction • Variations in discount rate
Modelling period	20 years (2012-32)
Discount rate	7.5%
Asset life of meters	20 years

3.3. Costs

The report sets out a range of unit costs for smart metering equipment and an average value of capital expenditure per metering point.

The expenditure per metering point in the CBA is calculated at €97.73 (reported value of RON430 in the CBA converted at €1=RON4.4).

The unit costs of metering and other equipment in the analysis are repeated below. Note that the core scenario assumes 99% installation of PLC module meters and 68117 balancing meters and data concentrators.

TABLE 18

ROMANIA - TOTAL COST BREAKDOWN BY TYPE OF COST (PRESENT VALUE)

Cost component	Average Cost (€/meter)
Price of single phase smart meter – GPRS module	122.73
Price of single phase smart meter – PLC module	75.00
Price of single phase smart meter – WiFi module	72.73
Price of single phase smart meter – WiMAX module	165.91
Price of three phase smart meter – GPRS module	150.00
Price of three phase smart meter – PLC module	104.55
Price of three phase smart meter – WiFi module	156.82
Price of three phase smart meter – WiMAX module	243.18
Average price of a concentrator	513.64
Average price of a balancing meter	145.45

Exchange rate of €1=RON4.4 used.

Since the release of the CBA the Regulator (ANRE) has advised that it now considers the average cost per metering point to have risen to €122 based on analysis on recent pilot projects. A key difference is the inclusion of a €25/metering point cost of distribution investment. The revised reported breakdown of costs per metering point are set out below:

TABLE 19

ROMANIA – REVISED COSTS (POST-CBA) BY TYPE (€,PRESENT VALUE)

Costs	Amount (€/metering point)
Smart meters	75.00
Communications	10.00
Information Technology	4.00
Distribution	25.00
Others not defined	8.00
TOTAL COSTS	**122.00**

Source: Data provided by ANRE.

3.4. Benefits

3.4.1. Key assumptions

Key assumptions on benefits are set out in the following table:

TABLE 20

ROMANIA - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Avoided meter reading costs	N°/year	4
Reduction in consumption	%	50% of reduced commercial losses results in lower consumption.
Reduction in outage time	%	1%
Reduction in commercial losses/theft	%	60% reduction (from initial level of 7%)

3.4.2. Total benefits

The report provides a breakdown of the share of total benefits by activity. An estimate of the benefit components by metering point has been made by subtracting the earlier cost estimate from the value of NPV of the project cited in the report, converted into a per meter value. The resulting estimates of the benefits are provided in the table below:

TABLE 21

ROMANIA - BENEFITS BY TYPE (PRESENT VALUE)

Benefit	Amount (€/metering point)
Benefits included in 2012/148/EU	
Reduction in meter reading and meter operations	46.57
Reduction in operational and maintenance costs	10.78
Deferred/avoided distribution capacity investments	
Deferred/avoided transmission capacity investments	
Deferred/avoided generation capacity investments	
Reduction in technical losses of electricity	11.44
Electricity cost savings	0.34
Reduction of commercial losses	43.55
Reduction of outage times	0.01
Reduction of CO_2 emissions	
Reduction of air pollution	
Benefits not included in 2012/148/EU	
Avoided investment in standard meters	16.75
TOTAL BENEFITS	**129.43**

3.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 22

ROMANIA - CONSIDERATION OF BENEFITS IN CBA AND THOSE IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Apply average cost of reading activity to number of reads avoided
Reduced call centre/customer care costs	No	Not explicitly considered
Reduced maintenance costs of assets	Yes	Optimisation of asset maintenance process, also savings in legalization costs of traditional meters
Reduced costs of equipment breakdown	No	
Deferred distribution capacity investment due to asset remuneration	No	The CBA states this is the case but the only considered investment deferral is that of metering assets
Deferred distribution capacity investment due to asset amortisation	No	
Deferred transmission capacity investment due to asset remuneration	No	Qualitative consideration given
Deferred transmission capacity investment due to asset amortisation	No	Qualitative consideration given
Deferred generation for peak load plants	No	
Deferred generation investments for spinning reserve	No	
Reduced technical losses of electricity	Yes	Consider reduction of energy consumed by the measurement system, reduction in threshold of meter initiation and indirect impact of lower commercial losses
Consumption reduction	No	Not explicitly included in the CBA (see below).
Peak load transfer	No	
Reduced electricity theft	Yes	Key component of the analysis
Recovered revenue related to contract power fraud	No	
Recovered revenue related to incremental 'contracted power'	No	State that qualitative consideration given
Reduction of outage times	Yes	Minor reduction included
Reduced cost of client indemnification	No	

Benefit	Included?	Treatment
Reduced CO_2 due to reduced line losses	No	The value of reduced CO_2 from reduced losses (technical and commercial) and reduced consumption is quantified in the report but not included in the CBA results
Reduced CO_2 due to wider spread of low carbon generation sources	No	
Reduced CO_2 due to truck rolls of field personnel	No	
Reduced air pollutant emissions due to reduced line losses	No	
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	
Reduced air pollutant emissions due to truck rolls of field personnel	No	

The report allows for a small allowance for reduced electricity costs arising due to greater accuracy in the forecasts of consumption (suppliers) and for losses (distributor).

Note that the only allowance included in the CBA for reduction in consumption by customers arises by virtue of the assumption that 50% of any reduction in commercial losses is manifest in a reduction in consumption (i.e., thieving customers who reduce consumption when faced with a price signal). The report notes that over time a consumption reduction of around 3.825% may be possible as the smart meters are installed, but these will need to be combined with other measures such as the investment in in-home display devices.

4. Belgium – Brussels

4.1. Functionality

The key functionalities of the proposed system ("Advanced Functionality") against the Minimum Functionalities in 2012/148/EU are assessed in the table below:

TABLE 23

BELGIUM BRUSSELS - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Consumer	FA: Provide readings directly to consumer or 3rd party	Readings provided via Internet	Compliant
	FB: Update reading frequently enough to use energy saving schemes	Readings provided via internet	Compliant
Metering operator	FC: Allow remote reading	Report states this is facilitated	Compliant
	FD: Provide 2-way communication for maintenance and control	Report states this is facilitated	Compliant
	FE: Allow frequent enough readings for network planning	Report states this is facilitated	Compliant
Commercial aspects of supply	FF: Support advanced tariff system	Report states this is facilitated	Compliant
	FG: Remote ON/OFF control supply and/or flow or power limitation	Report states this is facilitated	Compliant
Security – data protection	FH: Provide secure data communication	Report states this is facilitated	Compliant
	FI: Fraud prevention and detection	Report states this is facilitated	Compliant
Distributed generation	FJ: Provide import/export and reactive metering	Report states this is facilitated	Compliant

The proposed system is stated to meet all the functionalities in 2012/148/EU.

4.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 24

BELGIUM BRUSSELS - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Brugel
Period of roll out	2015-2019
Proportion of metering points covered	100% by 2019
Roll out alternatives included	Yes: • In-home display • Variation in functionalities
Counterfactual	No roll out
Sensitivity analysis considered	Yes
Modelling period	20 years (2011-2030)
Discount rate	6.5%
Asset life of meters	15 years

4.3. Costs

A breakdown of key incremental costs related to the introduction of smart meters is set out below. The key assumptions adopted in estimating electricity costs is that around 60% of the smart meter costs (including installation) are attributed to electricity, while in 20% of communications costs could be avoided with an electricity only roll out. These reductions have been estimated based on the costs and number of meters in the 2011 and 2014 reports.

As a result of the adjustment for gas the results differ from those in the Commission's benchmarking report.

TABLE 25

BELGIUM BRUSSELS - TOTAL COST BREAKDOWN FOR ELECTRICITY BY TYPE OF COST (PRESENT VALUE)

Cost type	Total cost – gas and electricity (€ million)	Estimated cost – electricity (€ million)	Average Cost electricity (€/metering point)
Smart meters	277.54	166.47	268.94
Information Technology	49.19	49.19	79.47
Communications	112.40	89.60	144.75
In-home display			
Generation			
Transmission			
Distribution			
Training costs	4.01	4.01	6.48
Customer care and other (project management etc)	17.51	17.51	28.29
TOTAL	**460.64**	**326.78**	**527.92**

Note: a) Smart meter costs include "Installation du matériel et techniciens" (200.368) and "Maintenance (non) planifiée" (77.170), b) Customer care and other costs include "Service à la clientèle et communication" (9.091) plus "Gestion opérationnelle" (8.419).

A breakdown of the total costs into capital and operating costs has been estimated by applying the per-installation capital and operating cost breakdowns in the CBA (p.22) to the above category totals. The following cost breakdown has been determined.

TABLE 26

BELGIUM-BRUSSELS – ESTIMATED ELECTRICITY COST BREAKDOWN BY CAPEX AND OPEX (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
CAPEX		
Investment in smart meters	120.18	194.16
Investment in Information Technology	27.71	44.77
TOTAL CAPEX	**147.89**	**238.92**
OPEX		
IT maintenance costs	21.48	34.70
Network management and front end costs	8.42	13.60
Communications/data transfer costs	89.60	144.75
Replacement/failure of smart meter systems	46.29	74.78
Training costs	4.01	6.46
TOTAL OPEX	**169.80**	**274.31**
OTHER COSTS		
Customer engagement programme	9.09	14.69
TOTAL OTHER COSTS	**9.09**	**14.69**

4.4. Benefits

4.4.1. Key assumptions

Key assumptions on benefits are set out in the following table:

TABLE 27

BELGIUM BRUSSELS - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Call centre cost savings	%	50%
Reduction in consumption	%	-4.6%
Reduction in non-supplied energy	%	10%
Reduction in theft	%	75%

4.4.2. Total benefits

A breakdown of key benefits by type of benefit is set out in the table below. In various benefit categories – meter reading and operations, operational and maintenance costs, commercial losses and the avoided investment in standard meters – the benefits for gas and electricity combined have been adjusted by the proportion of electricity meters in the joint roll-out. In other cases the benefits are assumed to only apply to electricity, including electricity cost savings where no consumption impact for gas is assumed in the CBA.

TABLE 28

BELGIUM BRUSSELS - BENEFITS BY TYPE (PRESENT VALUE)

Benefit	Amount gas and electricity (€ million)	Estimate electricity only (€ million)	Amount electricity (€/metering point)
Benefits included in 2012/148/EU			
Reduction in meter reading and meter operations	68.99	41.38	66.85
Reduction in operational and maintenance costs	9.51	9.51	15.37
Deferred/avoided distribution capacity investments			
Deferred/avoided transmission capacity investments			
Deferred/avoided generation capacity investments			
Reduction in technical losses of electricity	4.56	4.56	7.36
Electricity cost savings	178.81	107.26	173.27
Reduction of commercial losses	85.03	50.98	82.36
Reduction of outage times	3.01	3.01	4.85
Reduction of CO_2 emissions	15.61	15.61	25.21
Reduction of air pollution			
Benefits not included in 2012/148/EU			
Avoided investment in standard meters	15.52	9.31	15.04
TOTAL BENEFITS	**381.02**	**241.61**	**390.33**

4.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 29

BELGIUM BRUSSELS - COMPARISON OF BENEFITS INCLUDED IN CBA AND THOSE IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	100% reduction
Reduced call centre/customer care costs	Yes	50 % reduction
Reduced maintenance costs of assets	Yes	10 % reduction
Reduced costs of equipment breakdown	Yes	Reduced costs of fixing faults
Deferred distribution capacity investment due to asset remuneration	No	Not included
Deferred distribution capacity investment due to asset amortisation	No	Not included
Deferred transmission capacity investment due to asset remuneration	No	Not included
Deferred transmission capacity investment due to asset amortisation	No	Not included
Deferred generation for peak load plants	Yes	Also includes benefits from reduction in short run marginal cost
Deferred generation investments for spinning reserve	No	Not included
Reduced technical losses of electricity	Yes	10 % reduction
Consumption reduction	Yes	Estimated at 4.6%
Peak load transfer	Yes	One hour reduction
Reduced electricity theft	Yes	75 % reduction
Recovered revenue related to contract power fraud	Yes	
Recovered revenue related to incremental 'contracted power'	No	Not included
Reduction of outage times	Yes	10% reduction assumed
Reduced cost of client indemnification	No	Not included
Reduced CO_2 due to reduced line losses	Yes	5 % reduction due to technical losses
Reduced CO_2 due to wider spread of low carbon generation sources	No	Not included
Reduced CO_2 due to truck rolls of field personnel	No	Not included
Reduced air pollutant emissions due to reduced line losses	No	Not included
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	Not included
Reduced air pollutant emissions due to truck rolls of field personnel	No	Not included

5. Belgium – Flanders

5.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below. The functionalities invoked in the first CBA published in 2008 are also considered.

TABLE 30

BELGIUM FLANDERS - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Consumer	FA: Provide readings directly to consumer or 3rd party	Monthly reading and at the time of moving house or changing suppliers	CBA in the main scenario is based on indirect feedback to the customer
	FB: Update reading frequently enough to use energy saving schemes	Not considered in CBA	
Metering operator	FC: Allow remote reading	Remote reading available	Compliant
	FD: Provide 2-way communication for maintenance and control	Remote firmware upgrades, and programming. Power quality / state and voltage level on request	Compliant
	FE: Allow frequent enough readings for network planning	Capability to report outages, restoration of supply, measure maximum demand	Compliant
Commercial aspects of supply	FF: Support advanced tariff system	Capable of recording consumption in different tariff periods; remotely adjust tariffs / tariff periods	Compliant
	FG: Remote ON/OFF control supply and/or flow or power limitation	Capability for load limiting and disconnection	Compliant
Security – data protection	FH: Provide secure data communication	Assumed to be installed in the communication infrastructure	Compliant
	FI: Fraud prevention and detection	Fraud detection system	Compliant
Distributed generation	FJ: Provide import/export and reactive metering	4 quadrants metering	Compliant

A key distinguish feature of the proposed smart meters is the capability for connection with other meters. In particular, the electricity smart meter acts as a conduit through which data from the gas smart meter is also transferred to the data concentrators. In this way the electricity meter acts as a gateway.

Another distinguishing feature of the Flemish system is the use of the prepayment meters (known as Budget meters).

In the case of the CBA an approach that only considers indirect data transfer to customers is considered as the core scenario – that is not all potential functionalities are activated.

5.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 31

BELGIUM FLANDERS - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Flemish Regulator of the Electricity and Gas market (VREG).
Period of roll out	2015-2020 (5 years)
Proportion of metering points covered	96% by 2020
Roll out alternatives included	Yes
Counterfactual	Assume that a consumption reduction would be achieved with basic meters due to the new billing system of basic meters (twice a year instead of once)
Sensitivity analysis considered	Segmented roll out
Modelling period	30 years (2015-45)
Discount rate	5.5%
Asset life of meters	15 years

5.3. Costs

The 2012 report showed total costs of approximately €1925 million for gas and electricity combined. Based on high level estimates the amount attributed to electricity is estimated at €1363 million. The breakdown and adjustments applied are set out in the following table:

TABLE 32

BELGIUM FLANDERS - BREAKDOWN OF COSTS – 2012 CBA

Cost type	Total costs (electricity and gas) € million	Estimated total cost electricity (€ million)
Smart meters	950.00	478.00
Information Technology	275.00	275.00
Communications	450.00	360.00
In-home display	.	-
Generation	-	-
Transmission	-	-
Distribution	-	-
Training costs	-	-
Customer care and other (project management etc)	250.00	250.00
Sunk costs	-	-
TOTAL	**1925.00**	**1363.00**

The key assumptions adopted in estimating electricity costs is that around 50% of the smart meter costs (including installation) are attributed to electricity, while in 20% of communications costs could be avoided with an electricity only roll out.

These figures for electricity are updated below based on the 2014 report, the results of which are not reported in the Commission's benchmarking report. The key changes is a 267% increase in the per unit smart meter costs (meter plus installation), which are offset somewhat by reduced communications costs – features that are now included in the meter.

TABLE 33

BELGIUM FLANDERS - TOTAL COST BREAKDOWN 2014 FOR ELECTRICITY BY TYPE OF COST (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	1278.70	387.49
Information Technology	275.00	83.33
Communications	75.00	22.73
In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
Training costs	-	-
Customer care and other (project management etc)	250.00	75.76
Sunk costs	-	-
TOTAL	**1878.70**	**569.30**

The cost for smart meters include acquisition costs of €851 million and installation costs of €428 million. Customer care costs include €200 million for roll-out costs and €50 million for other costs.

5.4. Benefits

5.4.1. Key assumptions

Key assumptions on benefits in the 2014 analysis are set out in the following table:

TABLE 34

BELGIUM FLANDERS - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Avoided meter reading costs	€/meter/year	7,50
Call centre cost savings	€/meter/year	1
Reduction in consumption	%	-3.4%
Peak load transfer	%	15 for 20% of customers

5.4.2. Total benefits

The 2012 report showed total benefits of €2074 million for gas and electricity combined, which increases to €2135 in 2014 with increased avoided investment in standard meters partly offset by the removal of a gas consumption impact. Based on

high level estimates, based on cost changes included in the 2014 report the amount attributed to electricity is estimated at €1694 million. The breakdown and adjustments applied are set out in the following table:

TABLE 35

BELGIUM FLANDERS - TOTAL BENEFIT BREAKDOWN, 2014 (NPV BASIS)

Benefit	Electricity and gas combined (€ million)	Estimate of electricity only (€ million)	Amount (€/electricity metering point)
Benefits included in 2012/148/EU			
Reduction in meter reading and meter operations	648.00	536.00	162.42
Reduction in operational and maintenance costs	200.00	200.00	60.61
Deferred/avoided distribution capacity investments		-	-
Deferred/avoided transmission capacity investments		-	-
Deferred/avoided generation capacity investments		-	-
Reduction in technical losses of electricity	10.00	10.00	3.03
Electricity cost savings	359.00	359.00	108.79
Reduction of commercial losses	321.00	200.00	60.61
Reduction of outage times	75.00	75.00	22.73
Reduction of CO_2 emissions	-	-	-
Reduction of air pollution	-	-	-
Benefits not included in 2012/148/EU			
Avoided investment in standard meters	522.00	314.00	95.15
TOTAL BENEFITS	**2135.00**	**1694.00**	**513.33**

Notes: The reduction in meter reading and meter operations includes €276 million for meter reading savings. €130 million for operations improvement, €70 million for reduction in call centre costs and €60 million for switching cost reductions. Savings in O&M costs reflect reduced balancing costs. The electricity cost savings include consumption reduction of €259 million and €100 million for peak load shifting.

5.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 36

CONSIDERATION OF BENEFITS IN CBA AND THOSE IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 2 manual reads per year
Reduced call centre/customer care costs	Yes	Reduction of incorrect meter readings, this benefit is considered only after the roll-out
Reduced maintenance costs of assets	Yes	Allowance provided in CBA for better investment decisions and more accurate balancing facilitated by smart meters
Reduced costs of equipment breakdown	Yes	Reduced costs of fixing faults
Deferred distribution capacity investment due to asset remuneration	No	Not included
Deferred distribution capacity investment due to asset amortisation	No	Not included
Deferred transmission capacity investment due to asset remuneration	No	Not included
Deferred transmission capacity investment due to asset amortisation	No	Not included
Deferred generation for peak load plants	Yes	Also includes benefits from reduction in short run marginal cost
Deferred generation investments for spinning reserve	No	Not included
Reduced technical losses of electricity	Yes	
Consumption reduction	Yes	Estimated at 3.4%
Peak load transfer	Yes	Estimated at 15% for 20% of customers including the effect of smart grids
Reduced electricity theft	Yes	
Recovered revenue related to contract power fraud	No	Not included
Recovered revenue related to incremental 'contracted power'	No	Not included
Reduction of outage times	Yes	Faster detection of faults
Reduced cost of client indemnification	No	Not included

Benefit	Included?	Treatment
Reduced CO_2 due to reduced line losses	Indirectly	Included in consumption impact
Reduced CO_2 due to wider spread of low carbon generation sources	Indirectly	Included in consumption impact
Reduced CO_2 due to truck rolls of field personnel	Indirectly	Included in consumption impact
Reduced air pollutant emissions due to reduced line losses	No	Not included
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	Not included
Reduced air pollutant emissions due to truck rolls of field personnel	No	Not included

Additional benefits are set out in the following table:

TABLE 37

BELGIUM FLANDERS - BENEFITS INCLUDED IN CBA BUT NOT IN 2012/148/EU

Benefit	Treatment
Reduction in CO_2 emission	Included in the price of the energy
Savings in switching process	A more efficient switching process is envisaged for suppliers
Smart grids	Real-time response, load shaving

6. Belgium – Wallonia

6.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below:

TABLE 38

BELGIUM WALLONIA - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Feature(s)	Evaluation
Consumer	a) Provide readings directly to consumer or 3rd party	Communication system provides customer information on meter balance daily	Compliant
	b) Update reading frequently enough to use energy saving schemes	Ability to update every 15 minutes	Compliant
Metering operator	c) Allow remote reading	Capability to remote reading, report outages, voltage and generation (distributed generation)	Compliant
	d) Provide 2-way communication for maintenance and control	Remote parameterization, firmware updates etc.	Compliant
	e) Allow frequent enough readings for network planning	Ability to record information every 15 minutes	Compliant
Commercial aspects of supply	f) Support advanced tariff system	Not mentioned specifically	Potentially compliant. The interface can be updated to meet 3rd party/consumer requirements
	g) Remote ON/OFF control supply and/or flow or power limitation	Capability for load limiting and disconnection	Compliant
Security – data protection	h) Provide secure data communication	Included	Compliant
	i) Fraud prevention and detection	Use of security log system on meter to detect improper use	Compliant
Distributed generation	j) Provide import/export and reactive metering	Capable of recording import/ export and reactive power	Compliant

The features proposed for the system in Wallonia meet all the minimum functionalities in 2012/148/EU. It should be noted that some of them are mentioned as a possible update of the interface of the system.

As for Flanders and Brussels, a key distinguishing feature of the proposed smart meters is the capability for connection with other meters. In this way the electricity meter acts as a conduit or gateway through which data from the gas smart meter is transferred to the data concentrator.

6.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 39

BELGIUM WALLONIA - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	CWAPE (Comission Wallone pour l'Energie)
Period of roll out	2015-2020 (80%)
Proportion of metering points covered	80 % by 2020 100 % by 2026
Roll out alternatives included	100% prepaid meters installed by 2020, approximately 30% of the rest of the meters by 2020
Counterfactual	No roll-out, but includes interventions to meet renewables obligations
Sensitivity analysis considered	Yes – high and low scenarios
Modelling period	30 years
Discount rate	5.5% (WACC)
Asset life of meters	15 years

6.3. Costs

A breakdown of key incremental costs related to the introduction of smart meters and their operation of the 30 year analysis period is set out below. The report sets out a value of gas and electricity combined at €2,232 million. Based on high level assumptions, the following estimate for electricity only is provided. The key assumptions adopted in estimating electricity costs is that around 73% of the smart meter costs (including installation) are attributed to electricity, while 20% of communications costs could be avoided with an electricity only roll out. These reductions have been estimated based on the costs and number of meters in the 2012 report. Note that due to the adjustment for gas these results differ from those in the Commission's benchmarking report.

TABLE 40

BELGIUM WALLONIA - TOTAL COST BREAKDOWN FOR ELECTRICITY BY TYPE OF COST (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	1,245.33	493.74
Information Technology	232.69	92.26
Communications	172.87	68.54
In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
Training costs	10.12	4.01
Other (Project management)	68.78	27.27
Sunk costs	-	-
TOTAL	**1,729.29**	**685.82**

6.4. Benefits

6.4.1. Key assumptions

The following key assumptions are included in the base case:

TABLE 41

BELGIUM WALLONIA - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Reduction in commercial losses	€/meter/year	33%
Reduction in consumption	%	0%
Peak load transfer	%	12%

6.4.2. Total benefits

A breakdown of key benefits by type of benefit is set out in the table below.

TABLE 42

BELGIUM WALLONIA - BENEFITS FOR ELECTRICITY BY TYPE (PRESENT VALUE)

Benefit	Amount (€ million)	Amount (€/meter)
Benefits included in 2012/148/EU		
Reduction in meter reading and meter operations	322.49	127.86
Reduction in operational and maintenance costs	8.20	3.25
Deferred/avoided distribution capacity investments	-	-
Deferred/avoided transmission capacity investments	-	-
Deferred/avoided generation capacity investments	-	-
Reduction in technical losses of electricity	-	-
Electricity cost savings	262.60	104.11
Reduction of commercial losses	896.71	379.93
Reduction of outage times	-	-
Reduction of CO_2 emissions	-	-
Reduction of air pollution	-	-
Benefits not included in 2012/148/EU		
Competitiveness	77.29	30.65
TOTAL BENEFITS	**1,567.29**	**645.80**

6.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 43

BELGIUM WALLONIA - BENEFITS IN 2012/148/EU NOT INCLUDED IN THE CBA

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	-
Reduced call centre/customer care costs	Yes	-
Reduced maintenance costs of assets	Yes	-
Reduced costs of equipment breakdown	Yes	-

Benefit	Included?	Treatment
Deferred distribution capacity investment due to asset remuneration	No	However, peak load consumption impact included
Deferred distribution capacity investment due to asset amortisation	No	However, peak load consumption impact included
Deferred transmission capacity investment due to asset remuneration	No	-
Deferred transmission capacity investment due to asset amortisation	No	-
Deferred generation for peak load plants	No	-
Deferred generation investments for spinning reserve	No	-
Reduced technical losses of electricity	No	-
Consumption reduction	Yes	Estimated at 0%
Peak load transfer	Yes	Estimated at 12%
Reduced electricity theft	Yes	Commercial loss reduction the largest benefit
Recovered revenue related to contract power fraud	Yes	-
Recovered revenue related to incremental 'contracted power'	Yes	-
Reduction of outage times	Yes	-
Reduced cost of client indemnification	No	-
Reduced CO_2 due to reduced line losses	No	No emissions impact included
Reduced CO_2 due to wider spread of low carbon generation sources	No	
Reduced CO_2 due to truck rolls of field personnel	No	
Reduced air pollutant emissions due to reduced line losses	No	
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	
Reduced air pollutant emissions due to truck rolls of field personnel	No	

7. Czech Republic

7.1. Functionality

The CBA considered in the Czech Republic is the "Blanket" scenario, which is proposed for its strict compliance with the common minimum functionalities described in the EC Recommendation 2012/148/EU.

TABLE 44

CZECH REPUBLIC - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Feature(s)	Evaluation
Consumer	a) Provide readings directly to consumer or 3rd party	Included (see note)	IHDs are not considered for this case and it is not specified if any other interface which provides visualised individual consumption data to the customer is installed.
	b) Update reading frequently enough to use energy saving schemes	Technology compliant but CBA refers to annual billing	Compliant
Metering operator	c) Allow remote reading	Included	Compliant
	d) Provide 2-way communication for maintenance and control	Included	Compliant
	e) Allow frequent enough readings for network planning	Monitoring of voltage, consumed power, power factor permitted.	Compliant
Commercial aspects of supply	f) Support advanced tariff system	Possible with the metering system	Compliant
	g) Remote ON/OFF control supply and/or flow or power limitation	Disconnection included in metering specification	Compliant
Security – data protection	h) Provide secure data communication	Included	Compliant
	i) Fraud prevention and detection	Included	Compliant
Distributed generation	j) Provide import/export and reactive metering	Reactive metering included	Compliant

7.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 45

CZECH REPUBLIC - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Ministry of Industry and Trade
Period of roll out	2019-2026
Proportion of metering points covered	LV level on all consumers' points of delivery
Roll out alternatives included	Basic (no roll out scenario)
Communication Technology	PLC and GPRS
Counterfactual	Meters with built-in communications module
Sensitivity analysis considered	Yes
Modelling period	2012-2038
Discount rate	6.1%
Asset life of meters	12 years
Average annual growth in consumption (without the roll out)	1.5%
Currency rate [CZK/EUR]*	27.6271

**Used for the conversion in this document*

The CBA assumes a 26 year period for the roll out comprising the following:

- Preparatory period - 7 years
- Realisation phase – 7 years
- Operational phase – 12 years

7.3. Costs

A breakdown of costs by type of cost is set out in the table below. The total costs represent the Net Present Value (NPV) of the expenditures estimated for the period of the analysis, calculated with a discount rate of 6.1%.

The CBA of the Czech Republic expressed the costs as the extra costs of performing the smart metering roll-out compared to the basic scenario, which assumes the continuation of the current system. The following results have been created from disaggregated totals, which differ from the results reported in the Commission's benchmarking report.

TABLE 46

CZECH REPUBLIC - COST BREAKDOWN BY TYPE OF COST (€ MILLION, PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	1,417.46	248.13
Information Technology	628.55	110.03
Communications	348.97	61.09
In-home display		
Generation		
Transmission		
Distribution	14.88	2.60
Training costs		
Customer care and other	14.66	2.57
Sunk costs	7.78	1.36
Security	22.91	4.01
Others not defined	38.08	6.67
TOTAL	**2,493.29**	**436.46**

Costs converted using exchange rate of €1=27.6271 CZK

The following breakdown between capital and operating expenditure is set out in the following table:

TABLE 47

CZECH REPUBLIC - COST BREAKDOWN BY CAPEX AND OPEX (PRESENT VALUE)

Cost type	Total cost (€)	Average Cost (€/metering point)
CAPEX		
Investment in smart meters	1,298.40	227.29
Investment in Information Technology	254.03	44.47
Investment in Communications	249.79	43.73
Investment in In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
TOTAL CAPEX	**1,802.22**	**315.48**

Cost type	Total cost (€)	Average Cost (€/metering point)
OPEX		
IT maintenance costs	374.52	65.56
Network management and front end costs	1.63	0.29
Communications/data transfer costs	99.18	17.36
Scenario management costs	13.03	2.28
Replacement/failure of smart meter systems	119.06	20.84
Generation	-	-
Transmission	-	-
Distribution	14.88	2.60
Meter reading	-	-
Call centre/customer care	-	-
Training costs	-	-
TOTAL OPEX	**622.30**	**108.94**
OTHER COSTS		
Customer engagement programme	-	-
Sunk costs of previously installed meters	7.78	1.36
Security	22.91	4.01
Others not defined	38.08	6.67
TOTAL OTHER COSTS	**68.77**	**12.04**

Costs converted using exchange rate of €1=27.6271 CZK

These costs are broken down in more detail by component below:

TABLE 48

CZECH REPUBLIC – DETAILED COST BREAKDOWN

Cost type	Total cost (€)	Average Cost (€/metering point)
Smart meters	1,417.46	248.13
Smart meter purchase	599.38	104.92
Metering equipment	38.44	6.73
Smart metering roll-out	323.02	56.55
Inspection	15.64	2.74
Periodical inspections	118.43	20.73

Cost type	Total cost (€)	Average Cost (€/metering point)
Services for DTS	0.63	0.11
Information Technology	629.55	110.03
Data Collection System	160.02	28.01
Information System-Trader	71.60	12.53
Information System- Market operator	22.41	3.92
Data Collection System Maintenance	192.09	33.63
Info System-Trader Maintenance	145.62	25.49
Info System- Market Op. Maintenance	36.81	6.44
Communications	318.67	55.79
Data concentrators	245.05	42.90
Repeater	4.74	0.83
Data transmission from concentrators	99.18	17.36
In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	14.88	2.60
Training costs	-	-
Customer care and other	14.66	2.57
Legislative and other preparations	1.63	0.29
Project Management	0	0
Project Publicity	13.03	2.28
Sunk costs	7.78	1.36
Metering equipment liquidation	2.86	0.50
Disassembly of HDO transmitters	4.92	0.86
Security	22.91	4.01
Others not defined	38.08	6.67
TOTAL	**2,493.29**	**436.46**

7.4. Benefits

7.4.1. Assumptions and total benefits

Few key assumptions on benefits are listed in the report. A breakdown of total benefits is set out in the table below. The total amounts represent the Net Present Value (NPV) of the expected benefits for the period of the analysis, calculated with a discount rate of

6.1% for the financial analysis' benefits, and 5.5% for the economic analysis' benefits.

The CBA of the Czech Republic expresses the benefits as the reduction of certain costs when performing the smart metering roll-out compared to the basic scenario, which assumes the continuation of the current system.

TABLE 49

CZECH REPUBLIC - BENEFITS BY TYPE

Benefit	Amount (€ million)	Amount (€/metering point)
Benefits included in 2012/148/EU		
Reduction in meter reading and meter operations	175.19	30.67
Reduction in operational and maintenance costs	252.90	44.27
Disconnection and renewal of supply for non-payment	97.04	16.99
Visit to supply point due to changes	22.70	3.97
Supplier switch	37.93	6.64
Metering equipment assembly and disassembly	48.14	8.43
Metering equipment repair and certification	38.59	6.75
Deferred/avoided distribution capacity investments	-	-
Deferred/avoided transmission capacity investments	-	-
Deferred/avoided generation capacity investments	-	-
Reduction in technical losses of electricity	-	-
Electricity cost savings	8.51	1.49
Peak load shaving	8.51	1.49
Reduction of commercial losses	*	*
Reduction of outage times	-	-
Reduction of CO_2 emissions	-	-
Reduction of air pollution	-	-
Benefits not included in 2012/148/EU		
Avoided investment in standard meters	728.31	127.49
Standard meters	313.32	54.85
Assembly of standard meters	307.85	53.89
Metering equipment	92.84	16.25
Control automation & existing HDO transmitter	14.30	2.50
TOTAL BENEFITS	**1,156.40**	**202.43**

7.4.2. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA. In fact the CBA includes a table that explicitly addresses this issue:

TABLE 50

CZECH REPUBLIC - COMPARISON OF BENEFITS IN CBA AND THOSE SET OUT IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 1 regular manual reads per year, and a reduction of the processing costs.
Reduced meter operations costs	Yes	Based on the savings of connection and disconnection, repair and supplier switch.
Reduced billing costs	No	Not considered
Reduced call centre/customer care costs	Yes	Report states that is considered
Reduced maintenance costs of assets	No	Not considered
Reduced costs of equipment breakdown	No	Not considered
Deferred distribution capacity investment due to asset remuneration	No	Not considered applicable due to the benefits provided by the HDO system
Deferred distribution capacity investment due to asset amortisation	No	Not considered applicable due to the benefits provided by the HDO system
Deferred transmission capacity investment due to asset remuneration	No	Not considered applicable due to the benefits provided by the HDO system
Deferred transmission capacity investment due to asset amortisation	No	Not considered applicable due to the benefits provided by the HDO system
Deferred generation for peak load plants	No	Not considered applicable due to the benefits provided by the HDO system
Deferred generation investments for spinning reserve	No	Not considered applicable due to the benefits provided by the HDO system
Reduced technical losses of electricity	No	Base on pilot projects and DSO's experience the impact of this benefit is not considered.
Consumption reduction	No	State that the results of pilot projects implementation of the AMM did not show any changes in the volume of consumption.
Peak load transfer	Indirect	The impact of the peak shaving shall be minimal since load shifting is already performed in the country. The benefit comes from the reduction of the operational cost of RLCs
Reduced electricity theft	Yes	The report states that this is considered
Recovered revenue related to contract power fraud	Yes	Included in non-technical losses

Benefit	Included?	Treatment
Recovered revenue related to incremental 'contracted power'	No	Not included
Reduction of outage times	No	Not considered relevant
Reduced cost of client indemnification	No	Not included
Reduced CO_2 due to reduced line losses	No	State that issues related to emissions included in price of energy
Reduced CO_2 due to wider spread of low carbon generation sources	No	
Reduced CO_2 due to truck rolls of field personnel	No	
Reduced air pollutant emissions due to reduced line losses	No	
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	
Reduced air pollutant emissions due to truck rolls of field personnel	No	

Additional benefits are set out in the following table:

TABLE 51

BENEFITS INCLUDED IN CBA BUT NOT IN 2012/148/EU

Benefit	Treatment
Savings in install and replace standard metering system	Savings in the current replacement and install programs for meters.

8. Germany

8.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below:

TABLE 52

GERMANY - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Feature(s)	Evaluation
Consumer	a) Provide readings directly to consumer or 3rd party	Direct feedback through IHD	Compliant
	b) Update reading frequently enough to use energy saving schemes	Updates every 15 minutes	
Metering operator	c) Allow remote reading	Included	Compliant
	d) Provide 2-way communication for maintenance and control	Included	Compliant
	e) Allow frequent enough readings for network planning	Included	Compliant
Commercial aspects of supply	f) Support advanced tariff system	Included	Compliant
	g) Remote ON/OFF control supply and/or flow or power limitation	Included	Compliant
Security – data protection	h) Provide secure data communication	A specific German protocol is included and implemented through a security module.	Exceeds minimum requirement
	i) Fraud prevention and detection	Included	Compliant
Distributed generation	j) Provide import/export and reactive metering	Included	Compliant

The features proposed for the German system meet all the minimum functionalities in 2012/148/EU.

In some scenarios "intelligent meters" are proposed. The intelligent meters are not initially integrated into the external communication network, but they are able to reflect actual energy consumption and actual average usage time. However, the meters must have the ability to be upgraded through integration with a communication network that complies with the security protocols of Germany.

8.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 53

GERMANY - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Bundesministerium für Wirtscahft und Energie
Period of roll out	2012-2022
Proportion of metering points covered	80 % by 2022
Roll out alternatives included	• Lower proportion of metering points • Inclusion of intelligent meters
Counterfactual	Continuation of current practices
Sensitivity analysis considered	Yes, including for consumption reduction and reduction in the number of metering operators
Modelling period	20 years (2012-32)
Discount rate	5% commercial 3.1% end consumer and the company
Asset life of meters	13 years

8.3. Costs

The CBA of Germany does not explicitly include a breakdown of the total cost, with only total OPEX and CAPEX reported. However, a breakdown of costs has been made based on the unit costs included in the report.

The CAPEX includes the meters, SMGW, communication facilities, IHD and IT-systems. The CAPEX assumes that 110% communications coverage, of which 80% of metering points are covered by GPRS.

The OPEX includes electricity consumption of meters, communication costs, costs for meter reading and billing, calibration costs, maintenance and repairs, replacement of damaged meters, sunk costs for previously installed conventional meters and IT maintenance.

Estimated costs for the reported period up to 2032 under the EU scenario are set out below. Note these figures differ from those in the Commission's benchmarking report, which includes the results of the Roll Out Scenario Plus.

TABLE 54

GERMANY - COST BREAKDOWN BY TYPE OF COST (€ MILLION, PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	7,222.05	281.38
Information Technology	13.74	0.54
Communications	12,133.37	472.73
In-home display	1,288.93	50.22
Generation	0	-
Transmission	0	-
Distribution	0	-
Training costs	329.89	12.85
Customer care and other	0	0
Sunk costs	0	0
Security	0	0
Others not defined	0	0
TOTAL	**20,987.99**	**545.14**

The breakdown between capital and operating expenditure is set out in the following table:

TABLE 55

GERMANY - COST BREAKDOWN BY CAPEX AND OPEX (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
CAPEX		
Investment in smart meters	5,752.49	149.42
Investment in Information Technology	6.70	0.17
Investment in Communications	1,435.01	37.27
Investment in In-home display	1,288.93	33.48
Generation	-	-
Transmission	-	-
Distribution	-	-
TOTAL CAPEX	**8,483.14**	**220.34**
OPEX		
IT maintenance costs	7.04	0.18

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Network management and front end costs		
Communications/data transfer costs	10,698.36	277.88
Scenario management costs		
Replacement/failure of smart meter systems	1,469.56	38,17
Generation		
Transmission		
Distribution		
Meter reading		
Call centre/customer care		
Training costs	329.90	8.57
TOTAL OPEX	**12,504.85**	**324.80**

8.4. Benefits

8.4.1. Key assumptions

Key assumptions on benefits are set out in the following table:

TABLE 56

GERMANY - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Avoided meter reading costs	€/meter p.a.	3
Call centre cost savings	€/meter p.a.	2.5
Consumption reduction	%	Between 0.5% and 2.5%, depending on size of customer (average 1.8%)
Reduction in peak load	GW	6.1
Reduction in non-supplied energy	%	1 %
Reduction in theft	%	20 %

8.4.2. Total benefits

The CBA of Germany does not explicitly include a breakdown of benefits in the EU scenario. However, from the available information the following estimate is made.

TABLE 57

GERMANY - BENEFITS BY TYPE

Benefit	Amount (€ million)	Amount (€/metering point)
Benefits included in 2012/148/EU		
Reduction in meter reading and meter operations	480.74	12.65
Reduction in operational and maintenance costs		-
Deferred/avoided distribution capacity investments	1,554.00	40.89
Deferred/avoided transmission capacity investments	308.87	8.13
Deferred/avoided generation capacity investments	-	-
Reduction in technical losses of electricity	-	-
Electricity cost savings	4,604.38	121.17
Reduction of commercial losses	39.24	1.03
Reduction of outage times	12.88	0.34
Reduction of CO_2 emissions	-	-
Reduction of air pollution	-	-
Benefits not included in 2012/148/EU		
Avoided investment in standard meters	3,040.44	80.01
TOTAL BENEFITS	**10,040.54**	**264.22**

For the period solely to 2022 the net benefits are extremely negative. However, for the full period up to 2032 the net benefits are reported to have a NPV of -€0.1 billion.

8.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 58

GERMANY – COMPARISON OF BENEFITS IN CBA AND THOSE IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 1 manual reads per year
Reduced call centre/customer care costs	Yes	Considers savings due to claims reduction and information calls reduction
Reduced maintenance costs of assets	Yes	Especially in transformers maintenance

Benefit	Included?	Treatment
Reduced costs of equipment breakdown	Yes	Reduced costs of fixing faults
Deferred distribution capacity investment due to asset remuneration	No	Considered the amount of deferred investment and the expected period of deferral
Deferred distribution capacity investment due to asset amortisation	No	
Deferred transmission capacity investment due to asset remuneration	No	
Deferred transmission capacity investment due to asset amortisation	No	
Deferred generation for peak load plants	Yes	Also includes benefits from reduction in short run marginal cost
Deferred generation investments for spinning reserve	No	Not included
Reduced technical losses of electricity	Yes	Dependent on use of PLC technology (only 20% of 110% coverage)
Consumption reduction	Yes	Between 0.5% and 2.5% depending on customer (average 1.8%)
Peak load transfer	Yes	Assumed at 6.1 GW
Reduced electricity theft	Yes	Reduced 20%
Recovered revenue related to contract power fraud	Yes	20% reduction
Recovered revenue related to incremental 'contracted power'	Yes	
Reduction of outage times	Yes	1% reduction assumed
Reduced cost of client indemnification	Yes	Quantity not specified
Reduced CO_2 due to reduced line losses	Yes	CO_2 benefits included in the electricity consumption impact (via the price)
Reduced CO_2 due to wider spread of low carbon generation sources	No	Not included
Reduced CO_2 due to truck rolls of field personnel	No	Not included
Reduced air pollutant emissions due to reduced line losses	No	Not included
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	Not included
Reduced air pollutant emissions due to truck rolls of field personnel	No	Not included

9. Hungary

The CBA considered in this document is that produced by Energlobe Service Kft for the Ministry of National Development in June 2013. The detailed roll out scenario considered is labelled as "Scenario 1", which involves a distributor-based roll out of smart meters resulting in 80% coverage by 2023.

The CBA considers both electricity and gas, though these are separately reported.

9.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below:

TABLE 59

KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Consumer	FA: Provide readings directly to consumer or 3rd party	Provision for an in-home display (IHD) is included in the calculations	Exceeds minimum requirement, in particular use of IHD and data provided to the customer
	FB: Update reading frequently enough to use energy saving schemes	Able to provide real time information, though exact update time not specified in CBA	Meets minimum requirement
Metering operator	FC: Allow remote reading	Capability to remote reading	Compliant
	FD: Provide 2-way communication for maintenance and control	Remote parameterization, firmware updates etc.	Compliant
	FE: Allow frequent enough readings for network planning	CBA does not state the network planning impacts, nor include network benefits	Should meet minimum requirements
Commercial aspects of supply	FF: Support advanced tariff system	Dynamic tariffs permitted (though not included in all CBA scenarios)	Compliant
	FG: Remote ON/OFF control supply and/or flow or power limitation	Capability for load limiting and disconnection (though not activated in all CBA scenarios)	Compliant
Security – data protection	FH: Provide secure data communication	Appropriate protocols considered	Compliant
	FI: Fraud prevention and detection	Appropriate protocols considered	Compliant

Market role	2012/148/EU Minimum Functionality	Features of National System proposed in CBA	Evaluation
Distributed generation	FJ: Provide import/export and reactive metering	Included as a Smart Grid feature	Compliant

A key distinguishing feature of Hungarian system is the use of real time information. However, the Hungarian CBA does not provide accurate information about how to achieve this requirement in their specific case.

9.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 60

HUNGARY - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	The Hungarian Energy and Public Utility Regulatory Authority
Period of roll out	2015-2023
Proportion of metering points covered	60% by 2021, 80% by 2023
Roll out alternatives included	Joint
Counterfactual	No roll out of smart meters
Sensitivity analysis considered	Yes
Modelling period	18 years (2015-2033)
Discount rate	3.5%
Asset life of meters	15 years

The report considers various alternative roll out scenarios:

- "Scenario 2", a joint roll out by all DSOs, in which the companies concerned jointly develop the system that process and store the data provided by smart meters, and make them available to the competent companies and authorities for further use. Under this scenario there is a necessity to create a new entity known as the Smart Meter Operator responsible for data collation and transfer.
- "Scenario 3", a variation of scenario 2, with MAVIR the Transmission System Operator taking over the functions of the Smart Meter Operator,
- "Scenario 4", a variation of scenario 3 in which demand management functions are included in the smart meter set up (remote operations etc).

9.3. Costs

A breakdown of key incremental costs related to the introduction of smart meters in Scenario 1 are set out below:

TABLE 61

HUNGARY - TOTAL COST BREAKDOWN BY TYPE OF COST (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	510.14	125.55
Information Technology	46.70	11.49
Communications	220.51	54.27
In-home display	47.72	11.74
Generation		
Transmission		
Distribution		
Training costs	0.04	0.01
Customer care and other (project management etc)	117.77	28.98
Sunk costs	42.11	10.36
Others	0.06	0.01
TOTAL	**985.06**	**242.42**

Costs converted using exchange rate of €1= Ft. 294

TABLE 62

HUNGARY - COST BREAKDOWN BY CAPEX AND OPEX (NPV BASIS)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
CAPEX		
Investment in smart meters	390.54	96.11
Investment in Information Technology	28.56	7.03
Investment in Communications	78.13	19.23
Investment in In-home display	47.72	11.74
Generation		
Transmission		
Distribution		
TOTAL CAPEX	**544.95**	**134.11**
OPEX		
IT maintenance costs	18.15	4.47
Network management and front end costs	88.98	21.90
Communications/data transfer costs	142.38	35.04
Scenario management costs		
Replacement/failure of smart meter systems	119.60	29.43
Generation		
Transmission		
Distribution		
Meter reading		
Call centre/customer care	28.59	7.04
Training costs	0.04	0.01
TOTAL OPEX	**397.74**	**97.89**
OTHER COSTS		
Customer engagement programme	0.20	0.05
Sunk costs of previously installed meters	42.11	10.36
Electricity consumption of the meters	0.06	0.01
TOTAL OTHER COSTS	**42.36**	**10.43**

Costs converted using exchange rate of €1=Ft294

9.4. Benefits

9.4.1. Key assumptions

Key assumptions on benefits are set out in the following table:

TABLE 63

HUNGARY - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Avoided meter reading costs	%	75%
Call centre cost savings	%	30%-50%
Reduction in consumption	%	1.5%
Peak load transfer	%	-
Reduction in distribution losses	€/meter/year	-
Reduction in non-supplied energy	%	-
Reduction in theft	%	50%
Reduction in technical losses	%	1.5%

9.4.2. Total benefits

A breakdown of key benefits by type of benefit is set out in the table below:

TABLE 64

HUNGARY - BENEFITS BY TYPE (PRESENT VALUE)

Benefit	Amount (€ million)	Amount (€/metering point)
Benefits included in 2012/148/EU		
Reduction in meter reading and meter operations	59.01	14.52
Reduction in operational and maintenance costs	-	-
Deferred/avoided distribution capacity investments	-	-
Deferred/avoided transmission capacity investments	-	-
Deferred/avoided generation capacity investments	-	-
Reduction in technical losses of electricity	18.06	4.45
Electricity cost savings	30.93	7.61
Reduction of commercial losses	79.59	19.59
Reduction of outage times	-	-
Reduction of CO_2 emissions	-	-

Benefit	Amount (€ million)	Amount (€/metering point)
Reduction of air pollution	-	-
Benefits not included in 2012/148/EU		
Competitiveness	202.33	49.79
Generation efficiency improvement	279.01	68.66
Avoided investment in standard meters	-	-
TOTAL BENEFITS	**668.93**	**164.62**

Note that the electricity costs savings assume a decrease in the electricity price of a 0.5% per year.

The net impact is a negative result of over €85/meter. However, it needs to be noted that the other scenarios result in either a lower negative result (scenarios 2 and 3) or a positive result (scenario 4). In the case of scenario 4 the following benefits are reported:

- A 10% reduction in network losses,
- A 75% reduction in customer switchover costs,
- A 16% decrease in balancing power demand,
- A 6% decrease in wholesale prices, relating to a 2% in end-user prices due to more intense competition.

Scenario 4 is the highest cost scenario, but includes significant additional benefits due to the greater use of smart meter functionality. A question raised is whether some of these benefits can also be achieved under the core scenario (scenario 1).

An additional issue raised by the CBA is that the overall result is more favourable if the results of electricity and gas are combined.

9.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 65

BENEFITS IN 2012/148/EU NOT INCLUDED IN THE CBA

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 1 manual reads per year
Reduced call centre/customer care costs	Yes	Considers savings due to incorrect billing and metering
Reduced maintenance costs of assets	Yes	A better balancing of the elements of the grid is considered

Benefit	Included?	Treatment
Reduced costs of equipment breakdown	Yes	Reduced costs of fixing faults
Deferred distribution capacity investment due to asset remuneration	No	-
Deferred distribution capacity investment due to asset amortisation	No	-
Deferred transmission capacity investment due to asset remuneration	No	-
Deferred transmission capacity investment due to asset amortisation	No	-
Deferred generation for peak load plants	No	-
Deferred generation investments for spinning reserve	No	-
Reduced technical losses of electricity	Yes	1.5 % reduction assumed
Consumption reduction	Yes	1.5% reduction assumed
Peak load transfer	No	No
Reduced electricity theft	Yes	50 % reduction considered
Recovered revenue related to contract power fraud	Yes	50 % reduction assumed
Recovered revenue related to incremental 'contracted power'	No	-
Reduction of outage times	No	-
Reduced cost of client indemnification	No	-
Reduced CO_2 due to reduced line losses	No	-
Reduced CO_2 due to wider spread of low carbon generation sources	No	-
Reduced CO_2 due to truck rolls of field personnel	No	-
Reduced air pollutant emissions due to reduced line losses	No	-
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	-
Reduced air pollutant emissions due to truck rolls of field personnel	No	-

10. Lithuania

10.1. Functionality

The results of the CBA depend directly of several variables as: the communication technologies, roll-out time of the implementation, scope of the roll out, life span of the assets and the functionalities of the smart meters.

Based on this, for the analysis of the Lithuania's smart meter roll out three different scenarios have been defined: Base case scenario, Advanced Functionality scenario and Multi-metering scenario.

For the Base case scenario, the meter functionalities were chosen with compliance to the EC and CENELEC recommendations, and thus, is the scenario analysed in this report.

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below. Limited specification is provided but the report states the basic system is fully compliant with 2012/148/EU. Additional functionality is included in the other scenarios.

TABLE 66

LITHUANIA - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Feature(s)	Evaluation
Consumer	a) Provide readings directly to consumer or 3rd party	System capable of transferring data to DSO	Compliant. However, visual interfaces are not considered.
	b) Update reading frequently enough to use energy saving schemes	Meters with functionality of providing hourly electricity consumption profile and peak measurements in 1 hour period	Compliant
Metering operator	c) Allow remote reading	Facilitated	Compliant
	d) Provide 2-way communication for maintenance and control	Remote control functionality included	Compliant
	e) Allow frequent enough readings for network planning	Hourly peak demand and 63 day storage	Compliant
Commercial aspects of supply	f) Support advanced tariff system	Can be activated	Compliant
	g) Remote ON/OFF control supply and/or flow or power limitation	Facilitated	Compliant
Security – data protection	h) Provide secure data communication	Encrypted data transfer protocol	Compliant
	i) Fraud prevention and detection	Encrypted data transfer protocol	Compliant
Distributed generation	j) Provide import/export and reactive metering	Reactive metering included	Compliant

In the case of the other scenarios the following additional features apply:

- Advanced Functionality scenario: basic functionality with Home Area Network (HAN) support and in-house display
- Multi-metering scenario: basic functionality with HAN support, in-house display and a Multi-metering option.

10.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 67

LITHUANIA - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach	
Who undertook the CBA	Ernst & Young	
Period of roll out	2016-20	
Proportion of metering points covered	80%	
Roll out alternatives included	Three scenarios: • Base case: EU recommendations • Advanced Functionality scenario • Multi-metering scenario	
Communication Technology	Last mile: PLC and GPRS From data to concentrator: GPRS	
Counterfactual	No installation	
Sensitivity analysis considered	Yes	
Modelling period	2015-29	
Discount rate	5%	for Financial Analysis
	5.5%	for Economic Analysis
Asset life of meters	15 years	
Average annual growth in consumption (without the roll out)	2.10%	
Projected decline in losses without the project	2012	8.30%
	2013	8.24%
	2014	8.18%
	2020	7.80%
Currency rate [LTL/EUR]	3.4528	

10.3. Costs

A breakdown of costs by type of cost is set out in the table below. The total costs represent the Net Present Value (NPV) of the expenditures estimated for the period of the analysis, calculated with a discount rate of 5%.

TABLE 68

LITHUANIA - COST BREAKDOWN BY TYPE OF COST (€ MILLION, PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	161.06	103.57
Smart meter purchase	98.46	63.30
Balancing meter	11.65	7.49
Smart metering roll-out	47.12	30.29
Repeated smart metering roll-out	2.36	1.51
Information Technology	18.91	12.14
Data Collection System	0.92	0.59
MDM System	4.95	3.19
Data Collection Maintenance	2.04	1.31
MDM System Maintenance	11.00	7.07
Communications	52.12	33.48
Data concentrators	22.30	14.34
Data transmission from the meters	22.18	14.26
Data transmission from the concentrators	7.63	4.90
In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	18.70	12.02
Training costs	0.17	0.12
Customer care and other (project management etc)	3.18	2.06
Project Management	1.84	1.18
Project Publicity	1.35	0.87
Sunk costs	-	-
TOTAL	**254.15**	**163.37**

Costs converted using exchange rate of €1=3.4528 LTL

The breakdown between capital and operating expenditure is set out in the following table:

TABLE 69

LITHUANIA - COST BREAKDOWN BY CAPEX AND OPEX (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
CAPEX		
Investment in smart meters	159.59	102.61
Investment in Information Technology	5.87	3.77
Investment in Communications	22.30	14.34
Investment in In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
TOTAL CAPEX	**187.77**	**120.71**
OPEX		
IT maintenance costs	13.04	8.37
Network management and front end costs		
Communications/data transfer costs	29.81	19.14
Scenario management costs	1.84	1.19
Replacement/failure of smart meter systems	1.47	0.96
Generation		
Transmission		
Distribution	18.70	12.02
Meter reading		
Call centre/customer care		
Training costs	0.18	0.12
TOTAL OPEX	**65.04**	**41.79**
OTHER COSTS		
Customer engagement programme	1.35	0.87
Sunk costs of previously installed meters		
TOTAL OTHER COSTS	**1.35**	**0.87**

Costs converted using exchange rate of €1=3.4528 LTL

10.4. Benefits

10.4.1. Key assumptions

Key assumptions on benefits are set in the following table:

TABLE 70

LITHUANIA - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Avoided meter reading costs	€/meter/year	1.31
Call centre cost savings	€/meter/year	0.39
Reduction in consumption	%	See below
Peak load transfer	%	See below
Reduction in distribution losses	€/meter/year	3.70
Reduction in non-supplied energy	%	-
Reduction in theft	%	See below
Carbon costs saved	€/tonne	See below

In relation to these benefits:

- Reduction in consumption: it is estimated that the smart metering roll out-reduces the total consumption of electricity an average of these numbers:
    - Household customers without the in-house display: 2.3%
    - Household customers with the in-house display: 4.5% (3)
    - Commercial consumers up to 30 kW without the display: 0.1%
    - Commercial consumers up to 30 kW with the display: 1.1%
    - Commercial consumers over 30 kW without the display: 0.01%
    - Commercial consumers over 30 kW with the display: 0.1%
- Peak Load Transfer: based on the electricity consumption patterns in Lithuania, the potential values of shifting electricity from peak hours to off-peak hours estimated for the analysis were:
    - Household and commercial consumers (over 30 kW): 4.5%
    - Commercial consumers (over 30 kW): 0.725%
- The possibility of major commercial consumers (over 30 kW) to transfer the peak load was estimated taking into account that these customers have already installed smart meters.
- Reduction in theft: the reduction of theft and fraud was included as a variable in the reduction of commercial losses. At the moment of the study the commercial

3 *For the base case scenario only standard functionality smart meter without the in-house display is installed.*

losses of the DSO were approximately 8%. The potential reduction of commercial losses due to the roll out of smart meters was estimated to be 50%.

- Carbon costs saved: the quantitative benefits of reduced CO2 emissions were calculated based on the assumptions described below:
    - The pollution value of electricity consumed in Lithuania is 424g Co2/kWh
    - The price of CO2 emissions is 0.009442 €/kg.
    - Then the benefit from the reduced CO2 emissions was calculated as: the electricity consumption in an appropriate consumer group X decrement of electricity consumption (shown above) X electricity pollution value X CO2 emission price.

10.4.2. Total benefits

In the case of Lithuania, the analysis was separated in two: financial and economic analysis. The financial analysis took into account the benefits seen from the smart meter implementer side; meanwhile, the economic analysis takes into consideration the benefit for society and other stakeholders as the state or consumers.

A breakdown of costs is set out in the table below. The total amounts represent the Net Present Value (NPV) of the expected benefits for the period of the analysis, calculated with a discount rate of 5% for the financial analysis' benefits, and 5.5% for the economic analysis' benefits.

TABLE 71

LITHUANIA – KEY BENEFITS

Benefit	Amount (€ million)	Amount (€/metering point)
Benefits included in 2012/148/EU		
Reduction in meter reading and meter operations	6.75	4.34
Reading Costs reduction	4.92	3.16
Disconnection and renewal of supply for non-payment	1.83	1.18
Reduction in operational and maintenance costs	1.47	0.94
Deferred/avoided distribution capacity investments		
Deferred/avoided transmission capacity investments		
Deferred/avoided generation capacity investments		
Reduction in technical losses of electricity	13.90	8.94
Electricity cost savings	52.13	33.52
Consumption reduction	33.90	21.79
Peak load shaving	18.23	11.72

Benefit	Amount (€ million)	Amount (€/metering point)
Reduction of commercial losses	29.83	19.18
Reduction of outage times		
Reduction of CO_2 emissions	1.67	1.08
Reduction of air pollution		
Benefits not included in 2012/148/EU		
Avoided investment in standard meters	22.25	14.30
TOTAL BENEFITS	**127.99**	**82.29**

10.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 72

LITHUANIA - CONSIDERATION OF BENEFITS IN CBA AGAINST THOSE IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 1 regular manual reads per year, and visits to risky customers and direct debit customers.
Reduced meter operations costs	Yes	Based on the savings of connection and disconnection
Reduced billing costs	No	Not considered
Reduced call centre/customer care costs	Yes	Considers saving of the annual centre costs. Call centre costs related to failures could be reduced by 89.9%.
Reduced maintenance costs of assets	No	Not considered
Reduced costs of equipment breakdown	No	Not considered
Deferred distribution capacity investment due to asset remuneration	No	Not considered significant
Deferred distribution capacity investment due to asset amortisation	No	Not considered significant
Deferred transmission capacity investment due to asset remuneration	No	No benefits to transmission included
Deferred transmission capacity investment due to asset amortisation	No	No benefits to transmission included
Deferred generation for peak load plants	No	Not considered significant

Benefit	Included?	Treatment
Deferred generation investments for spinning reserve	No	Not considered significant
Reduced technical losses of electricity	Yes	In relation to the electricity consumption of the standard meters compared to the smart meters.
Consumption reduction	Yes	Different values for each type of customer. See above.
Peak load transfer	Yes	Includes the benefits of transferring the consumption load from peak hours to off-peak hours for the different customers.
Reduced electricity theft	Yes	Considered in the reduction of the commercial losses.
Recovered revenue related to contract power fraud	Yes	Considered in the reduction of the commercial losses.
Recovered revenue related to incremental 'contracted power'	No	Not included
Reduction of outage times	No	Not included
Reduced cost of client indemnification	No	Not included
Reduced CO_2 due to reduced line losses	Yes	Indirectly included in the reduction of CO_2 emissions due to consumption reduction
Reduced CO_2 due to wider spread of low carbon generation sources	No	Not included
Reduced CO_2 due to truck rolls of field personnel	No	Not included
Reduced air pollutant emissions due to reduced line losses	No	Not included
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	Not included
Reduced air pollutant emissions due to truck rolls of field personnel	No	Not included

11. Portugal

11.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below:

TABLE 73

PORTUGAL - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Feature(s)	Evaluation
Consumer	a) Provide readings directly to consumer or 3rd party	Communication system provides customer information on meter balance, daily, monthly and under request	Compliant as a feature of the meter. It should be noted however, that this feature is not used in the main scenario since only indirect feedback by monthly billing is taken into account
	b) Update reading frequently enough to use energy saving schemes	Ability to update every 15 minutes	
Metering operator	c) Allow remote reading	Capability to remote reading, report outages, voltage and generation (distributed generation)	Compliant
	d) Provide 2-way communication for maintenance and control	Remote parameterization, firmware updates etc.	Compliant
	e) Allow frequent enough readings for network planning	Ability to provide information about grid quality every 15 minutes	Compliant
Commercial aspects of supply	f) Support advanced tariff system	6 programmable periods, for two tariff systems simultaneously	Compliant
	g) Remote ON/OFF control supply and/or flow or power limitation	Capability for load limiting and disconnection	Compliant
Security – data protection	h) Provide secure data communication	Included	Compliant
	i) Fraud prevention and detection	Use of security log system on meter to detect improper use	Compliant
Distributed generation	j) Provide import/export and reactive metering	Capable of recording import/export and reactive power	Compliant

The features proposed for the Portuguese system meet all the minimum functionalities in 2012/148/EU. However, it should be noted that some of the features are not used for the main scenario. In particular, indirect feedback is used instead of direct feedback. In one of the system variants, 20 % of direct feedback is included and analysed.

11.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 74

PORTUGAL - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	ERSE
Period of roll out	2014-2022
Proportion of metering points covered	80 % by 2020 100 % by 2022
Roll out alternatives included	2016-2022 (80% by 2020 and 100% by 2022)
Sensitivity analysis considered	• 20 % IHD • No changes in consumers feedback
Modelling period	46 years (2014-60)
Discount rate	10%
Asset life of meters	15 years

Note that the MS has advised that the modelling period is best considered as 40 years.

11.3. Costs

A breakdown of key incremental costs related to the introduction of smart meters, and set out in the CBA is set out below. This data has been developed from disaggregated data in the CBA report, and differs from that in the Commission's benchmarking report, albeit with similar final results. A distinction between capital and operating costs is not provided.

TABLE 75

PORTUGAL - TOTAL COST BREAKDOWN BY TYPE OF COST (PRESENT VALUE)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	364.00	56.31
Smart meter acquisition	268.00	41.46
Installation	96.00	14.85
Information Technology	51.00	7.89
Communications	217.00	33.57
In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
Training costs	-	-
Customer care and other costs	121.00	18.72
Implementation programme management	16.00	2.48
Billing costs	96.00	14.85
Stranded costs	9.00	1.39
TOTAL	**753.00**	**116.50**

To apply aspects of the Portuguese approach in a common CBA methodology various considerations need to be taken into account:

- Billing costs are included as a negative benefit (cost) in the CBA. Bi-monthly paper billing is the current system used in Portugal. A monthly paper billing system is proposed once the smart meters are installed. According to the CBA, this will increase the costs of the billing system because more bills will be delivered.
- Stranded costs of the meters are also considered.

11.4. Benefits

11.4.1. Key assumptions

Key assumptions on benefits are set out in the following table:

TABLE 76

PORTUGAL - KEY ASSUMPTIONS ON BENEFITS

Variable	Unit	Value
Avoided meter reading costs	N°/year	4
Call centre cost savings	%	50 % information, 90 % complaints
Reduction in consumption	%	2 %
Peak load transfer	%	2 %
Reduction in distribution losses	€/meter/year	0,63
Reduction in non-supplied energy	%	8 %
Reduction in theft	%	90 %

11.4.2. Total benefits

A breakdown of key benefits by type of benefit is set out in the table below:

TABLE 77

PORTUGAL - BENEFITS BY TYPE

Benefit	Amount (€ million)	Amount (€/metering point)
Benefits included in 2012/148/EU		
Reduction in meter reading and meter operations	208.00	32.18
Reading Costs reduction	61.00	9.44
Switching costs	4.00	0.62
Reduced of call centre costs	33.00	5.11
Local operation cost reduction	109.00	16.86
Competitiveness	1.00	0.15
Reduction in operational and maintenance costs	-	-
Deferred/avoided distribution capacity investments	-	-
Deferred/avoided transmission capacity investments	-	-
Deferred/avoided generation capacity investments	-	-

Benefit	Amount (€ million)	Amount (€/metering point)
Reduction in technical losses of electricity	34.00	5.26
Electricity cost savings	530.00	82.00
Consumption reduction	349.00	54.00
Peak load shaving	181.00	28.00
Reduction of commercial losses	169.00	26.15
Reduction of outage times	7.00	1.08
Reduction of CO_2 emissions	-	-
Reduction of air pollution	-	-
Benefits not included in 2012/148/EU		
Avoided investment in standard meters	147.00	22.74
Avoided investment in conventional meters	111.00	17.17
Avoided installation cost of conventional meters	36.00	5.57
TOTAL BENEFITS	**1095.00**	**169.42**

11.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 78

PORTUGAL - CONSIDERATION OF BENEFITS IN CBA AND THOSE INCLUDED IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Based on savings of 4 manual reads per year
Reduced call centre/customer care costs	Yes	Considers savings due to claims reduction and information calls reduction
Reduced maintenance costs of assets	Yes	Especially in transformers maintenance
Reduced costs of equipment breakdown	Yes	Reduced costs of fixing faults
Deferred distribution capacity investment due to asset remuneration	No	Considered the amount of deferred investment and the expected period of deferral
Deferred distribution capacity investment due to asset amortisation	No	
Deferred transmission capacity investment due to asset remuneration	No	
Deferred transmission capacity investment due to asset amortisation	No	

Benefit	Included?	Treatment
Deferred generation for peak load plants	Yes	Also includes benefits from reduction in short run marginal cost
Deferred generation investments for spinning reserve	No	Not included
Reduced technical losses of electricity	Yes	Dependent on PLC technology used
Consumption reduction	Yes	Estimated at 2%
Peak load transfer	Yes	Assumed at 2%
Reduced electricity theft	Yes	Assumed at 0.5%
Recovered revenue related to contract power fraud	Yes	100% reduction and 10 EUR per year per consumer
Recovered revenue related to incremental 'contracted power'	Yes	3% change
Reduction of outage times	Yes	8% reduction assumed
Reduced cost of client indemnification	Yes	Quantity not specified
Reduced CO_2 due to reduced line losses	Yes	CO_2 benefits included in the electricity consumption impact (via the price)
Reduced CO_2 due to wider spread of low carbon generation sources	No	Not included
Reduced CO_2 due to truck rolls of field personnel	No	Not included
Reduced air pollutant emissions due to reduced line losses	No	Not included
Reduced air pollutant emissions due to wider spread of low carbon generation sources	No	Not included
Reduced air pollutant emissions due to truck rolls of field personnel	No	Not included

12. Slovak Republic

12.1. Functionality

The key functionalities of the proposed system against the Minimum Functionalities in 2012/148/EU are set out in the table below:

TABLE 79

SLOVAK REPUBLIC - KEY FUNCTIONALITIES OF THE PROPOSED SMART METERING SYSTEM

Market role	2012/148/EU Minimum Functionality	Feature(s)	Evaluation
Consumer	a) Provide readings directly to consumer or 3rd party	The meter displays information on consumption, while an option of displaying measurements on the electricity customer's home display screen (at the customers cost) is offered	Compliant
	b) Update reading frequently enough to use energy saving schemes	System allows the possibility of measuring the load history	Compliant
Metering operator	c) Allow remote reading	Included	Compliant
	d) Provide 2-way communication for maintenance and control	Remote connection/disconnection supported	Compliant
	e) Allow frequent enough readings for network planning	Ability to measure outages and other network occurrences	Compliant
Commercial aspects of supply	f) Support advanced tariff system	Not stated in the CBA	Unclear
	g) Remote ON/OFF control supply and/or flow or power limitation	Included	Compliant
Security – data protection	h) Provide secure data communication	Encrypted communication included	Compliant
	i) Fraud prevention and detection	Allows protection against meter tampering	Compliant
Distributed generation	j) Provide import/export and reactive metering	Not stated in CBA	Unclear

12.2. Approach to cost benefit analysis

Key framework considerations are set out in the table below:

TABLE 80

SLOVAK REPUBLIC - ISSUES REGARDING THE COST BENEFIT ANALYSIS

Considerations	Approach
Who undertook the CBA	Regulatory Office for Network Industries
Period of roll out	2013-2020
Proportion of metering points covered	23% by 2020
Roll out alternatives included	Within the 23% cap the following two options are considered: • Progressive – 70% of the smart meters covered will be installed during the first 4 years and 100% of the planned target will be fitted with smart meters after 8 years, in 2020. • Linear – Even implementation of smart meters
Counterfactual	No roll out
Sensitivity analysis considered	None apart from the 2 roll out alternatives
Modelling period	20 years (8 shown in the report)
Discount rate	6.04%
Asset life of meters	15 years

The CBA in the Slovak Republic considers a roll out covering only 23% of the LV supply points (SP) by 2020. These are the points with annual consumption of over 4 MWh. The total number of the supply points with installed smart meters will reach 603,750 by 2020, accounting for approximately 53% of total annual LV electricity consumption.

The report presents results for the period up to 2032, extrapolating the information in the 8 years to 2020 presented in the report. Note the reported numbers are the same as in the Commission's benchmarking report except for the longer modelling period (2032 instead of 2020).

12.3. Costs

The report sets out a range of unit costs for smart metering equipment and their installation/assembly. Of the total number of smart meters installed in 2020, approximately 92% will be three-phase and 8% single-phase smart meters. The high number of three-phase meters is consistent with the higher use profile of the affected customers. The costs associated with smart metering implementation also include project preparation, training, links with other systems and logistics.

The investment costs for information systems include investments in AMM/MDM, a web portal, interface, customer communications, billing and energy managements.

Key unit costs are set out in the following table:

TABLE 81

SLOVAK REPUBLIC- UNIT COSTS

Type	Cost component	Average Cost (€/metering point)
CAPEX	Price of single-phase SM	71.00
	Installation cost of single-phase SM	22.60
	Price of three-phase SM	96.00
	Installation cost of three-phase SM	24.40
	Concentrator price *	1.16
	Concentrator assembly*	0.20
	Information System price *	9.44
OPEX	Operating costs of communications*	6.56
	Operating costs of information systems*	1.67

** These prices are per SM (i.e. 1 concentrator on every 500 SMs; Concentrator price = 580 €; Concentrator communication OPEX per year = 90 €; SM comm OPEX p/y = 6€; Total information system cost = 5,699,400 €;)*

A breakdown of key (discounted) costs related to the introduction of smart meters under the linear scenario in the period up to 2032 is set out below:

TABLE 82

SLOVAK REPUBLIC- TOTAL COST BREAKDOWN BY TYPE OF COST (NPV)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
Smart meters	55.38	91.72
Information Technology	13.65	22.61
Communications	34.30	56.81
In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
Training costs	-	-
Additional billing	-	-
Sunk costs	-	-
TOTAL	**103.33**	**171.15**

The breakdown between capital and operating expenditure is set out in the following table:

TABLE 83

SLOVAK REPUBLIC - COST BREAKDOWN BY CAPEX AND OPEX (NPV)

Cost type	Total cost (€ million)	Average Cost (€/metering point)
CAPEX		
Investment in smart meters	55.38	91.72
Investment in Information Technology	5.08	8.42
Investment in Communications	0.64	1.05
Investment in In-home display	-	-
Generation	-	-
Transmission	-	-
Distribution	-	-
TOTAL CAPEX	**61.10**	**101.19**
OPEX		
IT maintenance costs	8.57	14.19
Network management and front end costs		
Communications/data transfer costs	33.66	55.76
Scenario management costs		
Replacement/failure of smart meter systems		
Generation		
Transmission		
Distribution		
Meter reading		
Call centre/customer care		
Training costs		
TOTAL OPEX	**42.23**	**69.95**

12.4. Benefits

12.4.1. Key assumptions

The report lists few key assumptions. However, the Commission's Benchmarking report notes the following:

- Energy savings of 1% per annum
- Peak load shifting of 2% per annum.

In addition, in the report, the impact of the reduction in balancing costs and the reduction in commercial losses are also pronounced.

12.4.2. Total benefits

A breakdown of key benefits by type of benefit for the year 2020 and extrapolated for the period 2013-32 is set out in the table below:

TABLE 84

SLOVAK REPUBLIC - BENEFITS BY TYPE (PRESENT VALUE)

Benefit	Amount in 2020 (€ million)	Amount 2013-32 (€ million)	Amount (€/metering point)
Benefits included in 2012/148/EU			
Reduction in meter reading and meter operations	2.74	23.23	38.48
Meter operations	1.60	13.56	22.47
Meter reading	1.14	9.67	16.01
Reduction in operational and maintenance costs*	0.72	6.10	10.10
Deferred/avoided distribution capacity investments	-	-	-
Deferred/avoided transmission capacity investments	-	-	-
Deferred/avoided generation capacity investments	-	-	-
Reduction in technical losses of electricity	1.00	8.47	14.02
Electricity cost savings	14.10	119.86	198.52
Consumption reduction	8.50	72.26	119.68
Peak load transfer	5.60	47.60	78.85
Reduction of commercial losses	3.03	25.79	42.71
Reduction of outage times	-		-
Reduction of CO_2 emissions	0.24	2.07	3.44
Reduction of air pollution	-		-
TOTAL BENEFITS	**21.83**	**185.52**	**307.27**

** Various items*

The net result of the CBA considering the period to 2032 is extremely positive. This result also applies under the progressive roll-out scenario. This result implies that a much broader roll-out may be economically justified than that assumed in the CBA.

12.4.3. Comparability

The following table considers whether all the benefits set out in 2012/148/EU have been included in the CBA:

TABLE 85

SLOVAK REPUBLIC - CONSIDERATION OF BENEFITS IN CBA AND THOSE INCLUDED IN 2012/148/EU

Benefit	Included?	Treatment
Reduced meter reading cost	Yes	Exact approach unclear
Reduced call centre/customer care costs	Yes	Exact approach unclear – includes call centre and invoicing
Reduced maintenance costs of assets	No	However, allowance for meter maintenance costs included
Reduced costs of equipment breakdown	No	
Deferred distribution capacity investment due to asset remuneration	Not clear	However, benefit included for load shifting
Deferred distribution capacity investment due to asset amortisation	Not clear	However, benefit included for load shifting
Deferred transmission capacity investment due to asset remuneration	No	
Deferred transmission capacity investment due to asset amortisation	No	
Deferred generation for peak load plants	No	
Deferred generation investments for spinning reserve	Not clear	Benefit included for reduction in balancing costs
Reduced technical losses of electricity	Yes	Exact approach unclear
Consumption reduction	Yes	Estimated at 1%
Peak load transfer	Yes	Assumed at 2%
Reduced electricity theft	Yes	Value not stated
Recovered revenue related to contract power fraud	No	
Recovered revenue related to incremental 'contracted power'	No	
Reduction of outage times	No	
Reduced cost of client indemnification	Yes	Exact approach unclear

Benefit	Included?	Treatment
Reduced CO_2 due to reduced line losses	Indirectly	An amount for reduced emissions included in the CBA
Reduced CO_2 due to wider spread of low carbon generation sources		
Reduced CO_2 due to truck rolls of field personnel		
Reduced air pollutant emissions due to reduced line losses	Indirectly	An amount for reduced emissions included in the CBA
Reduced air pollutant emissions due to wider spread of low carbon generation sources		
Reduced air pollutant emissions due to truck rolls of field personnel		

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