Study on the estimation of the cost of disruption of gas supply in Europe

VoLL/CoDG Workshop

Brussels, 18/06/2018

A brief introduction....

- **Kantor Management Consultants** is an **international consultancy firm**, committed to generating value for its corporate and institutional clients across Europe.
- **For more than 25 years,** Kantor's group has provided **value-adding consultancy services** to international institutions, local government authorities and major private sector companies.
- **Kantor provides expertise** in such fields as **corporate finance & valuations**, energy, agribusiness, rural development, funding & financial services, manufacturing, telecom, transport and public administration.

- **ECA** is a specialized economic consultancy that provides economic and regulatory consulting services to industry and government.
- **ECA** specializes in advising on economics, policy and regulatory issues in the utilities industries, with particular expertise in the electricity, natural gas and water sectors.
- Their team and approach are based on many years' experience of carrying out economic and policy analysis, in the UK and worldwide.

1. Project outline

The project

Tasks	Activities
A1 Review existing know-how and create a comprehensive stock of methodological approaches on security of gas supply and CoDG	A1.1 Identification of past practices and scientific approaches A1.2 Detailed review and codification of past practices and scientific approaches
A2 Assessment of the methodologies for the calculation of the CoDG	A2.1 Definition of the appropriate criteria for the development of the new methodology A2.2 Assessment of the existing practices based on the above criteria
A3 Development of the appropriate methodology for the estimation of the CoDG and the respective model valuation	A3.1 Definition of the variables for the development of the new assessment model of the of the CoDG A3.2 Detailed review of the required available data A3.3 Finalization of the methodology for assessing the value of the CoDG
B Application of the recommended method for the valuation of the CoDG & solidarity price	B.1 Data collection for the application of the recommended methodology B.2 Application of the proposed methodology and estimation of the CODG in €/MWh of non-supplied gas B.3 Documentation of the proposed methodology and the results from the estimation of the CoDG & Solidarity (SoS) price

Review existing know-how and create a comprehensive stock of methodological approaches on security of gas supply and CoDG

Objective

- **To create a stock of methodologies and practices that have been used until now for the assessment of the security of gas supply and its implications**

Activities

- A1.1 Identification of past practices and scientific approaches
- A1.2 Detailed review and codification of past practices and scientific approaches

Outputs

- Collection of the documents presenting relevant past practices and scientific approaches
- Report with codified data for each of the collected past practice and scientific approach.

A2

Assessment of the methodologies for the calculation of the CoDG

Objective

- **To develop a more thorough analysis of the existing methodologies and their key parameters/variables as well as the results produced.**

Activities

- A2.1 Definition of the appropriate criteria for the development of the new methodology
- A2.2 Assessment of the existing practices based on the above criteria

Outputs

- Report presenting the criteria and methodology for the assessment of existing practices
- Report presenting the outcome of the assessment of past practices

A3

Development of the appropriate methodology for the estimation of the CoDG and the respective model valuation

Objective

- **To develop a well-documented and user-friendly method for monetising CoDG in the EU Member States**

Activities

- A3.1 Definition of the variables for the development of the new assessment model of the of the CoGD
- A3.2 Detailed review of the required available data
- A3.3 Finalization of the methodology for assessing the value of the CoDG

Outputs

- Report summarising the required available data per member state
- Depository of the relevant reports and studies
- Methodology for assessing the value of the CoDG
- Model for assessing the value of the CoDG

Application of the recommended method for the valuation of the CoDG

Objective

- **The appropriate and effective implementation and documentation of the methodology proposed and agreed in Task A3.**

Activities

- B.1: Data collection for the application of the recommended methodology
- B.2: Application of the proposed methodology and estimation of the CoDG in €/MWh of non-supplied gas
- B.3: Documentation of the proposed methodology and the results from the estimation of the CoDG

Outputs

- Questionnaires of the proposed surveys
- List of participants of the proposed surveys
- Report with the results of each survey conducted
- Report summarizing the results from the application of the methodology
- Documentation of the implemented methodology

1. Project outline

2. Review and assessment of existing CoDG approaches

3. The proposed methodology for the estimation of CoDG

4. The proposed methodology for the estimation of Solidarity Price

5. Results

A disruption of the energy supply can have a range of negative effects on businesses and domestic users

Impact on Industry, Power and Services

Direct	Indirect
• Damaged or spoiled products • Damage to equipment • Purchase of more expensive fuel • Restart cost • Other	• Lost production or sales • Idle facilities or labour • Accidental injuries • Legal costs • Increase in insurance rates • Cost of capital (on delayed income) • Reputation losses • Choice of business location • Lower tax income

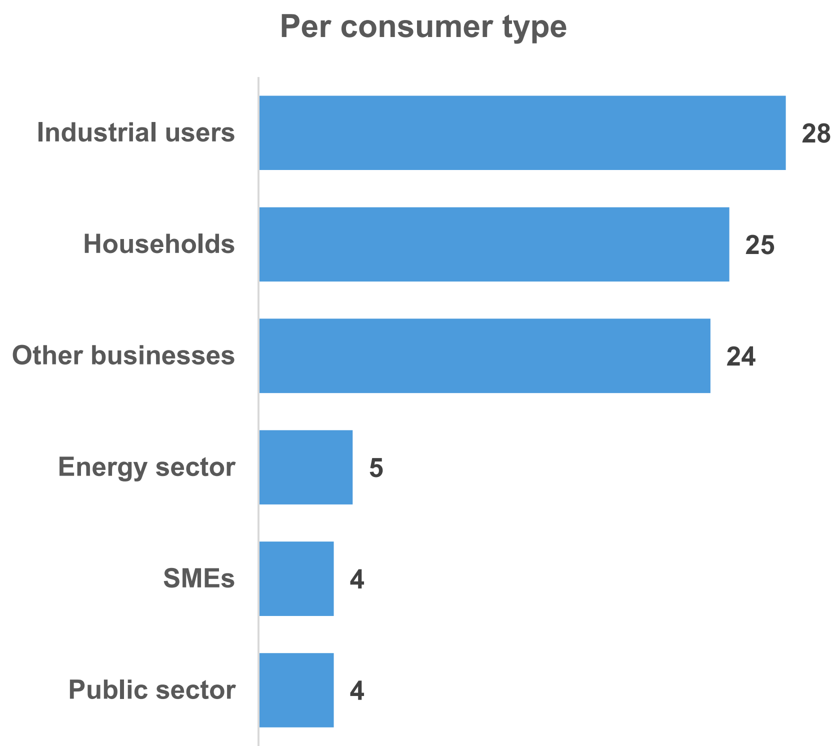
Impact on domestic users and services

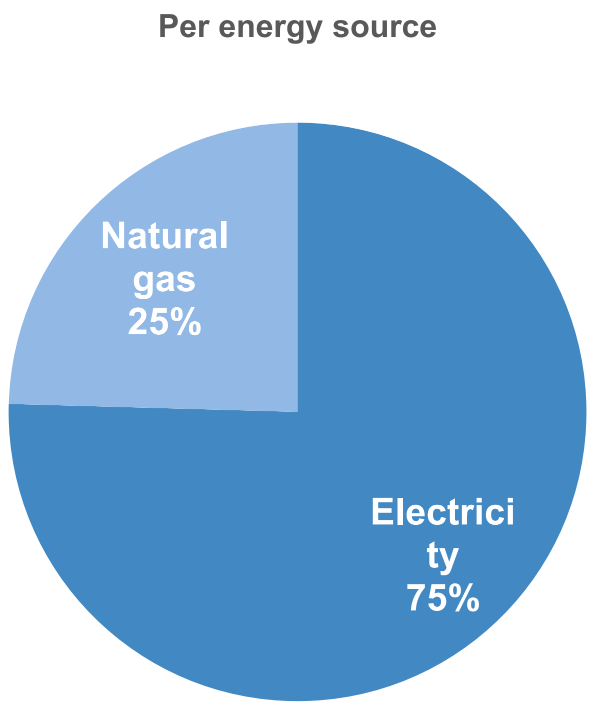
Direct	Indirect
• Purchase of more expensive fuel • Additional equipment cost • Damage to equipment	• Discomfort • Accidental injuries

Meanwhile, the severity of the impact depends on a range of factors, such as the duration and the timing (season, time of day, time of the week) of the experienced disruption

We reviewed 34 publications that applied approaches to estimate the value of security of supply

Composition of reviewed instances of past estimation approaches





Given that often the studies used more than one approach, we identified and reviewed 58 approaches (instances) towards the estimation of the CoDG

The past practices and scientific approaches of quantifying the value of disrupted energy supply can be grouped in three categories

Approaches to estimating CoDG

Cost-function approaches	Demand-function approaches	Production-function approaches
• Estimate the monetary cost of measures taken to mitigate or adapt to a supply disruption	• Estimate the loss of consumer welfare from a disruption of supply	• Quantify the loss of revenue from the interruption of production in case of disruption
This type of approaches try to respond to the question:	This type of approaches try to respond to the question:	This type of approaches try to respond to the question:
How much would it cost me to adapt to a disruption situation?	*How valuable is to me as a consumer each unit of energy that is not being supplied?*	*What is the value of the output that I cannot produce due to a supply disruption?*

To assess the approaches in the context of this study, we identified a set of 5 criteria

Criteria	Rational
Granularity	• The approaches should differentiate the CoDG along several dimensions • Dimension examples: geography (member states), sectors and consumer types (households, small commercial outlets, SMEs, industrial clients, heavy industries, power generation plants), duration of disruption (hours, days, weeks), timing of disruption (e.g. day, night), seasonality (e.g. winter, summer), curtailment level, prior notice
Applicability to natural gas disruptions	• Some approaches are designed with particular electricity uses in mind and are not as suitable in natural gas settings
Data availability, accessibility, homogeneity and robustness	• Ideally all required data should stem from a single reliable data base, e.g. Eurostat • If any additional data are required, these should also be derived from reliable and transparent, preferably publicly available, sources
Estimation practicality and replicability	• Academic sophistication is not the aim here • The approaches that do not require sophisticated software and estimation techniques are preferable (ceteris paribus) in the context of this work
Public acceptability	• Some of the approaches are simple in their execution, yet their underlying justification relies on economic theory concepts that might be hard to justify to all stakeholders • The approach should be easy to understand by regulators, policy makers, stakeholders and the general public

The cost-function approaches quantify expenses to mitigate or adapt to supply disruption

Approach	CoDG source or proxy	Key advantages	Key disadvantages
Case studies	Recorded costs in historic precedents of disruption	Provides the most direct possible estimation of CoDG	• The results are hard to generalize • Limited granularity
Fuel switch	Cost of using alternative fuels in case of disruption	Straightforward, transparent and objective	• Not all relevant data may be readily available
Hypothetical cost estimates	Estimates provided by the consumers under hypothetical mitigation scenarios	Capacity to provide estimates at significant level of granularity	• Entails a degree of subjectivity • More resource-intensive, as it relies on surveys
The EIB approach	Cost of measures to comply with the N-1 standard and to hedge the price volatility associated with risks of gas supply interruptions	Strong routing in economic theory and finance	• Inflexibility to provide estimates at sufficient levels of granularity

Cost – function approach assessment (1/2)

Practice/ approach	Granularity	Applicability to natural gas disruptions	Data availability, accessibility, homogeneity and robustness	Estimation practicality and replicability	Public acceptability
Case studies	⊖⊖	⊕⊕⊕	⊖	⊖	⊕⊕⊕
Fuel switch	⊕	⊕⊕⊕	⊕	⊕⊕	⊕⊕
Hypothetical estimates of costs	⊕⊕⊕	⊕⊕⊕	⊖⊖	⊕	⊕
EIB	⊖⊖⊖	⊕⊕⊕	⊖⊖⊖	⊖⊖⊖	⊖⊖

- **Granularity:**
  - The hypothetical cost approach is the most promising among the cost-function approaches, as it relies on surveys to collect the required data
  - The EIB approach has limited granularity, as it allows only for country dependence
- **Applicability to natural gas disruptions**: All cost-function approaches are applicable in NG settings
- **Data availability**:
  - The fuel-switch approach relies on publicly available data
  - In the EIB approach, some data needed as input (e.g. the risk aversion of consumers) are not directly obtainable and are often substituted with assumptions

Cost – function approach assessment (2/2)

Practice/ approach	Granularity	Applicability to natural gas disruptions	Data availability, accessibility, homogeneity and robustness	Estimation practicality and replicability	Public acceptability
Case studies	−−	+++	−	−	+++
Fuel switch	+	+++	+	++	++
Hypothetical estimates of costs	+++	+++	−−	+	+
EIB	−−−	+++	−−−	−−−	−−

- **Estimation practicality and replicability**
  - – The fuel-switch approach provides straightforward estimates that can be easily replicated
  - – The EIB approach relies on methods of relatively high level of sophistication and its usability in non-academic settings is limited
- **Public acceptability**
  - – The case studies report actual incurred costs in an ex-post context
  - – The EIB approach relies on economic models and assumptions, which are not easy to communicate to the wider public

The demand-function approaches aim to quantify consumer welfare losses from energy supply disruptions

Approach	CoDG source or proxy	Key advantages	Key disadvantages
Revealed preferences	Lost consumer surplus derived from econometric estimates of energy demand elasticity	Relies on observed market prices and quantities (prices and quantities)	May not capture the security of supply attribute
Contingent valuation	Consumer survey responses on willingness to pay (WTP) for security of supply or to accept (WTA) a compensation for its disruption	Simpler to execute than contingent ranking and choice experiment studies	Subjective and unreliable estimates due to cognitive biases (e.g. the endowment effect)
Contingent ranking	Consumer rankings of hypothetical disruption scenarios with WTP or WTA elements	Less arbitrary estimates, compared to contingent valuation	Requires a large sample size to arrive at meaningful set of estimates
Choice experiment / discrete choice modelling	Consumer binary choices between pairs of hypothetical disruption scenarios with WTP or WTA elements	Less arbitrary estimates, compared to contingent valuation	Requires a large sample size to arrive at meaningful set of estimates

Demand – function approach assessment (1/2)

Practice/ approach	Granularity	Applicability to natural gas disruptions	Data availability, accessibility, homogeneity and robustness	Estimation practicality and replicability	Public acceptability
Revealed preferences	−	+ + +	+	− −	− − −
Contingent valuation	+	+ + +	− − −	+	−
Contingent ranking	+ +	+ + +	− − −	− − −	− −
Choice experiment	+ +	+ + +	− − −	− − −	− −

- **Granularity:**
  - The contingent ranking and the choice experiment approaches allow for the highest degree of granularity, as granularity is an integral part of the scenario/choice attributes
  - The granularity of the revealed preferences approach is limited as it depends on the granularity of the underlying data on prices and quantities of gas demand
- **Applicability to natural gas disruptions: All demand-function approaches are applicable in NG settings**
- **Data availability:**
  - Contingent valuation, contingent ranking and the choice experiment approaches depend on surveys, rather than publicly available data

Demand – function approach assessment (2/2)

Practice/ approach	Granularity	Applicability to natural gas disruptions	Data availability, accessibility, homogeneity and robustness	Estimation practicality and replicability	Public acceptability
Revealed preferences	−	+ + +	+	− −	− − −
Contingent valuation	+	+ + +	− − −	+	−
Contingent ranking	+ +	+ + +	− − −	− − −	− −
Choice experiment	+ +	+ + +	− − −	− − −	− −

- **Estimation practicality and replicability:**
  - The contingent valuation approach relies on fairly simple statistical techniques
  - The contingent ranking and choice experiment methods require advanced statistical techniques (such as fractional factorial design)
- **Public acceptability:**
  - All demand-function approaches suffer from limited public acceptability in the NG setting, as they measure consumer welfare losses, a rather abstract concept, given the possibility of fuel-switching
  - The contingent valuation method has the highest public acceptability score of the four approaches, as it directly asks for CoDG estimates

The production-function approaches quantify the value of production losses from energy supply disruptions (1/2)

Approach	CoDG source or proxy	Key advantages	Key disadvantages
GDP-at-risk	Loss of GDP from energy supply disruption	Straightforward calculation with very limited need for data and resources	Very limited granularity
GVA-at-risk	Loss of Gross Value Added (GVA) per sector from energy supply disruption	Takes into account cross-sector differences on intensity of energy use	Does not take into account cross-sector differences in the criticality of energy supply
Adjusted GVA-at-risk	Loss of GVA with an adjustment, based on considerations such as fuel-switching possibilities, spare production capacity and storage capabilities	Takes into account cross-sector differences in the criticality of energy supply	• Lack of publicly available data on criticality • Arbitrariness in the setting of the adjustment parameter
Input-output	Loss of GVA in sectors that participate in the value chain of energy-consuming industries	Takes into account the interdependencies that exist across the sectors in an economy	Overestimation of CoDG if inventory storage capacities are not taken into account

The production-function approaches quantify the value of production losses from energy supply disruptions (2/2)

Approach	CoDG source or proxy	Key advantages	Key disadvantages
Producer surplus	Difference between the forgone revenue of energy suppliers and the cost of energy supply	Straightforward method	Limited to energy suppliers
Real options	Loss of production in electricity generation from disruption of gas supply	Takes into account the fact that electricity generation plants would not operate with negative spark spread	• Limited to electricity generation plants • Relies on data which is not readily available
Tax-at-risk	Tax revenue loss from energy supply disruption	Identifies losses for public finances	Might lead to double counting if combined with GVA-at-risk
Leisure-at-risk	Monetary value of leisure lost due to energy supply disruption	Rooted in economic theory	Counterintuitive, particularly in NG settings

Production – function approach assessment

Practice/ approach	Granularity	Applicability to natural gas disruptions
GDP-at-risk	− − −	+ +
GVA-at-risk	− −	+ +
Adjusted GVA-at-risk	+	+ +
Input-output	− −	+
Producer surplus	−	+ + +
Real options	−	+ + +
Tax-at-risk	− − −	+ +
Leisure-at-risk	−	− − −

- **Granularity:**
  - GDP-at-risk and Tax-at-risk examine corresponding losses only at country or region level, without further granularity
  - The adjustment parameter of the adjusted GVA-at-risk approach allows for relatively more granularity than the other production-function approaches
- **Applicability to natural gas disruptions:**
  - The real options and producer surplus approaches were designed specifically for gas-fuelled power plants and natural gas distribution companies respectively
  - The leisure-at-risk approach assumes that the households cease their leisure activities (e.g. watching TV) as a result of electricity supply disruption, which cannot be extended to NG setting

Production – function approach assessment

Practice/ approach	Data availability, accessibility, homogeneity and robustness	Estimation practicality and replicability	Public acceptability
GDP-at-risk	⊕ ⊕ ⊕	⊕ ⊕ ⊕	⊖ ⊖
GVA-at-risk	⊕ ⊕ ⊕	⊕ ⊕ ⊕	⊖ ⊖
Adjusted GVA-at-risk	⊖	⊕ ⊕ ⊕	⊕ ⊕
Input-output	⊕ ⊕ ⊕	⊖ ⊖ ⊖	⊖ ⊖
Producer surplus	⊕	⊕	⊕
Real options	⊖ ⊖ ⊖	⊖ ⊖	⊕
Tax-at-risk	⊕ ⊕ ⊕	⊕ ⊕ ⊕	⊖ ⊖
Leisure-at-risk	⊕ ⊕ ⊕	⊕ ⊕	⊖ ⊖ ⊖

- **Data availability:**
  - In general, the production-function approaches rely on publicly available data
  - The real options approach relies on high-frequency energy pricing data and plant thermal efficiency parameters
- **Estimation practicality and replicability:**
  - Most production function approaches are straightforward to implement and can be replicated
  - The input-output approach requires the estimation of Leontief-type economic models and the use of advanced mathematical software
- **Public acceptability:**
  - The Adjusted GVA-at-risk approach has an intuitively appealing use in economic activities, where natural gas is used as a feedstock or critical input (e.g. manufacture of fertilizers)

Assessment summary

- The assessment exercise revealed that a number of approaches can be utilized (independently or in combination with each other) towards the estimation of CoDG.
- The fuel switch approach can well provide a base for calculating the CoDG in the residential and business sectors, as well as in industrial and power generation firing natural gas as a fuel.
- These estimates can be supplemented with findings from Case Studies (where applicable and available), so as to provide a form of ex-post assessment of the methodology and the calculated CoDG values.
- For the remaining elements of the CoDG that are not related to the use of alternative fuels (e.g. machinery adjustment or damage costs), especially in sectors with high intensity of natural gas use, and also to ensure CoDG estimates with sufficient granularity, the hypothetical cost approach can provide a useful supplementary input.
- The Adjusted GVA-at-risk seems to be the best suited approach to monetize CoDG in sectors that rely critically on the use of natural gas for their production (gas as feedstock)..
- We note that this review and assessment was done with a view of establishing a CoDG methodology. This process also forms a base for the estimation of the solidarity price - with the CoDG being one of its components

From theory to practice : eSurvey with the NRAs (1/4)

- One Questionnaire was addressed to the NRAs
- The aim of the Questionnaire was
- to identify national policies, if any, on Demand Side Measures to deal with gas disruptions and
- Existing methodologies to calculate the cost of gas disruption (or willingness to accept a disruption, or compensation offered to non protected customers disrupted for the benefit of protected customers.
- We also asked the NRAs to provide us with appropriate contacts in the industrial, power, services and residential sectors

18 NRA s have responded

From theory to practice : eSurvey with the NRAs (2/4)

Questions	Number of Responses (percent)		Total Respondents
	YES	NO	
Is the NRA the competent authority for Security of Gas Supply according to Regulation 2017/1938?	3	15	18
Is there a methodology for calculating the cost of gas disruption (CoDG) in your country?	1	17	18
To address gas disruptions, some EU Member States have in place a voluntary gas demand reduction schedule. Is such a demand side measure in place in your country?	8	10	18
Do gas consumers participating in a demand side scheme receive compensation?	4	4	8
Do power plants in your country have fuel switching obligations in case of gas disruption (e.g. switch to diesel oil)?	7	11	18
Is there a scheme in place for the compensation of power plants for maintaining dual fuel facilities and operating on alternative fuel?	1	6	7
Do suppliers of protected customers (or other gas consumers) in your country have storage obligations?	8	10	18
Is there an obligation for strategic storage in place in your country?	6	12	18
Are these suppliers compensated for the cost maintaining gas in storage for security of supply?	3	5	8
Is there a security of supply levy imposed on gas customers to fund security of supply actions (e.g. emergency actions in the case of disruption) in your country?	4	13	17

From theory to practice : eSurvey with the NRAs (3/4)

- **ILR, Luxemburg** : Customers indicate in their contractual arrangements if they want their load to be reduced in case there is a problem, before the national shedding plan enters into application in case of bigger problems
- **CRE, France** At this stage, there is only one existing mechanism: consumers volunteer in their responses to a DSO request, to reduce their consumption in case of supply crisis. There is no financial compensation and no penalty if the consumer does not reduce effectively its consumption. All consumers suitable for load-shedding do not pay the dedicated storage tariff fee included in the Gas Transmission Tariff (297,1 €/MWh/d/y).
- **Ofgem, UK** National Grid DSR mechanism allows industrial and commercial users to signal their willingness to make additional DSR energy quantities available following a Gas Deficit Warning. DSR offers are posted on the OCM Locational market and include a price. For non daily metered customers (residential, etc), the CoDG value is £14/therm (approx. 545 euros/MWh)
- **eControl, Austria** Gas Market Model Ordinance section 20 (6): Balance responsible parties shall conclude agreements about the participation in and handling of the merit order list pursuant to para. 31 with all those load-metered consumers in their balance group that have a contracted capacity of more than 10,000 kWh/h and intend to participate in the merit order mechanism.
- **Energy Authority Finland**: A market based load reduction mechanism is in place. In emergency situations retail customers are protected customers.

From theory to practice : eSurvey with the NRAs (4/4)

Conclusions:

- There is no concise methodology for the calculation of the Cost of Gas Disruption in most Member States.
- There is also a distinct absence of methodologies for the calculation of compensations for involuntary disruption.
- The NRAs of 8 MS (Denmark, Ireland, Luxembourg, France, United Kingdom, Hungary, Austria, Finland) indicated that a voluntary demand side mechanism targeting the industrial sector (market based/merit order) is in place. With the exception of UK, no information on the frequency of utilization of this mechanism (as well as prices for disruption) were provided.

1. Project outline

2. Review and assessment of existing CoDG approaches

3. The proposed methodology for the estimation of CoDG

4. The proposed methodology for the estimation of Solidarity Price

5. Results

Overview of CoDG methodology

Methodology	Approach
Fuel switching	1 Estimate the Unit Cost Measurement (UCM) for all sectors using natural gas as a fuel
GVA-at-risk	2 Estimate UCM in the industrial subsectors where natural gas is used as a feedstock
Modified Hypothetical Cost approach	3 Use a modified hypothetical cost approach to determine granularity parameters and refine UCM estimates

4 Estimate the CoDG

More on the CoDG methodology – fuel switching

Unit Cost measurement (UCM Euro/MWh)

UCM= $\frac{CAPEX}{H} + \Delta\text{OPEX}$

H=util.*365*LT

where

CAPEX [€/MW]	**Capital cost of equipment**
ΔOPEX [€/MWh]	Alternative fuel price-Price of natural gas
Util [hours]	Utilisation
LT [years]	Life Time

Applicability

The applicability of the UCM to serve as the CoDG (or part of the CoDG) will be determined following the responses to the Hypothetical Survey which will also assess the effect of the items above.

- Time of day
- Duration
- Frequency
- Early warning
- Curtailment level
- Day of week

Approach

1 Estimate the Unit Cost Measurement (UCM) for all sectors using natural gas as a fuel

2 Estimate UCM in the industrial subsectors where natural gas is used as a feedstock

3 Use the hypothetical cost approach to determine granularity parameters and refine UCM estimates

More on the CoDG methodology – GVA-at-risk

Unit Cost measurement (UCM Euro/MWh)

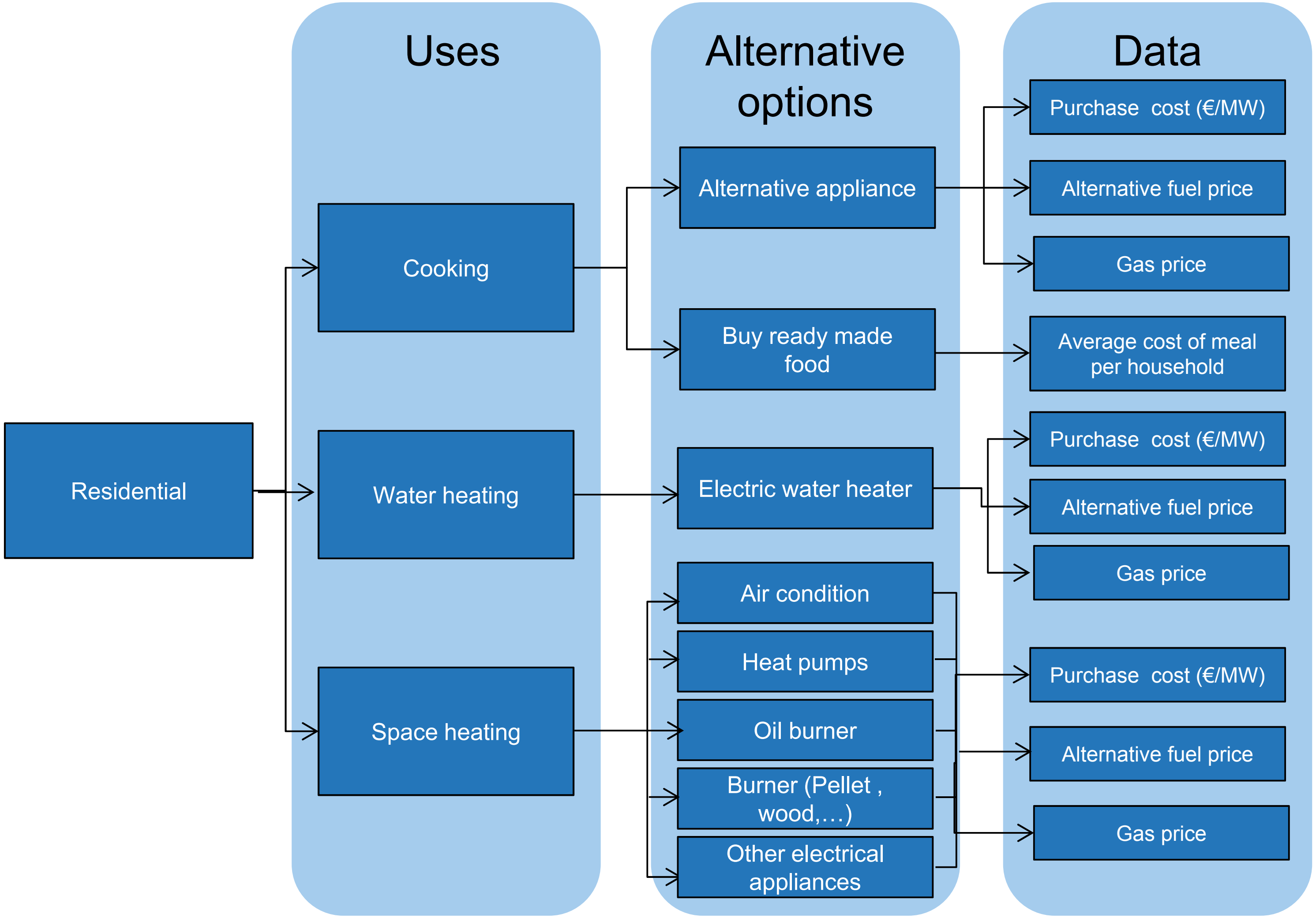
$$UCM = \frac{GVA}{Total\ Fuel\ consumption}$$

Applicability

The applicability of the UCM to serve as the CoDG (or part of the CoDG) will be determined following the responses to the Hypothetical Survey which will also assess the effect of the items above.

- Time of day
- Duration
- Frequency
- Early warning
- Curtailment level
- Day of week

UCM calculations for the Residential sector (1/2)

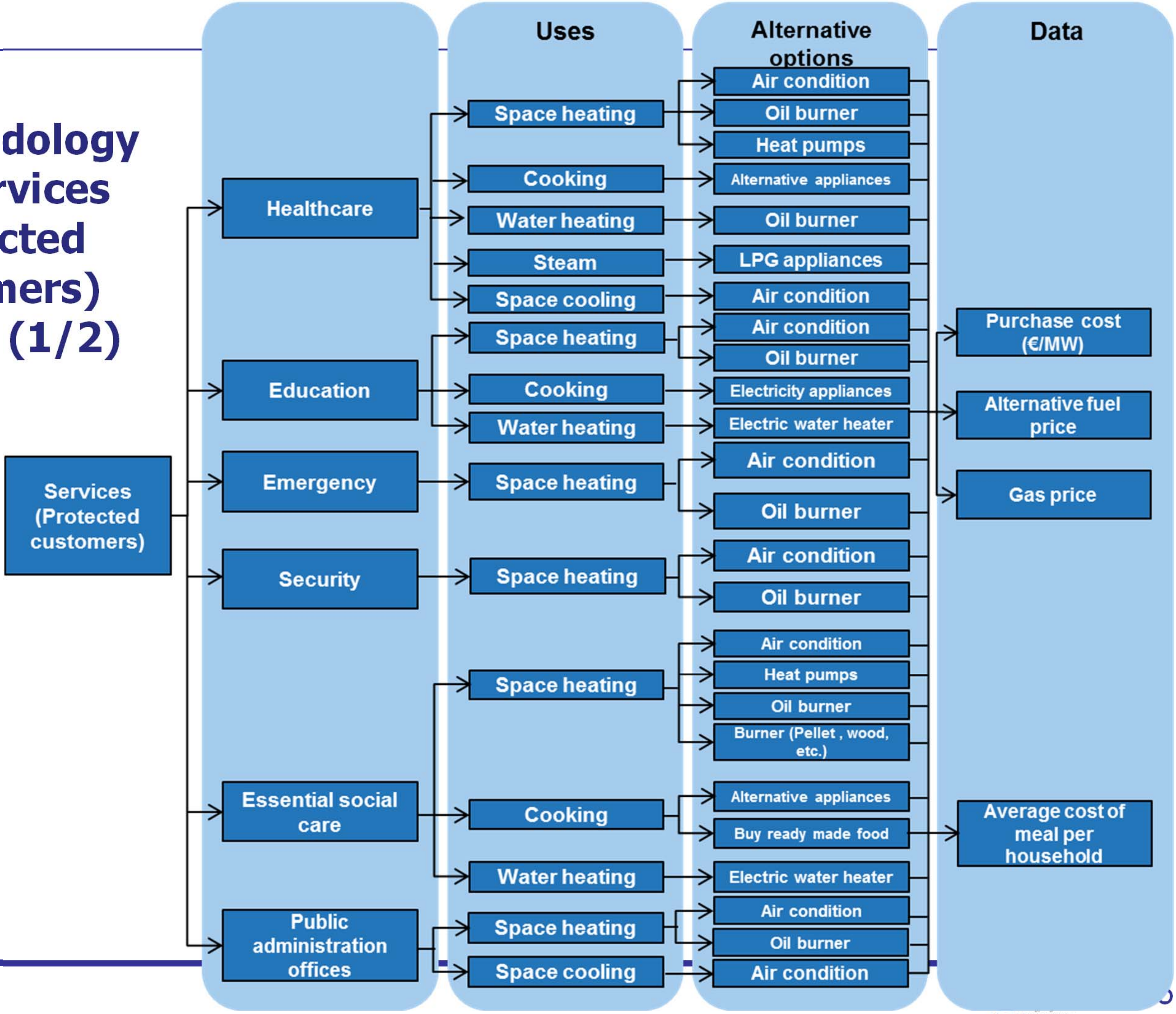


UCM calculations for the Residential sector (2/2)

Assumptions

	% of week		
Appliances	Residential	%of year	Life time (yeas)
Stove	4%	100%	10
A/C	5%	50%	10
Other electric appliances	5%	100%	7
Electric Water heater	1%	100%	10
Heat pump	5%	50%	15
Oil Burner	5%	50%	20
Burner (Pellet, wood)	5%	50%	20

CoDG methodology for Services (protected customers) sector (1/2)

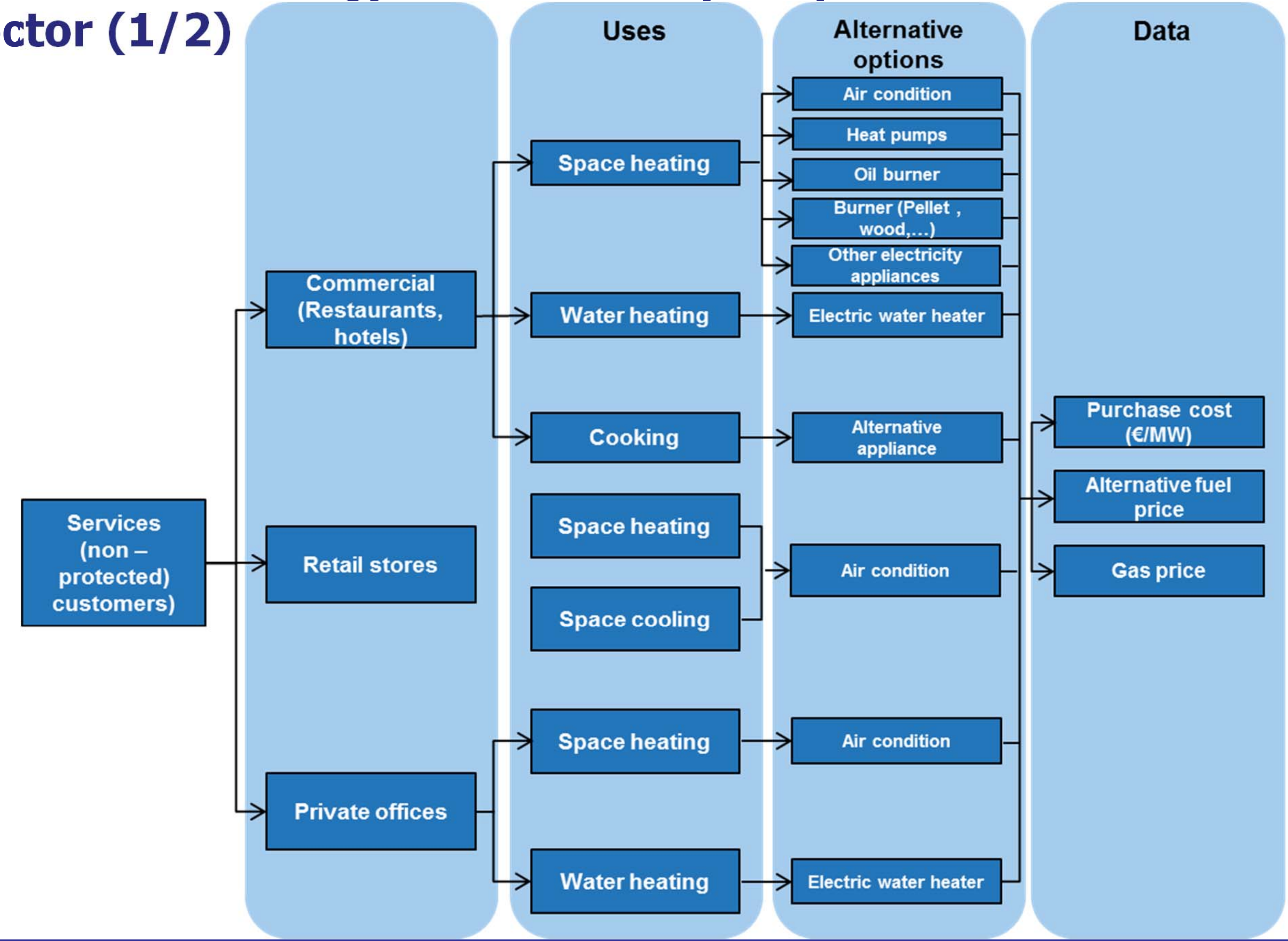


CoDG methodology for Services (protected customers) sector (2/2)

Assumptions

Appliances	% of week						%of year	Life time (yeas)
	Health care	Education	Emergency	Security	Essential social care	Public Admin.		
Stove	17%	9%	4%	4%	17%		100%	10
A/C	100%	24%	100%	100%	100%	24%	100%	10
Other electric appliances	100%	24%	100%	100%	100%	24%	50%	7
Electric Water heater	100%	24%	100%	100%	100%	24%	100%	10
Heat pump	100%	24%	100%	100%	100%	24%	50%	15
Oil Burner	100%	24%	100%	100%	100%	24%	50%	20
Burner (Pellet, wood)	100%	24%	100%	100%	100%	24%	50%	20

CoDG methodology for Services (non protected customers) sector (1/2)

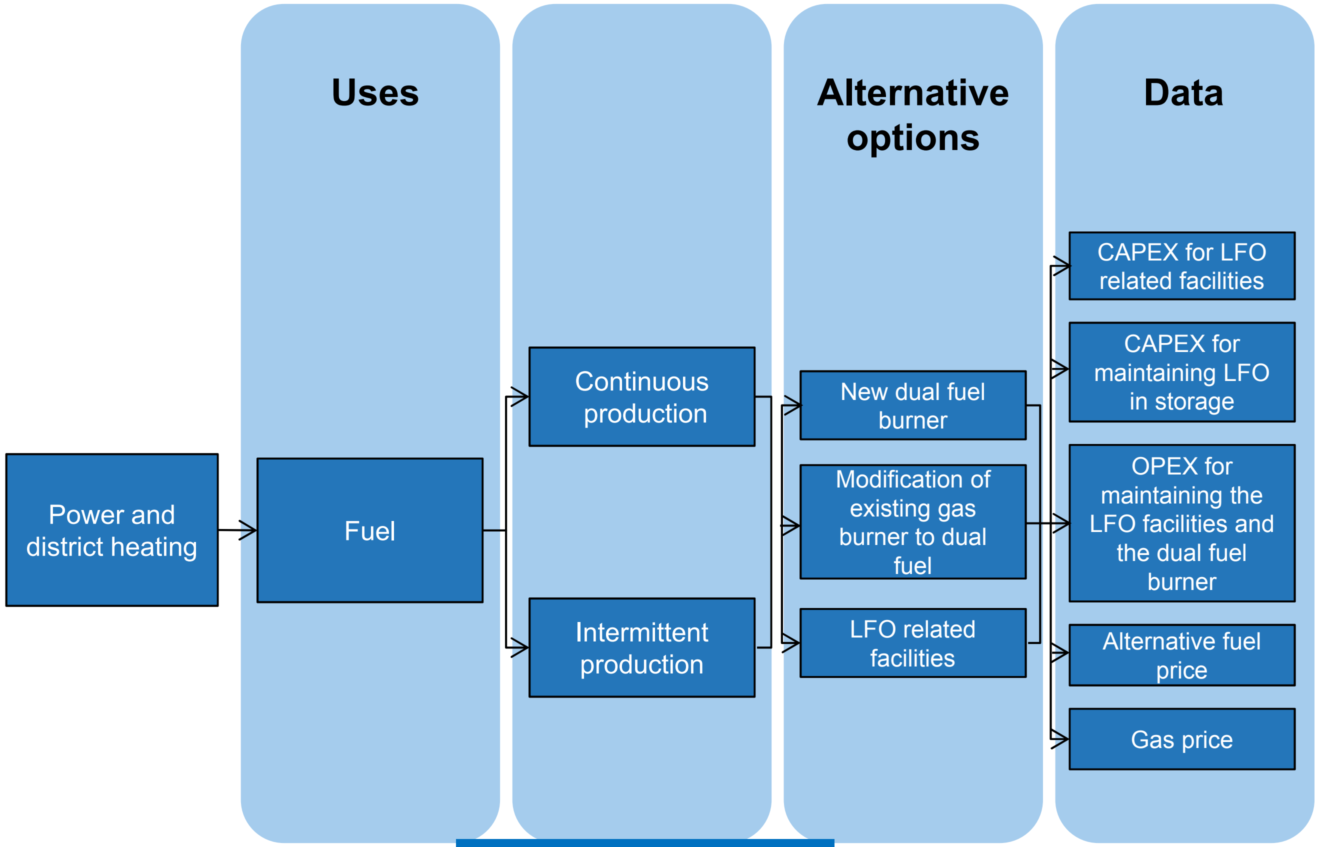


CoDG methodology for Services (non protected customers) sector (2/2)

Assumptions

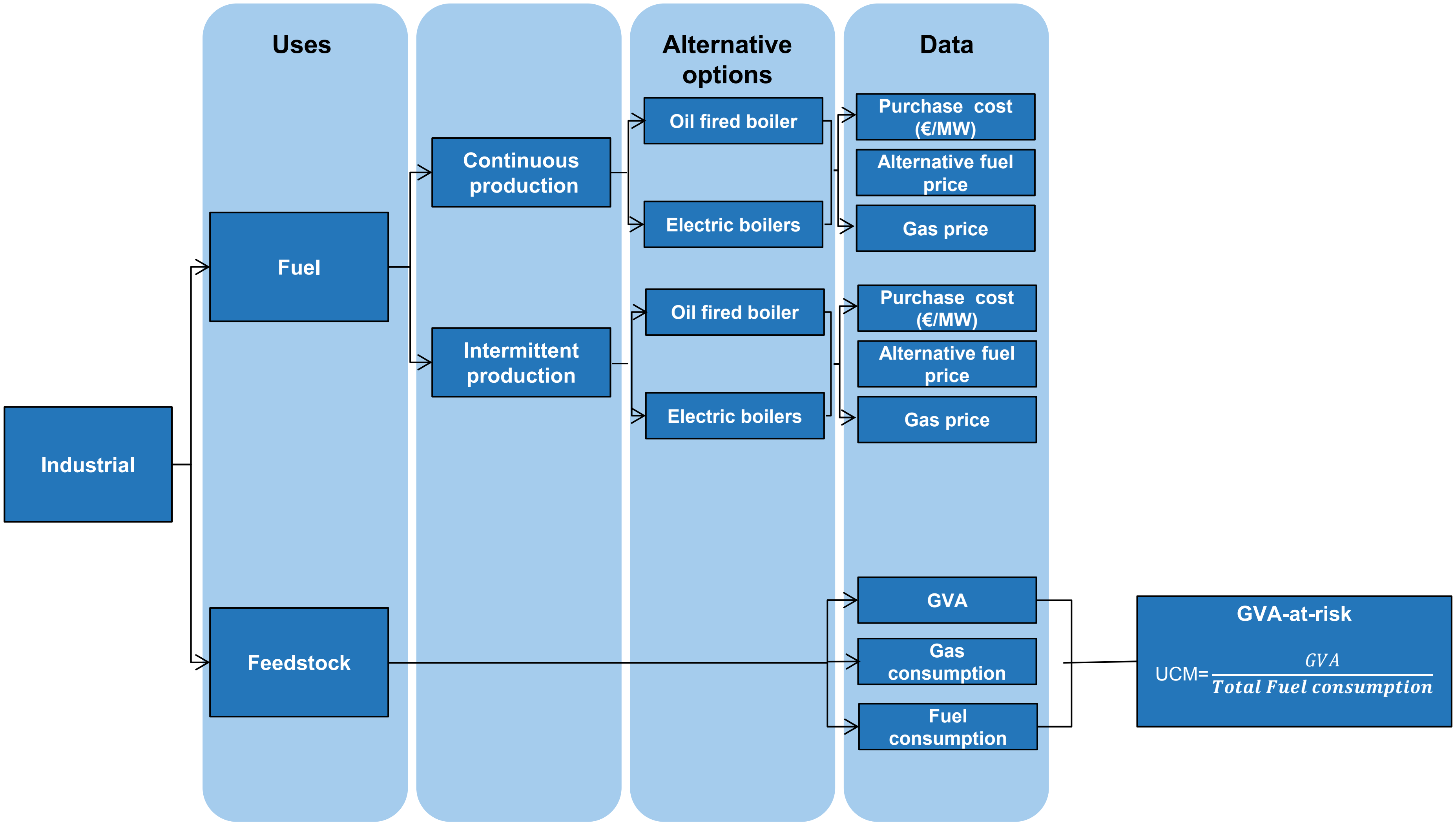
Appliances	% of week: Commercial	% of week: Retail store	% of week: Private office	%of year	Life time (yeas)
Stove	33%	0%	0%	100%	10
A/C	33%	36%	24%	100%	10
Other electric appliances	33%	36%	24%	50%	7
Electric Water heater	33%	0%	24%	100%	10
Heat pump	33%	36%	0%	50%	15
Oil Burner	33%	0%	0%	50%	20
Burner (Pellet, wood)	33%	0%	0%	50%	20

CoDG methodology for Power and District Heating sectors



	% of week		
Appliances	Power sector	%of year	Life time (yeas)
new dual fuel burner	33%	100%	20
modification of existing gas burner to dual fuel	33%	100%	20

CoDG methodology for Industrial sector (1/2)

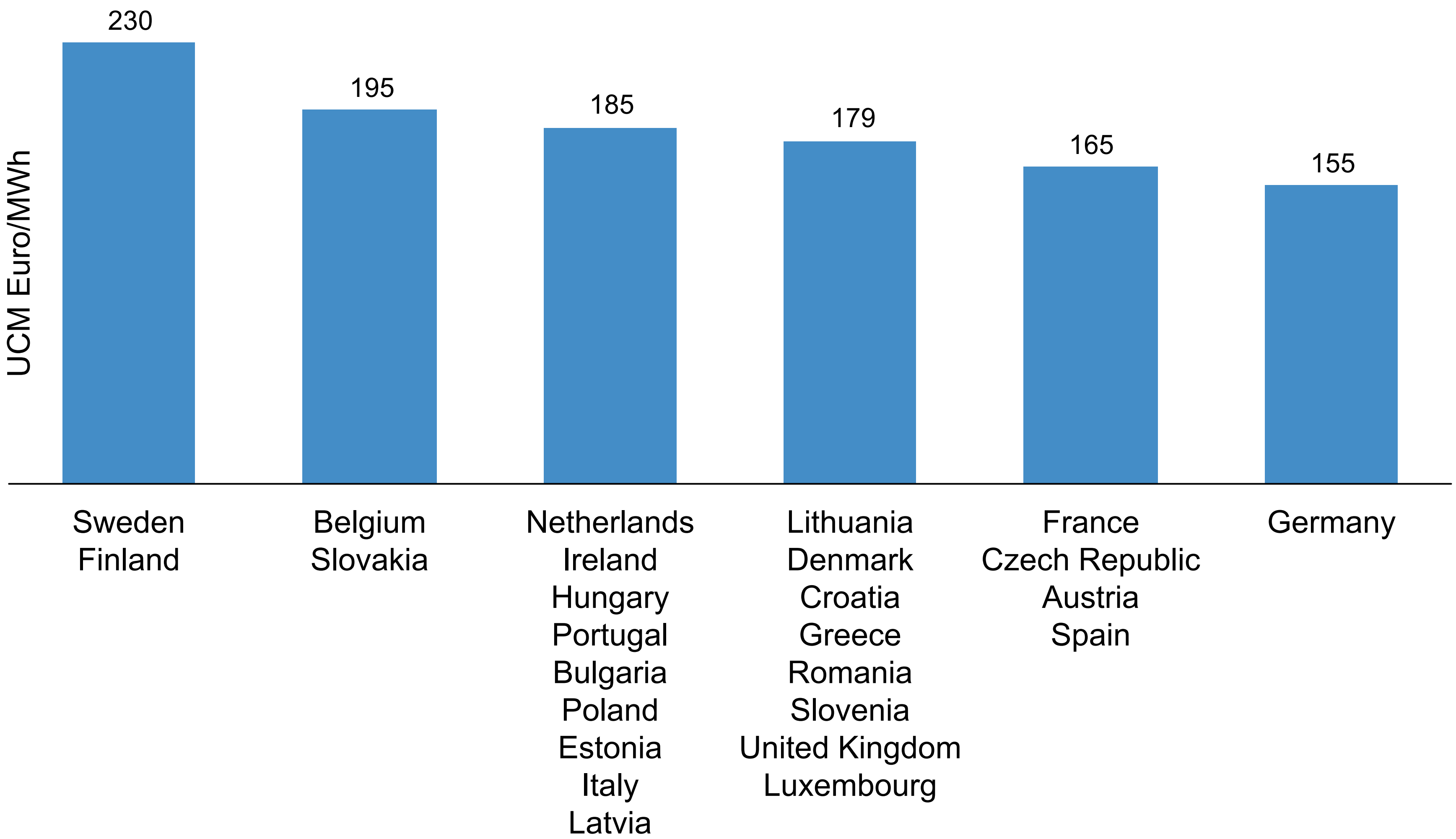


CoDG methodology for Industrial sector (2/2)

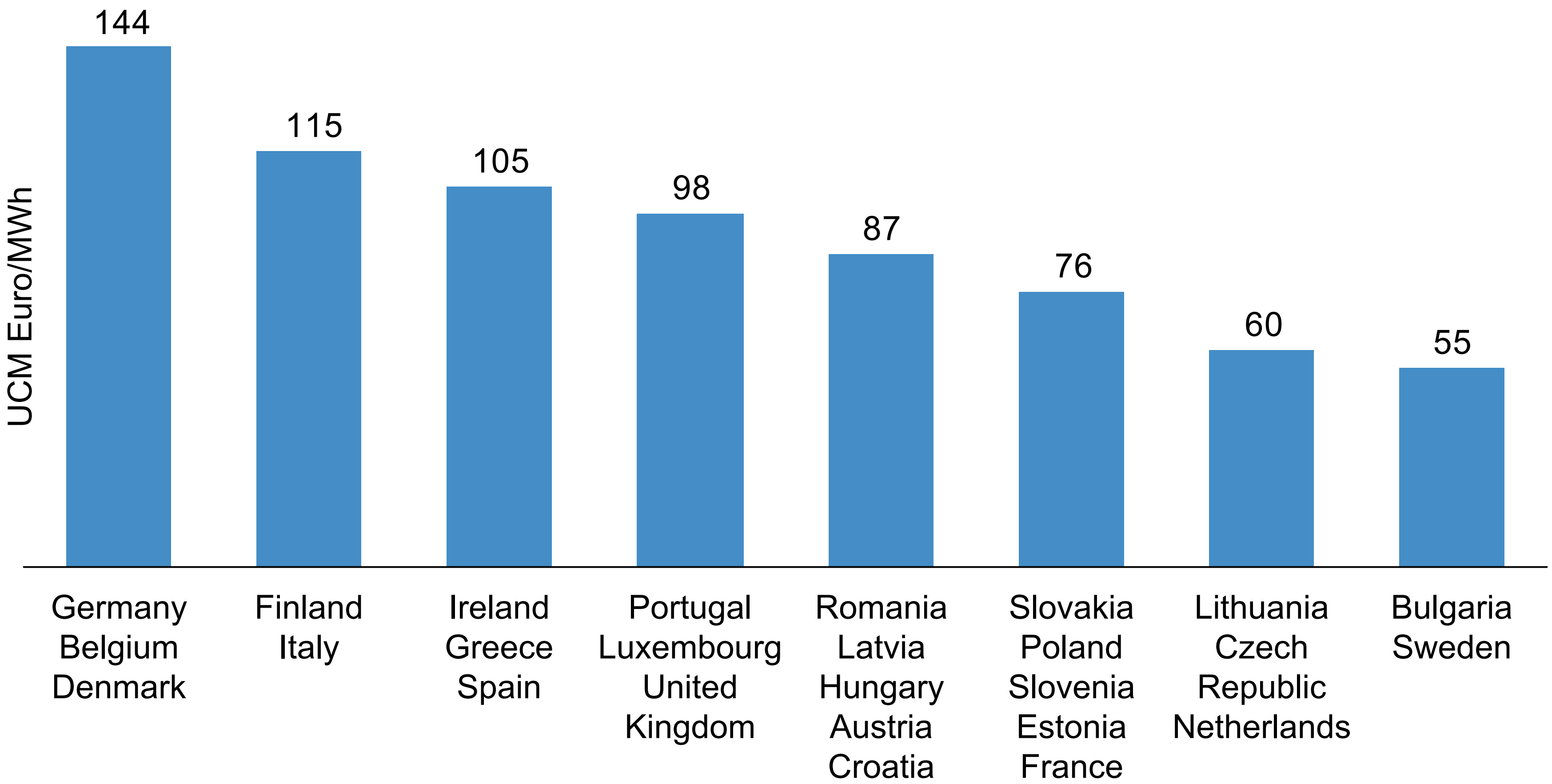
Assumptions

	% of week			
Appliances	Continuous	Intermittent	%of year	Life time (yeas)
Oiled fired boiler	100%	50%	100%	10
Electric boiler	100%	50%	100%	10

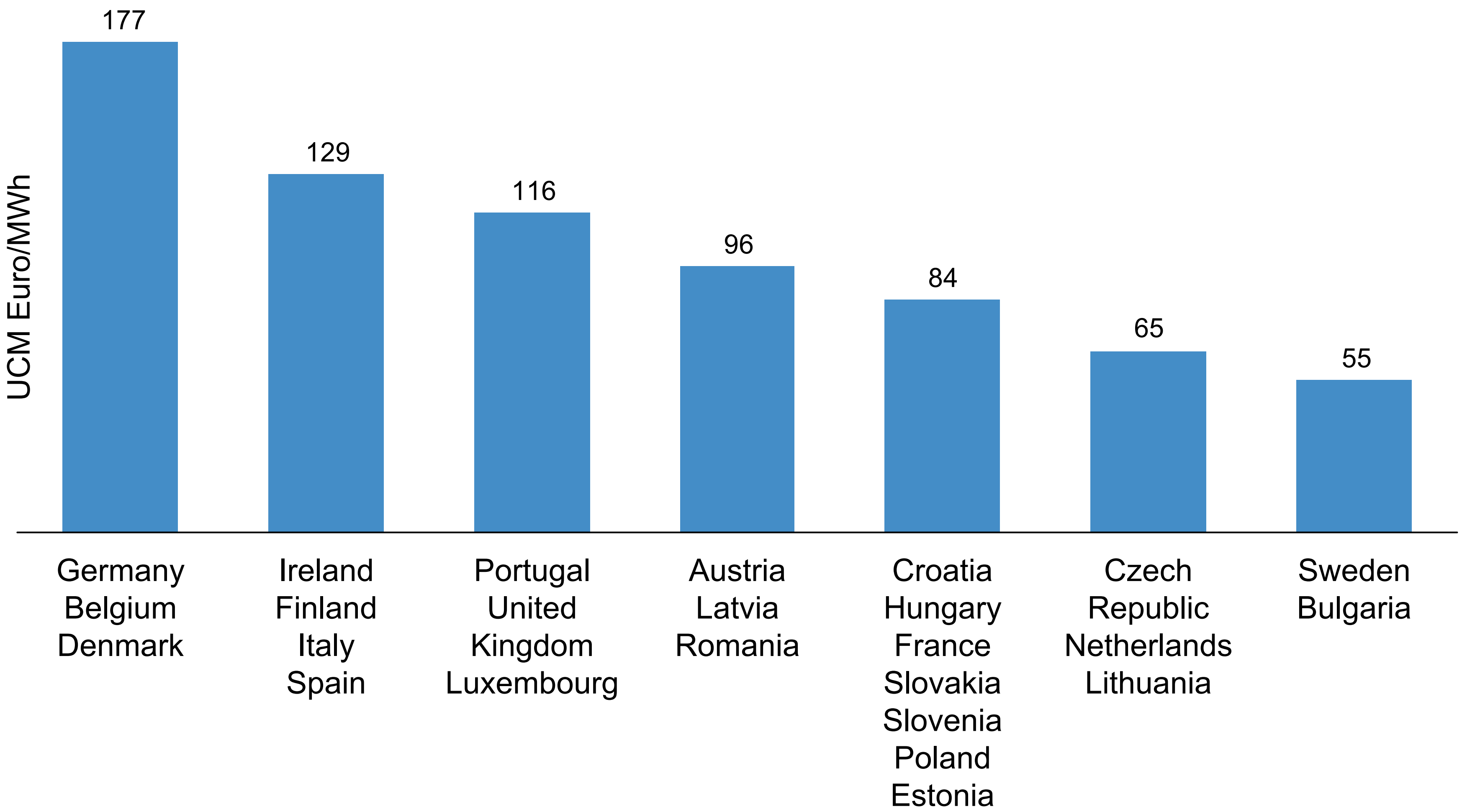
UCM values per Member State – Residential sector



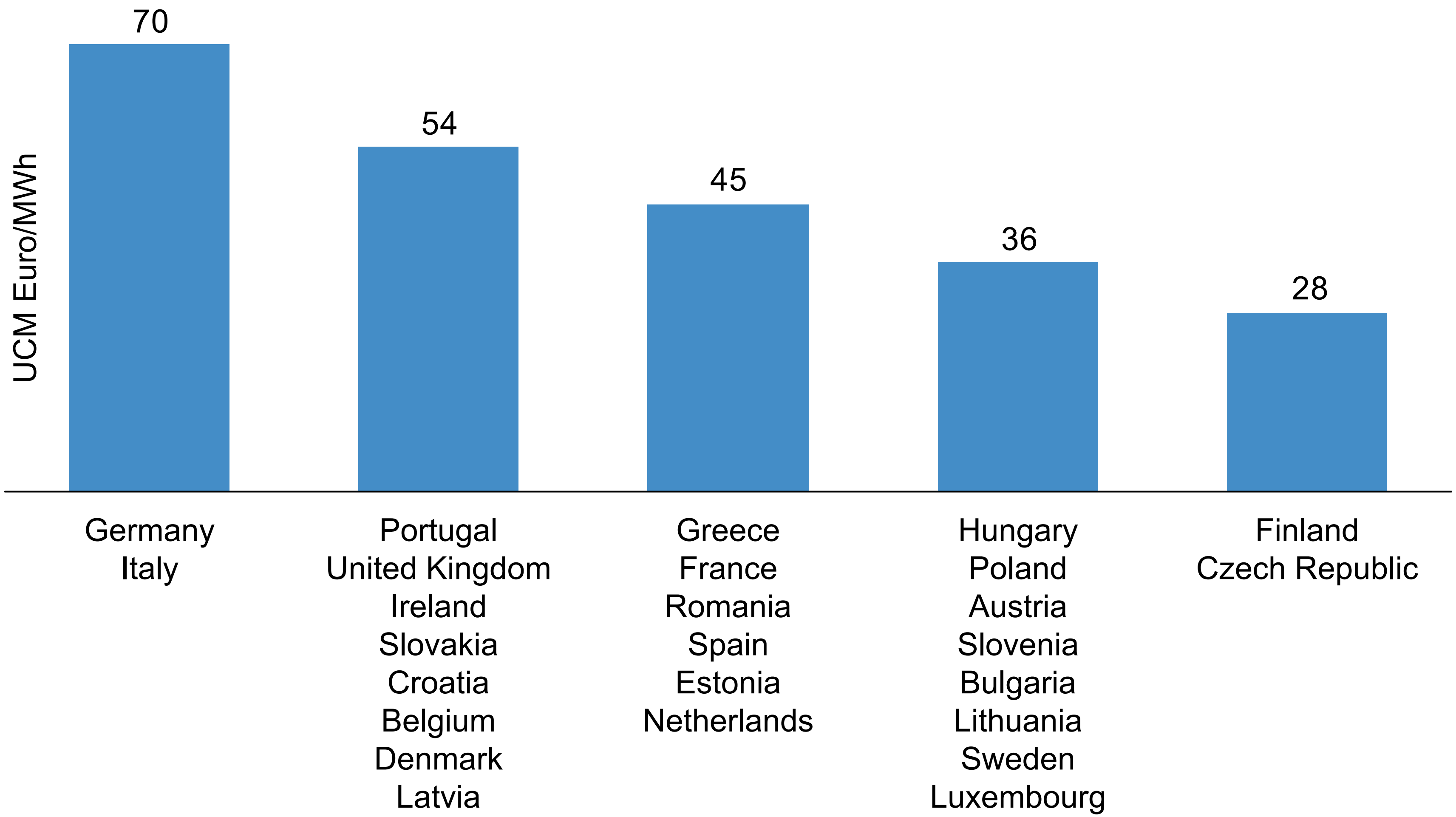
UCM values per Member State – Services (protected customers) sector



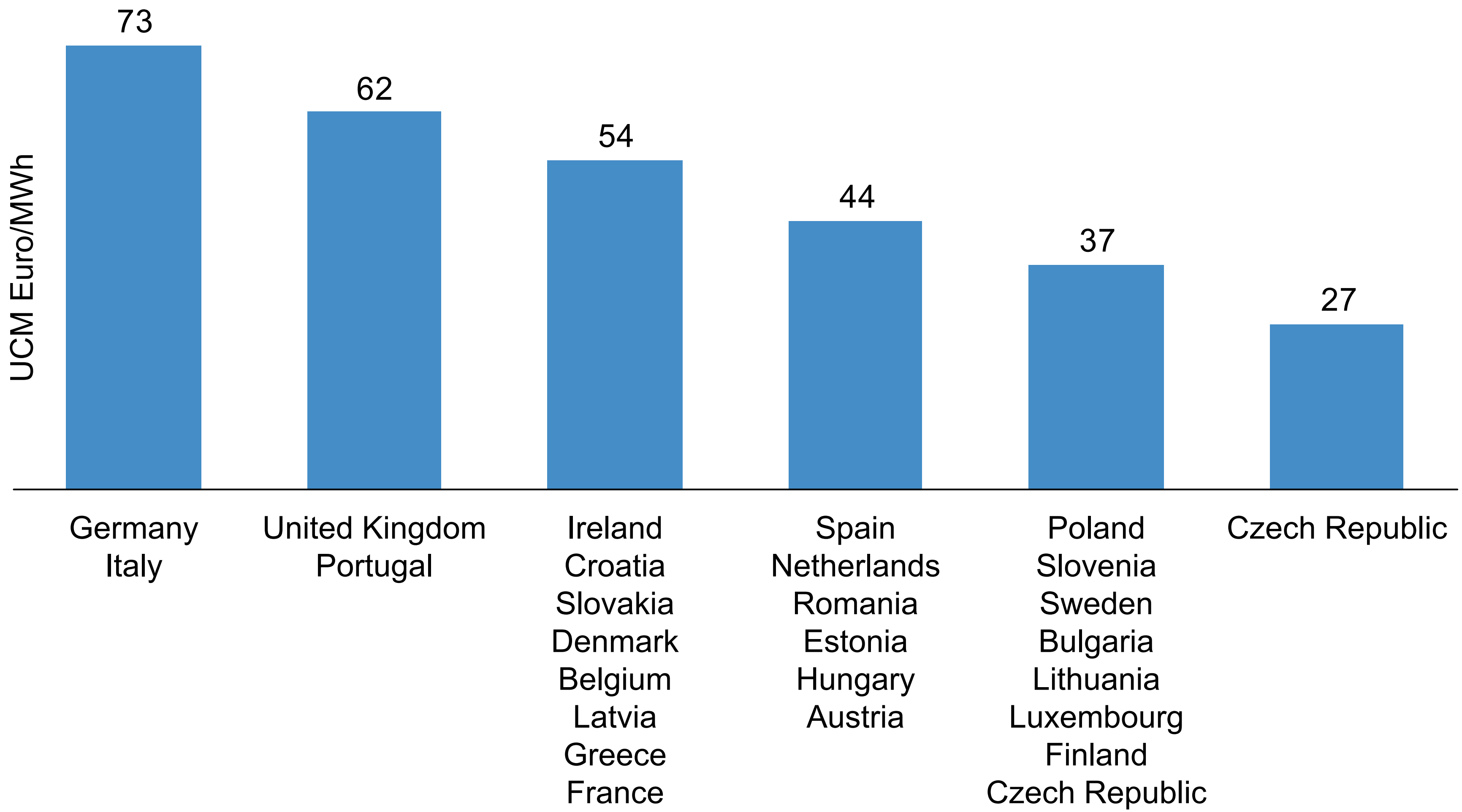
UCM values per Member State – Services (non-protected customers) sector



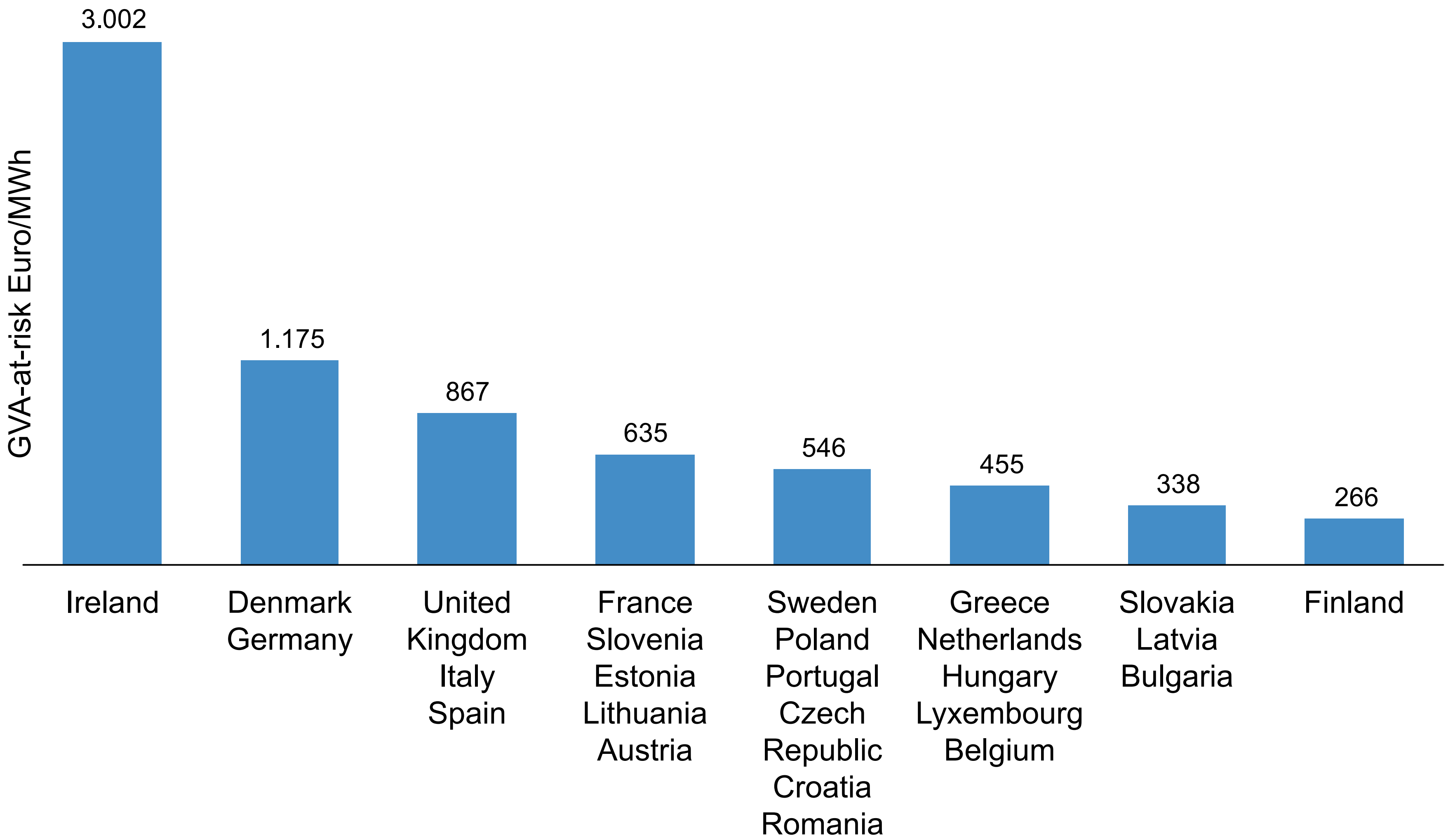
UCM values per Member State – Industrial sector – continuous process



UCM values per Member State – Industrial sector – intermittent process



UCM values per Member State – Industrial sector – GVA-at-risk



UCM values– Power sector

	UCM Euro/MWh	
	New dual fuel burner	Modification of existing gas burner to dual fuel
EU28	89.6	90.1

Modified Hypothetical Cost approach

- **Three Questionnaires have been prepared**
  - **Industrial and Power Sectors**
  - **Servicies**
  - **Residential sector**
- **In all Questionnaires,**
  - Participants are asked to provide information on granularity
    - What is the percentage of production that can be maintained as a function of curtailment?
    - What is the effect of an early warning?
    - Is there a seasonal/daily/within day specific dependence on gas?
  - Participants are also asked if they have alternative sources (i.e. alternative fuel) to address a gas disruption.
  - Participants are further ask to comment on the UCM methodology and respond if they think the proposed UCM value can serve as the CoDG.
  - If not they are asked to propose to increase/decrese it by a certain percentage.

Approach

1 Estimate the Unit Cost Measurement (UCM) for all sectors using natural gas as a fuel

2 Estimate UCM in the industrial subsectors where natural gas is used as a feedstock

3 Use the hypothetical cost approach to determine granularity parameters and refine UCM estimates

Questionnaires to the Industrial and Power Sectors

The Questionnaire addressed to the industrial and power sectors aims to identify:

a) Fuel switching possibilities

b) Costs related to fuel switching

c) Switching possibilities if gas is used as a feedstock

d) Cost for switching if gas is used as feedstock

e) The effect of gas disruption in the industrial and power sectors in terms of loss of production, damage to equipment etc.

f) The cost of disruption and if there is dependence on seasonality, day of week and time of day

Questionnaires to the Industrial, Power, Services and Domestic Sectors

The Questionnaire addressed to the services sector aims to identify:

a) Fuel switching possibilities
b) Costs related to fuel switching
c) Switching possibilities if gas is used as a feedstock
d) Cost for switching if gas is used as feedstock
e) The effect of gas disruption in the industrial and power sectors in terms of loss of production, damage to equipment etc.
f) The cost of disruption and if there is dependence on seasonality, day of week and time of day

The Questionnaire addressed to the residential sector aims to identify:

a) Fuel switching possibilities
b) Costs related to fuel switching
c) Switching possibilities if gas is used as a feedstock
d) Cost for switching if gas is used as feedstock
e) The effect of gas disruption in the industrial and power sectors in terms of loss of production, damage to equipment etc.
f) The cost of disruption and if there is dependence on seasonality, day of week and time of day

Questionnaires to the Industrial, Power, Services and Domestic Sectors (1/2)

	Industrial and Power	Services	Residential
Date of release	29/05/2018	06/06/2018	06/06/2018
Deadline	30/06/2018	20/06/2018	20/06/2018
Number of completed questionnaires	44	2	15
Number of respondents	92	4	21
Screen views	821	57	188
Target Groups	Associations of energy intensive industries and their members across Europe, Associations of gas producers across Europe and their Members	Consumer Associations and consumers across Europe	Consumer Associations and consumers across Europe

Questionnaires to the Industrial, Power, Services and Domestic Sectors (2/2)

- All questionnaires are still available on
- Please contact us for the link
- For industrial and power sectors please visit: https://s.chkmkt.com/CoDGsurvey

Assessment of the proposed CoDG methodology – fuel switching + Modified Hypothetical Cost approach (1/2)

Practice/ approach	Granularity	Applicability to natural gas disruptions	Data availability, accessibility, homogeneity and robustness	Estimation practicality and replicability	Public acceptability
Proposed methodology	⊕⊕	⊕⊕⊕	⊕	⊕⊕⊕	⊕⊕

- **Granularity:**
  - UCM provides estimates that are differentiated per country and sector
  - The modified hypothetical cost approach allows for further differentiation, based on the survey responses
- **Data availability:**
  - UCM requires data from both publicly available databases and some ad-hoc sources (e.g. “mystery shopping” for appliances in e-shops in order to collect CAPEX data)
  - The modified hypothetical cost approach requires surveys
  - Estimation practicality and replicability:
  - The estimation does not require sophisticated software and estimation techniques
- **Public acceptability:**
  - The approach to quantify the cost of disruption as the cost of adaptation measures in cases when adaptation is possible is highly intuitive

Assessment of the proposed CoDG methodology – GVA-at-risk + Modified Hypothetical Cost approach

Practice/ approach	Granularity	Applicability to natural gas disruptions	Data availability, accessibility, homogeneity and robustness	Estimation practicality and replicability	Public acceptability
Proposed methodology	⊕⊕	⊕⊕⊕	⊕	⊕⊕	⊕⊕

- **Granularity:**
  – GVA-at-risk provides estimates for specific sectors per country
  – The modified hypothetical cost approach allows for further differentiation, based on the survey responses
- **Data availability:**
  – GVA-at-risk relies on data from publicly available databases
  – The modified hypothetical cost approach requires surveys
- **Estimation practicality and replicability:**
  – The estimation does not require sophisticated software and estimation techniques
- **Public acceptability:**
  – Given that the scope of this approach is limited to sectors and uses where it is reasonable to expect a production interruption in case of gas supply disruption, the adopted approach can be seen to have a high degree of intuitive appeal

Assessment of the proposed CoDG methodology – fuel switching + Modified Hypothetical Cost approach (2/2)

Other considerations

- The modified hypothetical cost approach introduces a subjective element in the estimation of CoDG
    - The subjectivity is limited by anchoring the answers by asking for adjustment based on UCM figures
    - The approach is less subjective, compared to direct willingness-to-pay and willingness-to-accept questions, as the respondents are asked to provide their opinion on cost of adaptation
    - Nevertheless, some degree of subjectivity is introduced, which is largely inevitable with survey-based approaches.
- The Questionnaire is onlyy available in English and web-based (sample bias)
- Sample size is still limited : WE NEED RESPONSES !!!!!!!

1. Project outline

2. Review and assessment of existing CoDG approaches

3. The proposed methodology for the estimation of CoDG

4. The proposed methodology for the estimation of Solidarity Price

5. Results

Solidarity Gas Price methodology

Input Data	Elements
TSO Transparency Template for tariff calculation	1 The cost of using capacity at the interconnection point (IP) between the SP-MS and the SR-MS
	2 LNG regasification costs and costs of reserving capacity at an LNG entry point
	3 Costs related to the use of strategic storage
Need to define other costs if any	4 Administrative costs incurred by the transmission system operator of the MS providing the solidarity
CoDG	5 Compensation for disrupted consumers in the MS providing the solidarity calculated based on the CoDG
Spot gas market price (if available) and other scarcity components	6 Cost of gas supplied to the requesting MS
	7 Reimbursement for judicial procedures as per paragraph 8(c) of the regulation

Elements 1–6: Paid promptly by the requesting MS after the end of the incident

Element 7: Paid by the requesting if such procedures occur

Commodity gas price

- The European Commission recommendation 2018/177 on the mechanisms for solidarity gas state clearly that the price of the commodity gas should be reflective of market signals.

- This means that the cost of the gas should be directly set by market prices at the time the solidary request is activated.

- The market price may however not always be as easy to establish. Particularly not in the case of a major supply disruption, where spot markets may be suspended (if spot market exist at all) or prices may be capped or frozen.

- Should different price indicators be applied under different circumstances ?

- Should different price indicators be used across different Member States ?

Elements

1. The cost of using capacity at the interconnection point (IP) between the SP-MS and the SR-MS
2. LNG regasification costs and costs of reserving capacity at an LNG entry point
3. Costs related to the use of strategic storage
4. Administrative costs incurred by the transmission system operator of the MS providing the solidarity
5. Compensation for disrupted consumers in the MS providing the solidarity calculated based on the CoDG
6. Cost of gas supplied to the requesting MS
7. Reimbursement for judicial procedures as per paragraph 8(c) of the regulation

Solidarity Gas Price – Market price

- **Price indicator 1: spot market price** in the sending market at the time of the solidarity gas request. Gas spot market price as and when solidarity gas is requested.
- **Price indicator 2**: **last observed spot market price** – Last observed gas spot market price in the sending market if the market is suspended at the time of the solidarity gas request.
- **Price indicator 3**: **skewed market price** – Gas price in the sending market if government intervention in the market has skewed prices (eg frozen or capped prices).
- **Price indicator 4: bilateral contract price** – Highest bilateral contract price of non-protected customers interrupted as a result of solidarity gas request.
- **Price indicator 5: regional gas price** – Gas prices of a neighboring market or regional hub where prices are most closely correlated with sending market prices.

Price indicator 1: spot market price

- If the sending member state has a spot market, which continues to function effectively after the supply disruption, the spot market price at the time of the solidarity gas request should apply.
- Prices under such circumstances would reflect the supply shortages in neighboring markets (providing the interconnector capacities are not restricted) allowing for a fair and adequate reflection of market conditions.
- Depending on the urgency required for gas supplies and the spot market structure in the sending market, the price could be set by
  – day ahead prices or intraday settlement prices
  – intraday prices (short term (within day) requirements)
  – the day ahead market price (next day
- The details of timing on request for solidarity gas and delivery should be specified in the bilateral agreement between sending and receiving member state.
- Additional demand from solidarity gas may result in a higher spot market price which essentially means that domestic consumers are charged for providing solidarity.
- In the absence of physical congestion at interconnections between the MS providing the solidarity and the MS receiving the solidarity, Is a functioning market compatible with the provision of solidarity gas ??

Price indicator 2: last observed market price

- If the sending member state has a spot market, but the market has ceased to function as a result of the supply disruption, the last observed market price – under specified circumstances – should apply.
- Non functioning market = suspension of spot market trading
  - Lack of liquidity on the market or a state entity acting as single buyer and redistributing gas at set prices. In such circumstances the spot market cannot provide an accurate price signal for solidarity gas.
- The last observed market price should only apply when spot markets have reacted to supply shortages before the market was suspended.

Volatility

-Gas spot prices in trading days (e.g. 5 days) before the market disruption display a volatility of a pre-determined percentage (e.g. 10%) above the average price volatility observed in an extended period before (e.g. 20 weeks).

Time between request and market disruption:

The solidarity request should be within a pre-determined period of time (eg 5 days) after the spot market in the sending market is disrupted.

Market price - Price indicator 3: skewed market price

- A supply disruption in the solidarity gas receiving market is likely to have knock-on effects on the sending market; at worst the sending market could be also facing some disruption.
- This may result in some government intervention in the setting of prices, e.g. price caps or price freezes (despite the EC recommendation).
- Theoretically two pricing options could apply:

Solidarity gas is priced at the theoretical spot market price

Domestic customers face the capped or frozen price

Receiving market customers pay the full market price to be determined by the market operator on the basis of supply/demand conditions.

However, the circumstances in this scenario are not normal and government intervention in gas prices – which is also illegal as it may constitute state aid – is only likely to be a last resort measure resulting from force majeure. .

- Discriminatory pricing
- Government intervention maybe considered as state aid. .
- Cross subsidisation : SP-MS subsidising SR-MS
- Difficulty in establishing the theoretical market price

There is a bilateral agreement between the Solidarity Receiver and the Solidarity Provider Member State

Solidarity gas is priced at the skewed market price – under this pricing option, customers in the receiving market would pay the same price as customers in the sending market.

Market price - Price indicator 4: bilateral contracts market

- In a situation where no spot market exists in the sending market and the criteria for pricing Price Indicator 2: are not met, the highest priced bilateral contract price of the non-protected customers that is disrupted as a result of the solidarity request can be used as a proxy.
  - This represents the marginal price of gas in the absence of a functioning spot market.
  - It is a more accurate price indicator of the market conditions on the sending market than a regional gas hub price, which will be driven by supply and demand flows that may be irrelevant for the sending gas market.
- BUT OTC prices are not readily available and not public.
- Non protected customers will need an incentive to collaborate and disclose prices (e.g. their compensation for being disrupted to include cost of gas plus other components included in the SP formula)
- If there is no OTC price disclosure, another pricing option needs to apply (see pricing option 5: regional gas hub prices)

Market price - Price indicator 5: regional gas price

- The solidarity gas price is a regional gas price, i.e. a price of the most adequate functioning gas market at the time of the solidarity request
- This is a last resort option when everything else fails and it should not be restricted to the prices of major hubs (eg NBP,TIFF, ZEE, CEGH
- Despite strong (and improving) interconnectedness of European gas markets, regional gas price differences still apply. This is particularly the case for localized supply disruptions.
- The selection of regional gas markets to act as proxies for market conditions in a sending market may not be adequate and reflective of the market conditions in that market. The selection of an adequate regional gas price should be based on:
- Historical correlation of prices of the sending market with other gas markets over the space of a gas year.
- This analysis should be conducted for the sending market prior to negotiation solidarity gas agreements. It would result in a ranking of gas markets that can then be used in case of a market disruption in the sending market. It should be reviewed on an annual basis.
- The ranking is needed to guard against a breakdown of other spot markets.
- If the closest correlated spot market also breaks down, price should be set by the second closest correlated spot market. If that is broken down, it should go to the third closest and all the way until a functioning spot market is reached.
- For those member states with no spot market, the ranking of regional gas markets and applicable prices should be done on a measure of interconnectedness of the market with surrounding markets and hubs. One possible way to estimate this is by assessing the physical flows into the sending market on the basis of interconnector capacity booking and usage of the last year (or the current year if data is available) eg on the basis of ACER's Annual Report on the Results of Monitoring the Internal Electricity and Gas Markets

Scenarios and market pricing 'decision tree'

- Five distinct scenarios can be identified:

  1. **Scenario A**: The sending market has a spot market, where price signals have not been affected by the emergency situation
  2. **Scenario B**: The sending market has a spot market which has been affected – through government intervention - such that the price does not reflect market realities anymore

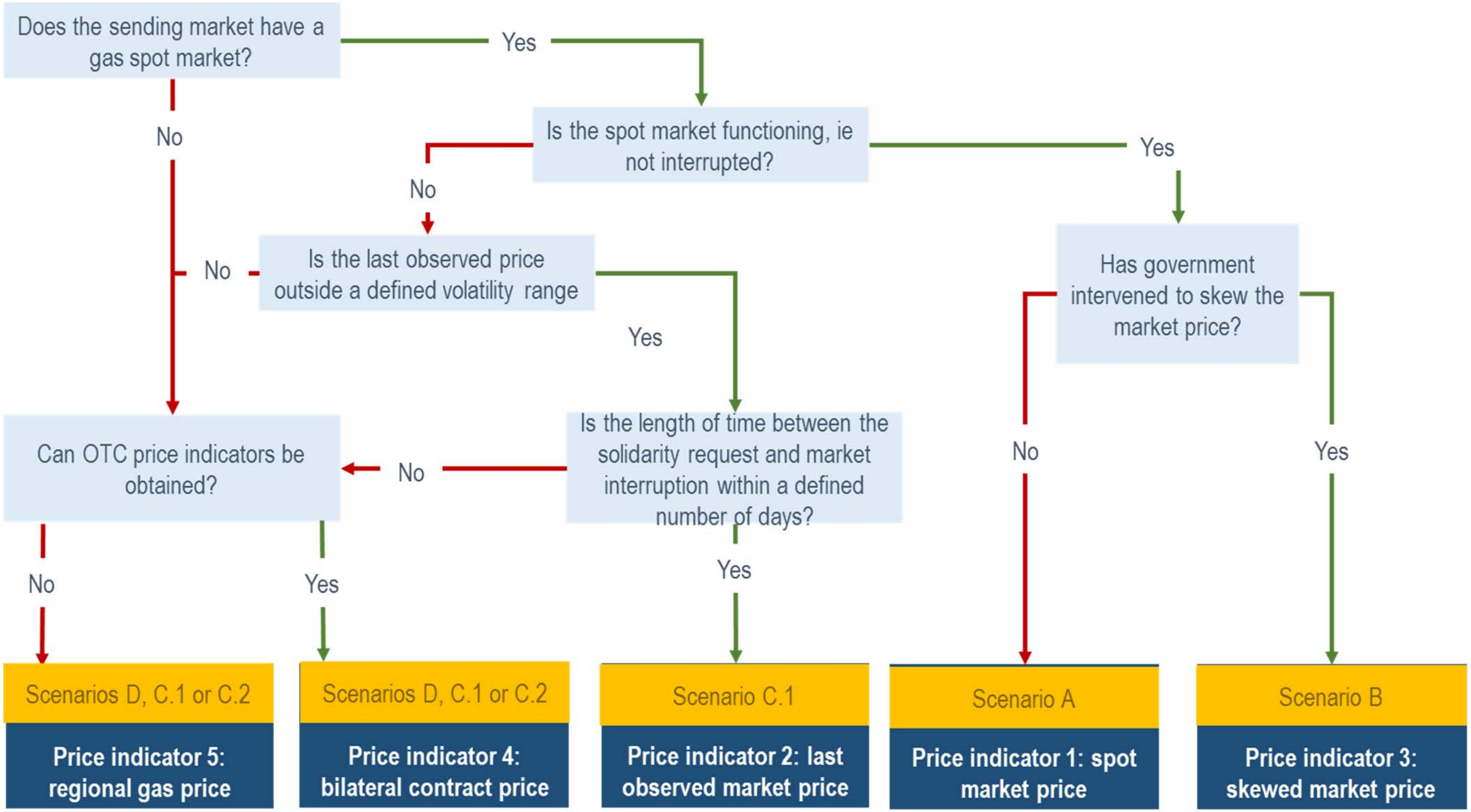
  Scenario C: The sending market has a spot market which has been suspended and provides no price signal at all at the time of the solidarity request.

  Two sub-scenarios can be further specified:

  3. **Scenario C.1**: spot gas prices before the market breakdown reflect impending supply disruptions
  4. **Scenario C.2:** spot gas prices before the market breakdown do not reflect impending supply disruptions

  5. **Scenario D:** The sending market has no spot market

Solidarity gas price - Scenarios



Elements

1. The cost of using capacity at the interconnection point (IP) between the SP-MS and the SR-MS
2. LNG regasification costs and costs of reserving capacity at an LNG entry point
3. Costs related to the use of strategic storage
4. Administrative costs incurred by the transmission system operator of the MS providing the solidarity
5. Compensation for disrupted consumers in the MS providing the solidarity calculated based on the CoDG
6. Cost of gas supplied to the requesting MS
7. Reimbursement for judicial procedures as per paragraph 8(c) of the regulation

Capacity pricing for the provision of solidarity gas

- The pricing of capacity (existing tariffs and their defined methodologies – as prescribed in the sending Member States' tariff regulation).
- As capacity charges typically vary by type of product - firm capacity, interruptible, short term or long term , the solidarity gas request should therefore specify the type of capacity product that will be needed.
- Capacity charges include
  - Transmission tariffs for the utilization of the Interconnection Point between the SP-MS and the MS receiving the solidarity
  - Transmission tariffs for the utilization of an LNG entry point to the transmission system of a solidarity provider MS
  - Transmission tariffs for the utilization of an entry point from a UGS storage of a solidarity provider MS.
  - Capacity charges related to regassification of LNG (if not included in the commodity cost of gas)
  - Capacity charges related to the withdrawal of gas from a gas storage (if not included in the cost of stored gas)

Elements

Costs of release of strategic storage or having storage obligations

sending member state to replace strategic storage, or volume of storage obligations withdrawn

Receiving member state to be charged with the respective withdrawal and injection costs, for the volumes withdrawn and injected, respectively, or the Standard Bundled Unit (SBU), as applied to the storage sites concerned.

The receiving member state is also charged for gas stocks

The receiving member state to replace strategic storage, or volume of storage obligations withdrawn, and be charged at the SBU applied to the storage sites concerned.

In that case, the receiving state undertakes the procurement of the respective volumes, and should not be charged by the sending member state for the value of the gas.

Timing is a decisive factor to ensure that receiving member state dies not gain from arbitrage. Replacement of storage should be well defined in agreement between SP-MS and SR-MS, takin also account the time of year, technical conditions of the two systems

1. The cost of using capacity at the interconnection point (IP) between the SP-MS and the SR-MS
2. LNG regasification costs and costs of reserving capacity at an LNG entry point
3. Costs related to the use of strategic storage
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Administrative costs for TSO

- Administrative costs could be for example related to the actions necessary for the initiation of the emergency physical reverse such as
- -Fuel and electricity additional costs, if any, for the initiation of physical reverse flow if not already incorporated in the Regulatory Asset Base and the respective Tariffs
- UFG and other system losses if any (increased due to the provision of the physical reverse in comparison to normal flow direction) again if not incorporated in the RAB and respective Tariffs
- Operational expenses for exraordinaty maintenance of the equipment to be used in physical reverse (if any and if not already included in the tariffs of the SR-MS as a result of the CBCA mechanism.
- Additional operational costs to support the physical reverse (extra shifts to be provided by the TSO, or the GSO, or the LSO -I doubt there is a need for the last 2 but I included them here for completeness) if such can be identified
- -Other cost components related to the conclusion of the solidarity provision agreement.
- A simple approach would be to include all such costs, following the approval of the regulator to the reverse flow tariff.

Elements

1 The cost of using capacity at the interconnection point (IP) between the SP-MS and the SR-MS

2 LNG regasification costs and costs of reserving capacity at an LNG entry point

3 Costs related to the use of strategic storage

4 Administrative costs incurred by the transmission system operator of the MS providing the solidarity

5 Compensation for disrupted consumers in the MS providing the solidarity calculated based on the CoDG

6 Cost of gas supplied to the requesting MS

7 Reimbursement for judicial procedures as per paragraph 8(c) of the regulation

A compensation for non-protected customers in the country providing solidarity gas

- The compensation for non-protected customers should be the Cost of Disrupted Gas measure (CoDG) established in Task A of the report needs to be applied.
- As outlined in Task A this will be the Unit Cost Measurement (UCM) for those consumers using gas as a source of heating and the Gross Value Add (GVA) at risk for those industrial users using gas as a raw material input into the production process.

Elements

1. The cost of using capacity at the interconnection point (IP) between the SP-MS and the SR-MS
2. LNG regasification costs and costs of reserving capacity at an LNG entry point
3. Costs related to the use of strategic storage
4. Administrative costs incurred by the transmission system operator of the MS providing the solidarity
5. Compensation for disrupted consumers in the MS providing the solidarity calculated based on the CoDG
6. Cost of gas supplied to the requesting MS
7. Reimbursement for judicial procedures as per paragraph 8(c) of the regulation

Cost of judicial proceedings in Member State providing solidarity (1/2)

Many legal questions may arise from a supply interruption of the non-protected customers in the sending market as a result of triggering the solidarity mechanism. The most important legal questions are:

The legality of the interruption: The existing supply contracts with non-protected customers currently are unlikely to have a solidarity clause. There is therefore no legal underpinning for the market operator or TSO in interrupting supplies to these customers. Although this may qualify as a ‘force majeure’ incident, it is likely that customers would legally challenge this decision,

The level of compensation: The compensation defined through the solidarity gas methodology would to a large extent (apart from the administrative cost and transportation costs) be given to the interrupted non-protective customers.

The compensation may not capture the true costs incurred by disrupted suppliers because it may be

(i) below the lost GVA as a result of the interruption,

(ii) ignore the impact of disruptions on production equipment and

(iii) underestimate the long term effects of interruptions such as loss of customers.

Cost of judicial proceedings in Member State providing solidarity (2/2)

- It is highly likely that customers will challenge their suppliers and the associated compensation, which will incur legal fees and costs to suppliers for any settlement rulings, should the case be made that solidarity gas is not sufficient to cover losses.

- This could be a very significant cost component of the solidarity gas mechanism.

- There is no single methodology that can be applied across the EU that would capture these costs accurately.

- The costs of judicial proceedings and final compensation are complicated and will depend on a case by case basis.

- The solidarity gas contracts therefore need to unambiguously assign the costs associated with arbitration proceedings and settlement of arbitration rulings to the parties involved.

Overarching themes

- The cost components of the solidarity gas should be summed and in their solidarity gas contracts Member States need to specify how costs are combined.

- Factors that will need to be considered are:
  - **Timing of payments and interest rates** –
    - Payments of the costs should be prompt.
    - However this may not always be possible as some costs may be incurred at a later stage (e.g. costs due to judicial proceedings)
    - Member states should agree when payments are due and how to deal with late payments (specification of an interest rate=
  - **Currency and exchange rates**
    - The agreement should also specify the applicable exchange rate and currency.
    - We would recommend to apply the exchange rates at the time of supplying solidarity gas to ensure that the sending market has no incentive to delay or accelerate the invoicing of the payment on the basis of the exchange rate.
    - As for the interest rate, a reliable source for exchange rates should be specified in the agreement

Project outline

Review and assessment of existing CoDG approaches

CoDG & SoS Methodology

Results

Industrial and Power sector - Basic Statistics (1/5)

Response	Total	% of responses	%
Active in the Industrial Sector	78		85%
Gas fired Electricity Producer	29		32%

Response	Total	% of responses	%
electricity production solely for own needs	17		63%
active in the power market	15		56%

Industrial and Power sector - Basic Statistics (2/5)

Gas in power

Response	Total	% of responses	%
Natural gas fired in CHPs	18		69%
Natural gas fired in Combined Cycle Gas Turbines	8		31%
Natural gas fired in open cycle gas turbines	4		15%
Other, please specify	2		8%
	Total respondents: 26 Skipped question: 50	0% 20% 40% 60% 80%	

Industrial and Power sector - Basic Statistics (3/5)

Gas in industry

Response	Total	% of responses	%
Natural gas used as a fuel	62		81%
Natural gas used as a feedstock	20		26%
	Total respondents: 77 Skipped question: 12	0% 20% 40% 60% 80%	

Response	Total	% of responses	%
boiler	28		57%
Other, please specify	21		43%
CHP unit	20		41%
	Total respondents: 49 Skipped question: 23	0% 20% 40% 60% 80%	

Industrial and Power sector

Participation by country

Response	Total	% of responses	%
Italy	64		71%
United Kingdom	8		9%
Germany	7		8%
France	6		7%
Hungary	5		6%
Greece	5		6%
Austria	5		6%
Spain	5		6%
Czech Republic	4		4%
Poland	4		4%
Sweden	3		3%
Finland	3		3%
Romania	3		3%
Ireland	3		3%
Lithuania	2		2%
Denmark	2		2%
Bulgaria	2		2%
Belgium	2		2%
Portugal	2		2%
Netherlands	1		1%
Luxembourg	1		1%
Latvia	1		1%
	Total respondents: 90 Skipped question: 0	0% 20% 40%	

Industrial and Power Sectors

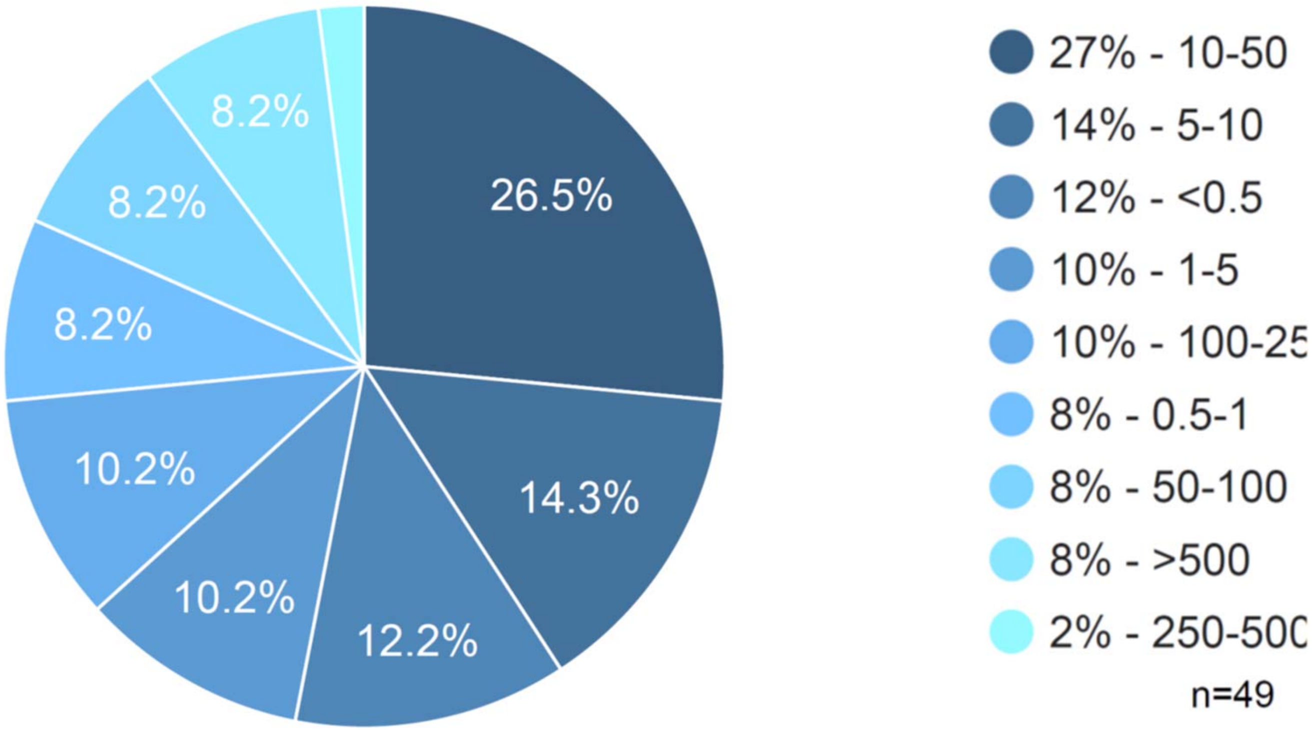
Participation by sector

Response	Total	%
Iron & steel industry	27	35%
Textile and Leather	15	19%
Paper, Pulp and Print	13	17%
Chemical and Petrochemical industry	9	12%
Non-ferrous metal industry	7	9%
Other, please specify	4	5%
Machinery	2	3%
Wood and Wood Products	1	1%
Construction	1	1%
Mining and Quarrying	1	1%
Food and Tobacco	0	0%
Non-metallic Minerals (Glass, pottery & building mat. Industry)	0	0%
Transport Equipment	0	0%

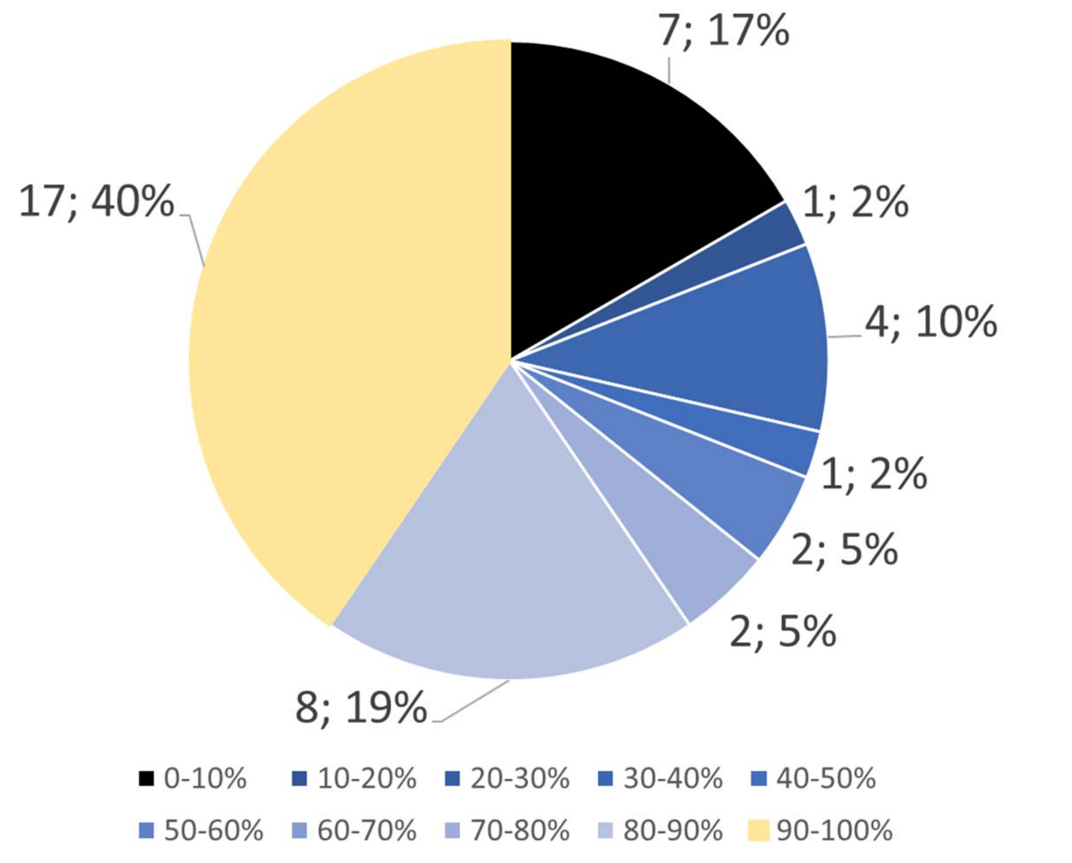
Total respondents: 77
Skipped question: 12

Industrial and power sector

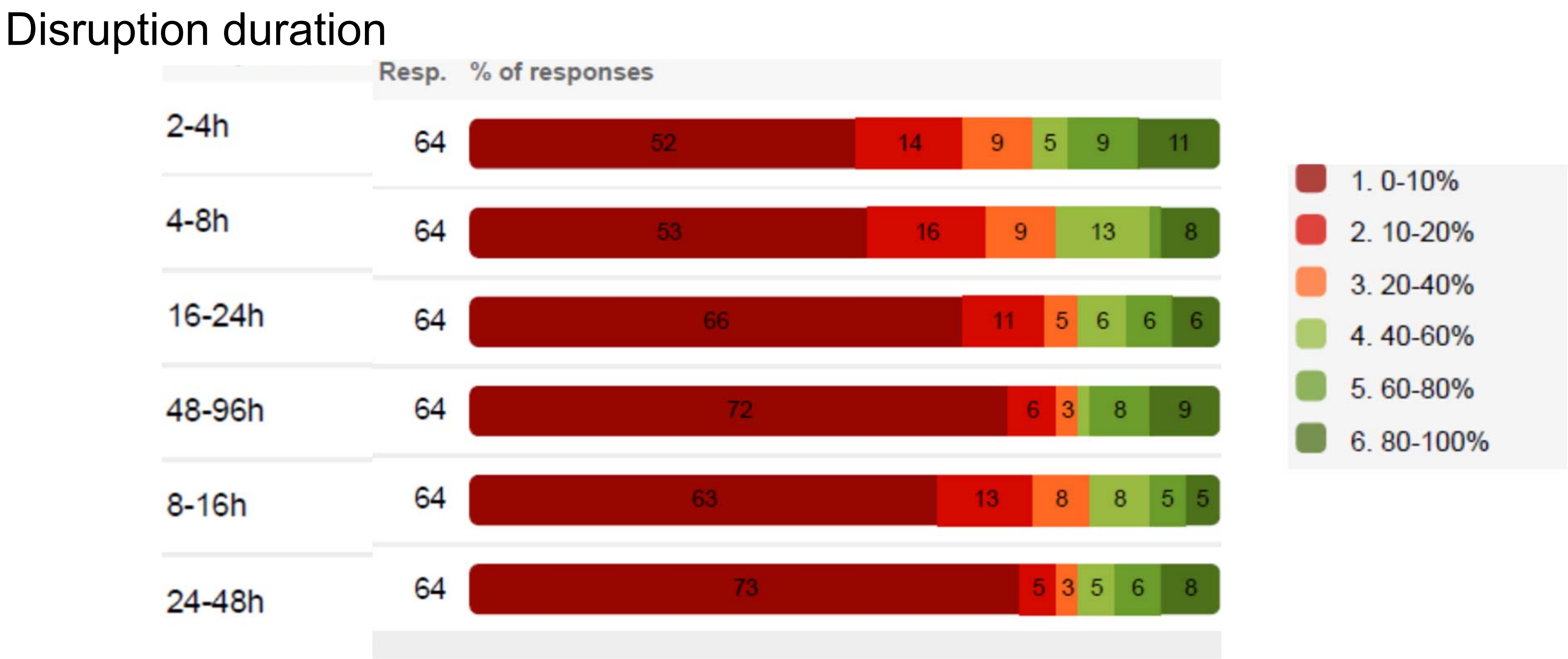
Range of gas firing equipment [MW]



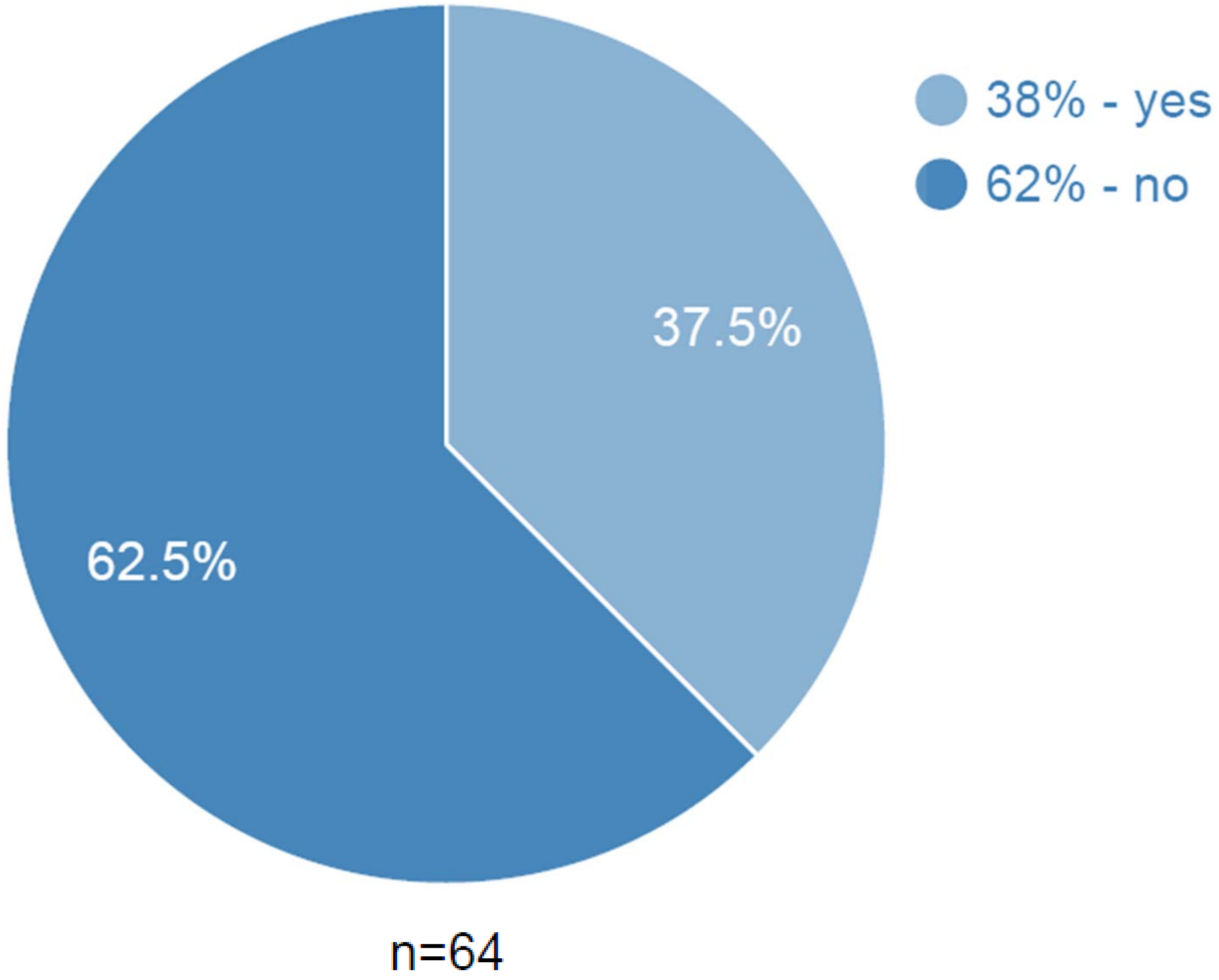
Industrial and power sector - Requirements in natural gas as a fuel as a percentage of overall fuel consumption



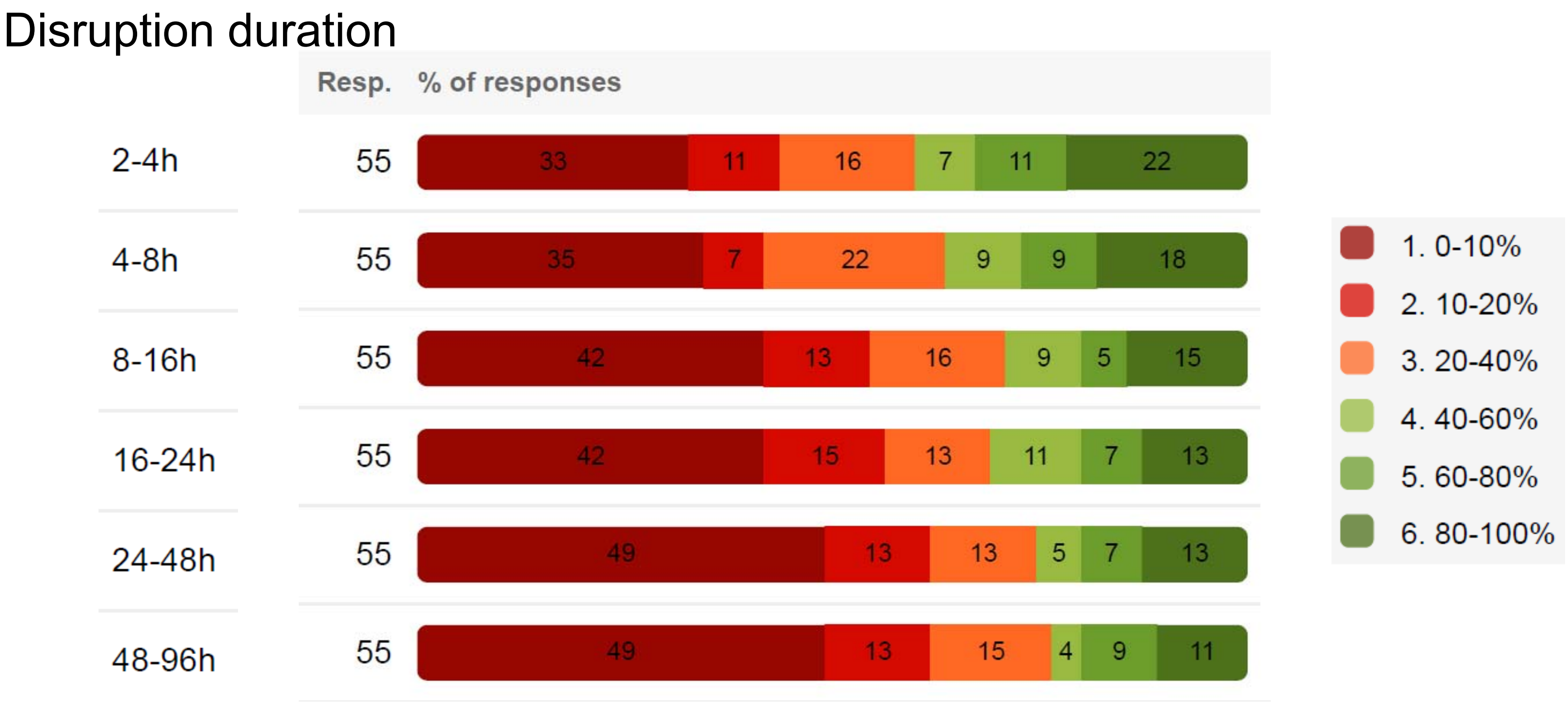
Industrial and power sector - % of activity output which can be continued in the event of a 100 % loss of gas supply



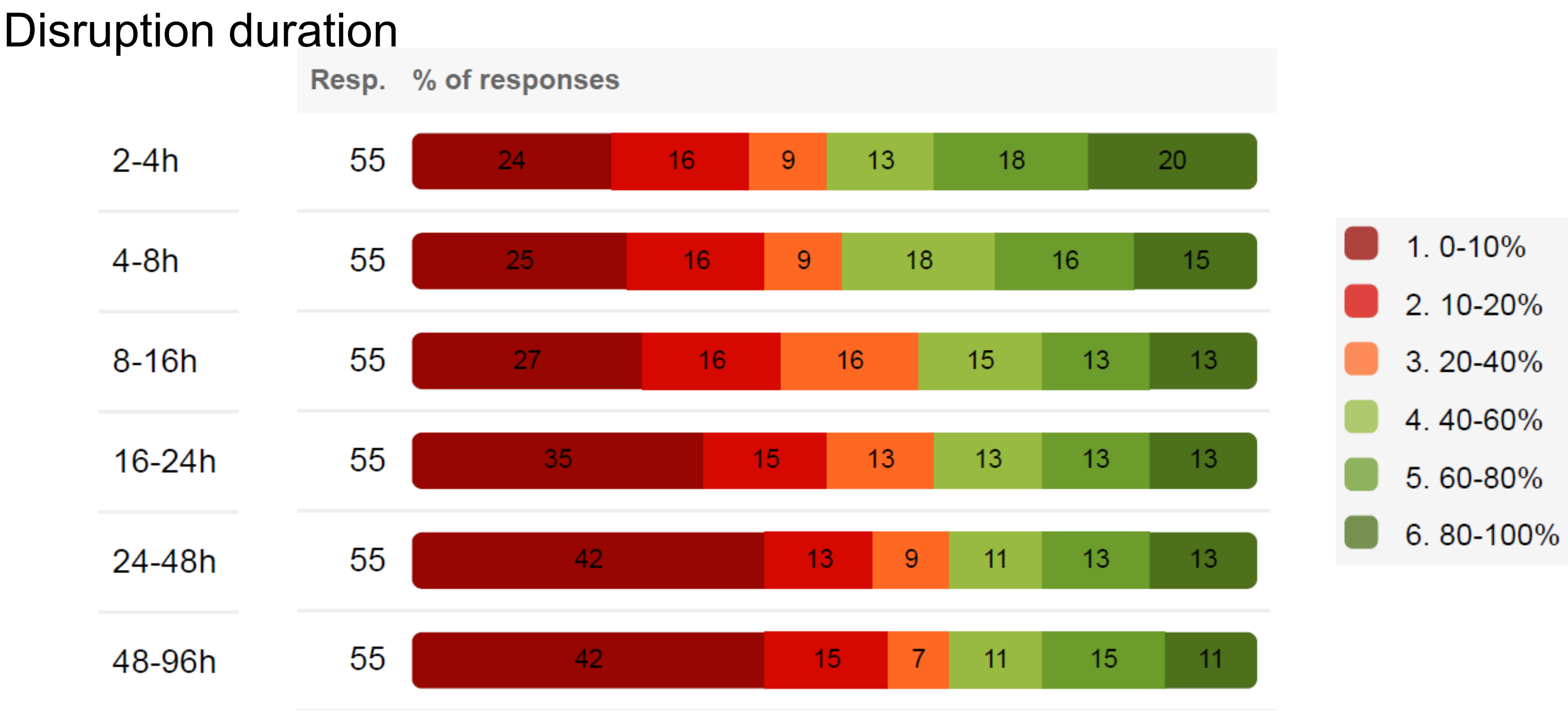
Industrial and power sector - different response when an early warning



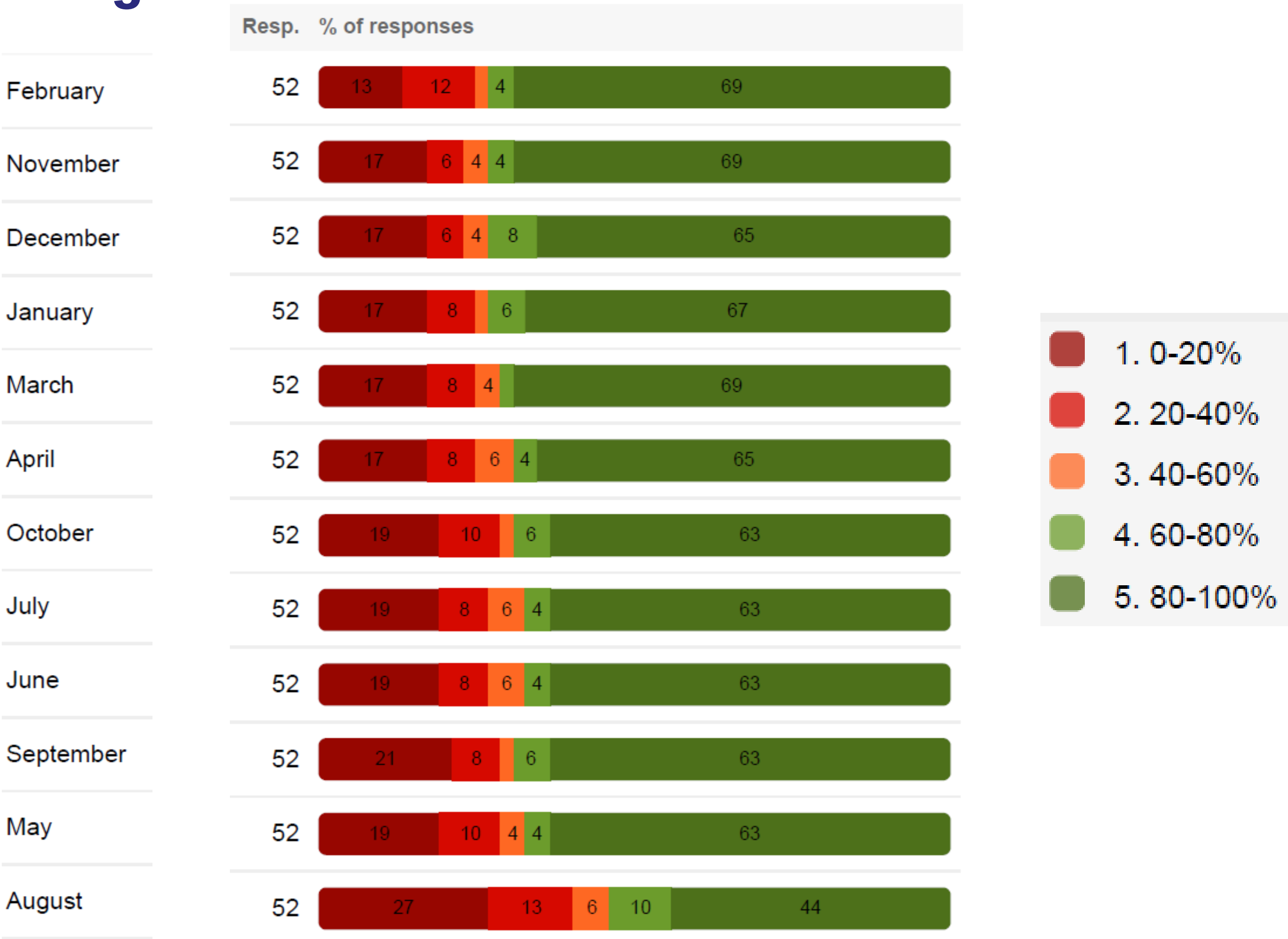
Industrial and power sector - % of the output can be continued in the event of a 70 % curtailment of hourly gas



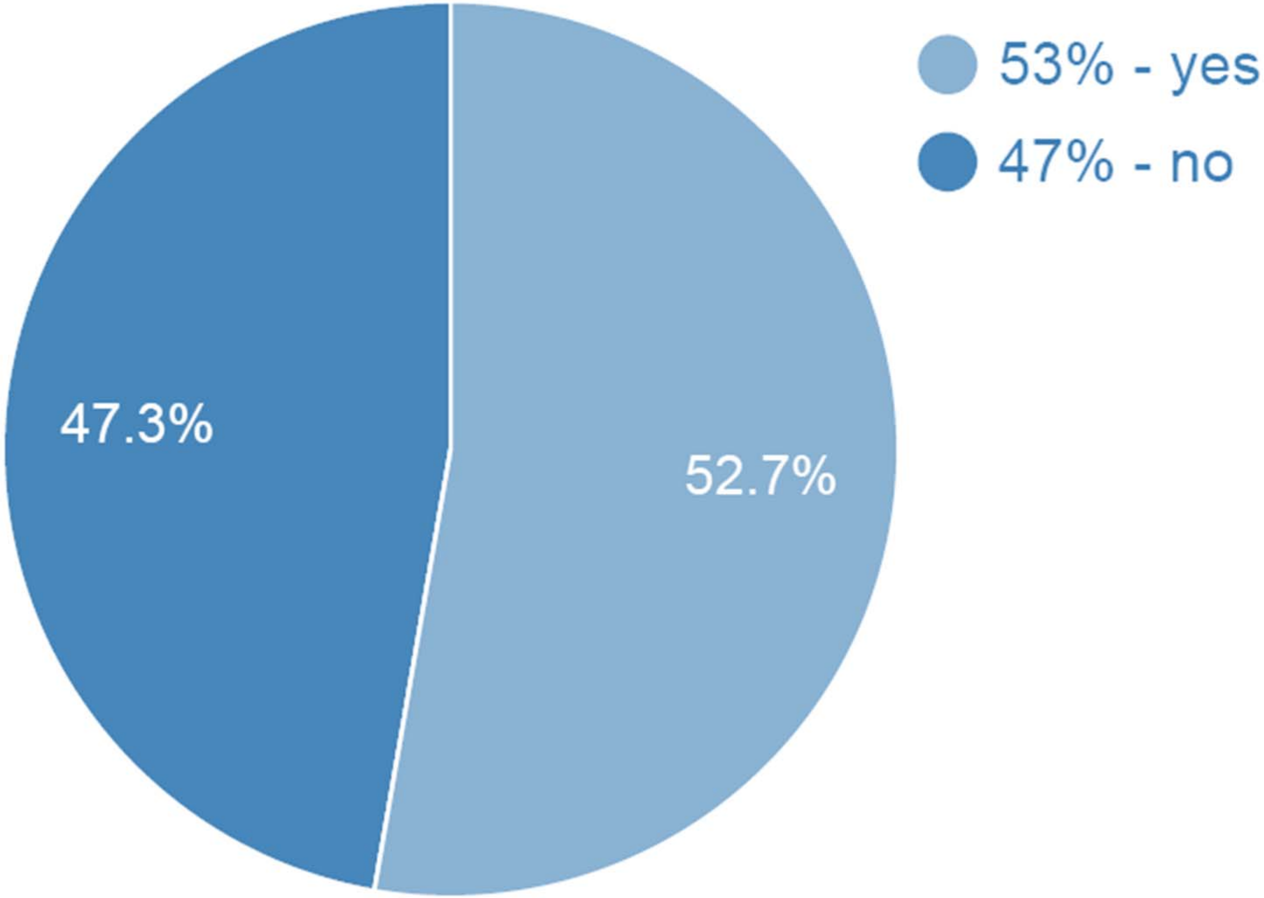
Industrial and power sector - % of the output can be continued in the event of a 30 % curtailment of hourly gas



Industrial and power sector – months are most dependent on natural gas

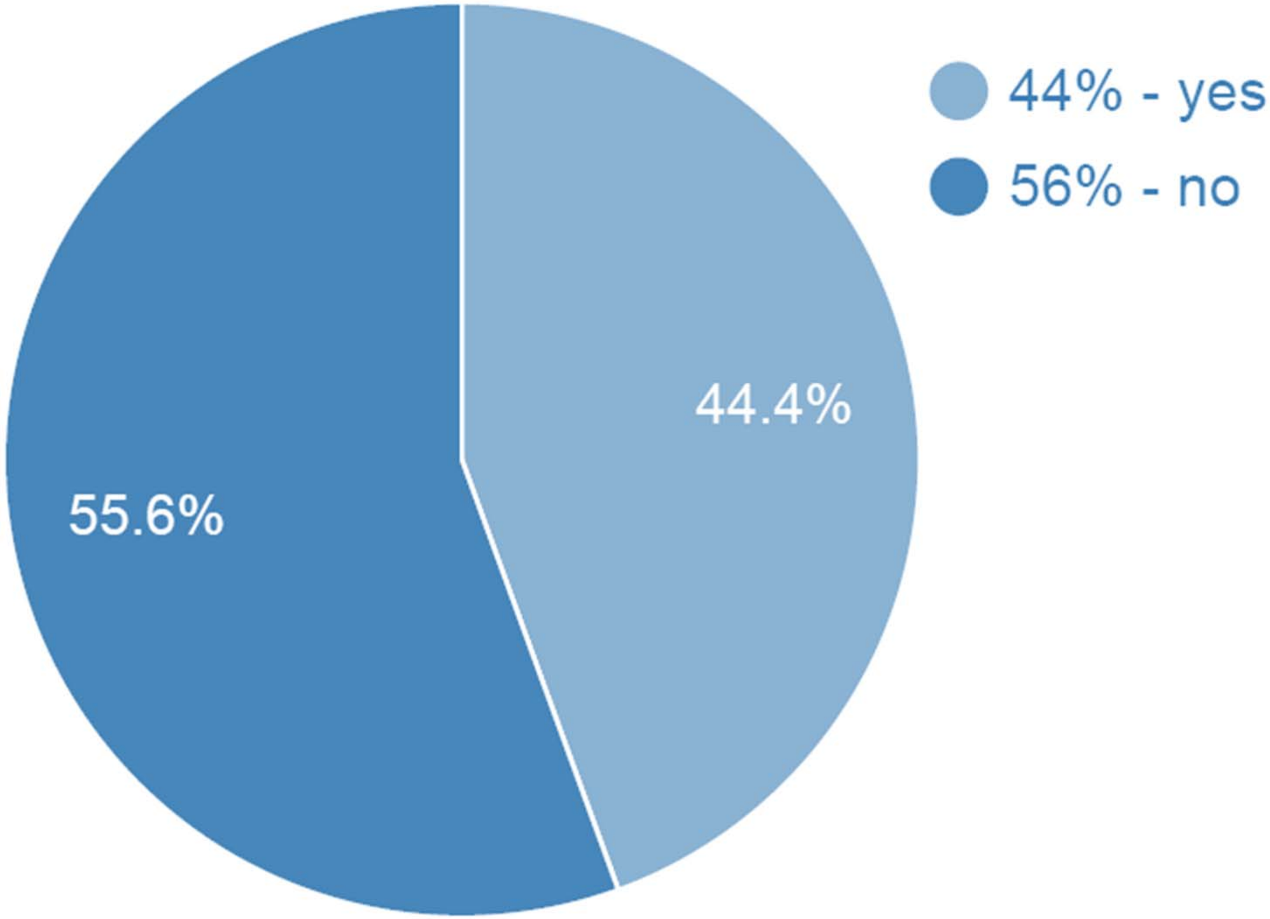


Industrial and power sector - the months which are most dependent in gas is the gas demand independent of time in day



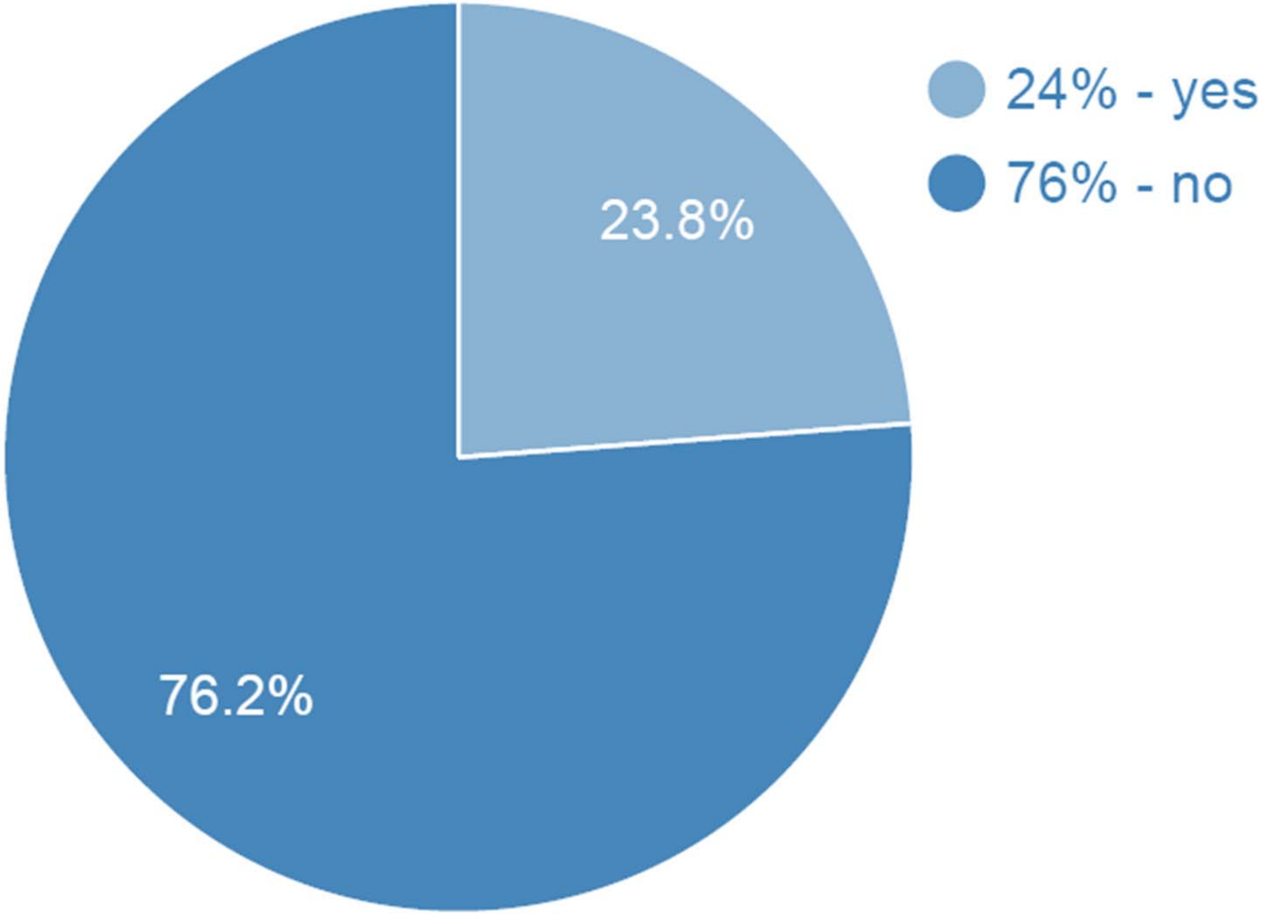
n=55

Industrial and power sector - if there is a voluntary gas demand reduction schedule in their country



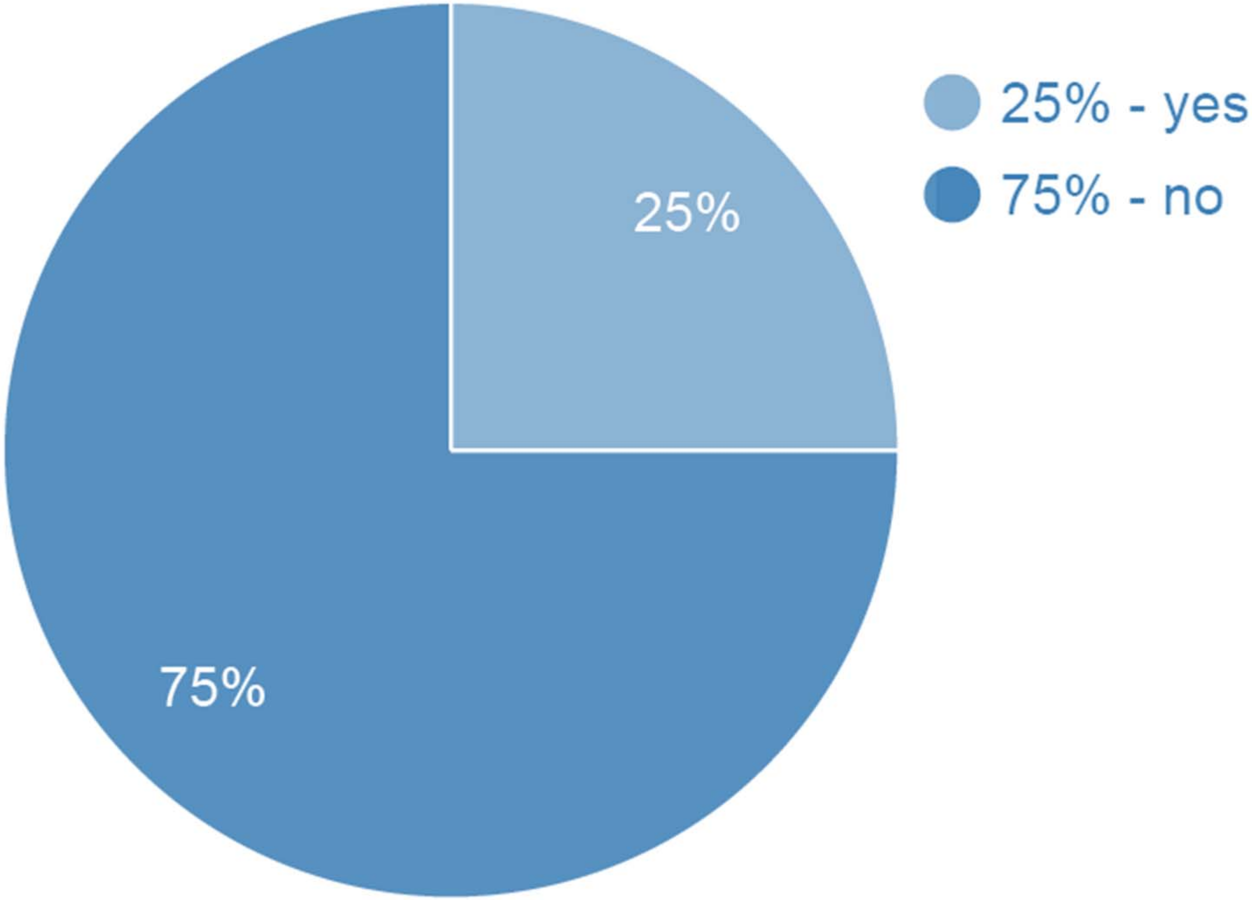
n=45

Industrial and power sector – do facilities have fuel switching capabilities



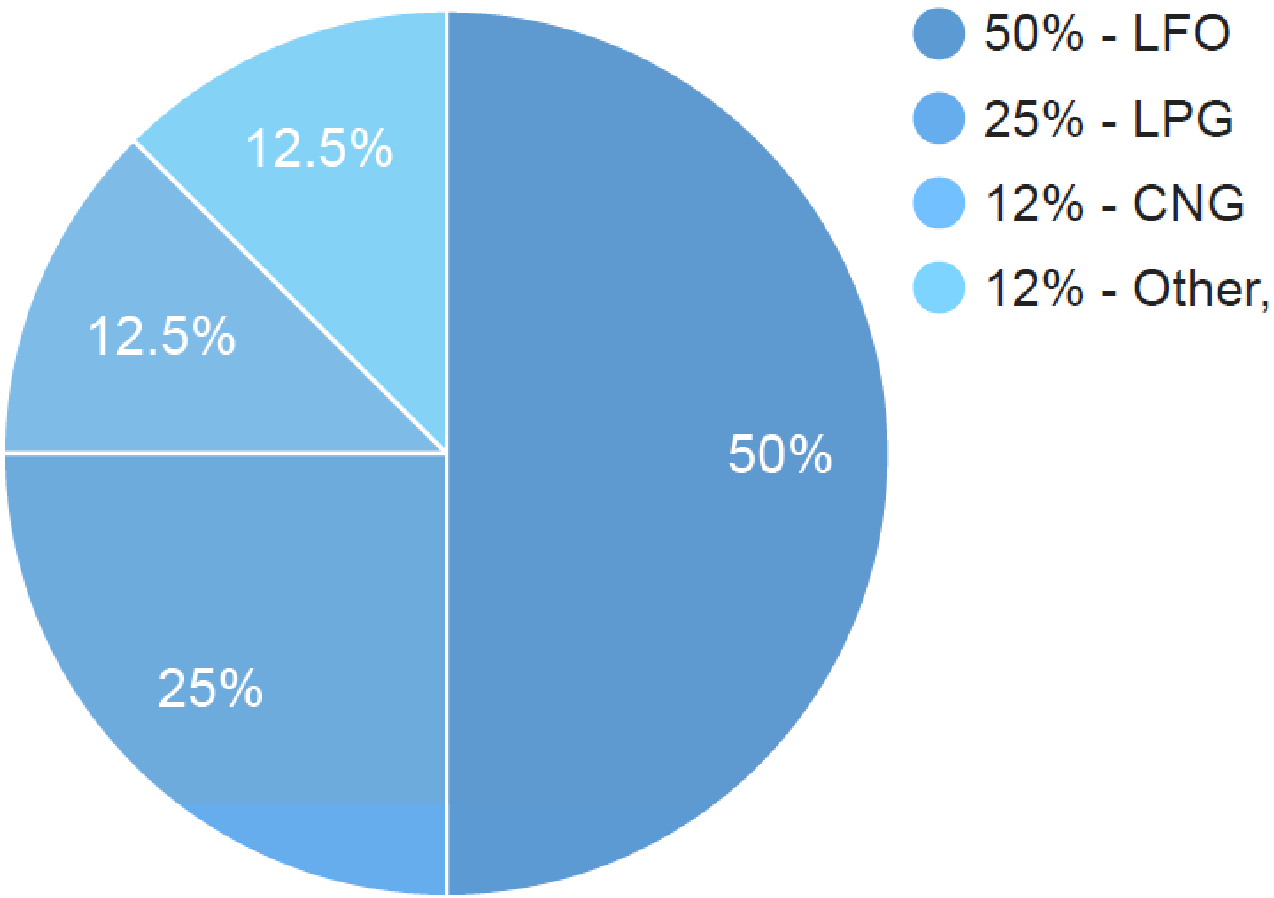
n=42

Industrial and power sector – Was a decision of installing dual fuel capabilities made after a gas supply interruption



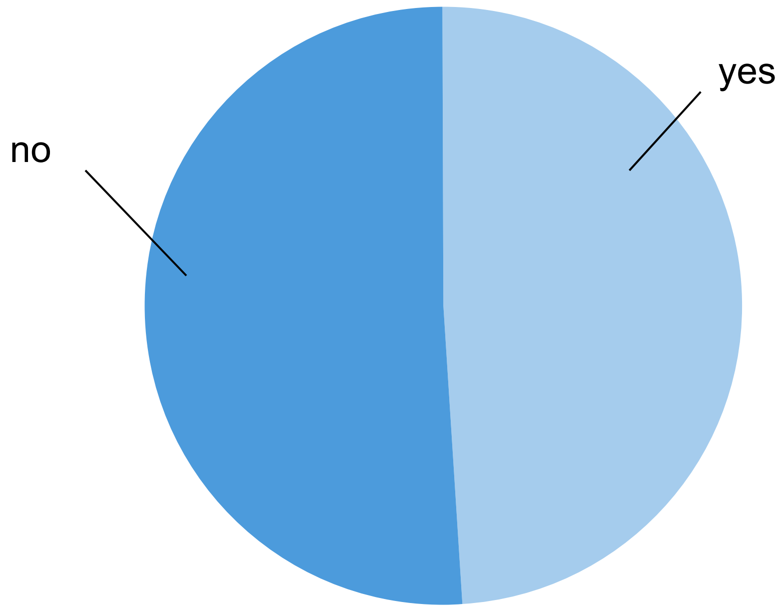
n=8

Industrial and power sector - the type of alternative fuel

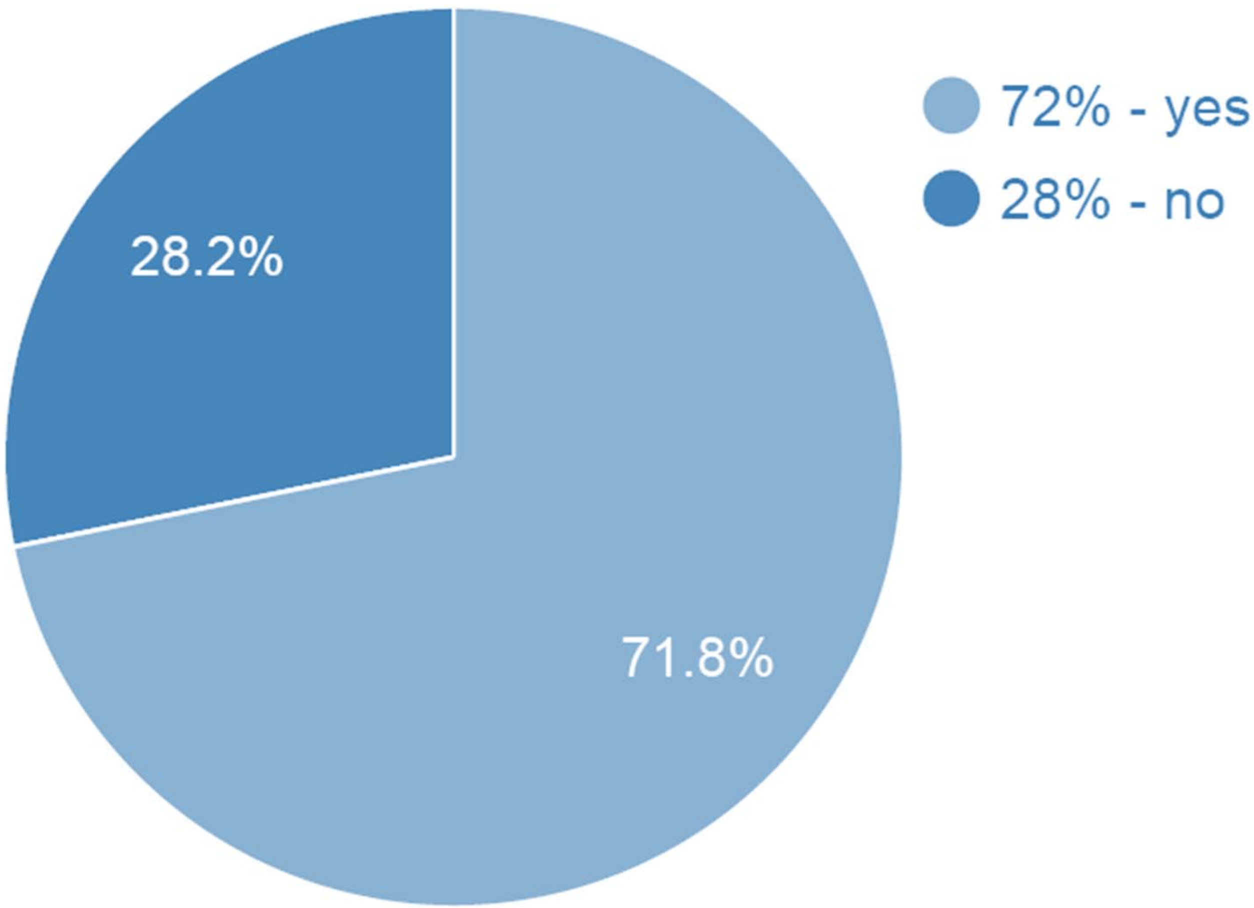


n=8

Industrial and power sector – Is natural gas used as a fuel continuously (e.g. 24 hours per day, 350 days a year with 15 days reserved for planned and unplanned maintenance)?

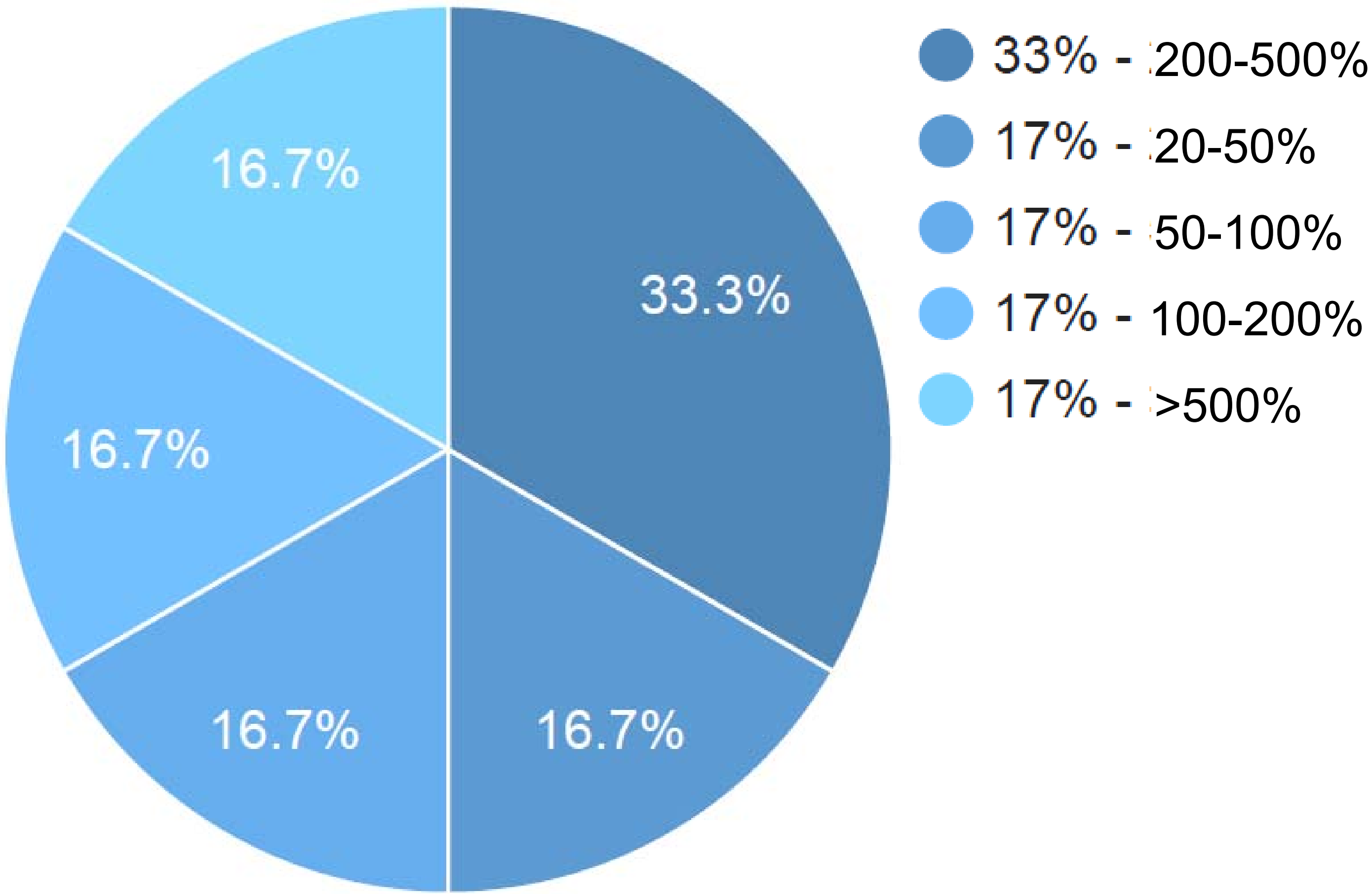


Industrial and power sector - if the participants agree with our methodology



n=39

Industrial and power sector - how much the UCM should be increased?



n=6

CoDG values Member State – Industrial sector
Survey results (3/5)

Reaction to the UCM methodology

Natural Gas as Fuel (Continuous)											
Countries	Respondents	UCM (oil fired boiler) (€/MWh)	UCM (electric boiler) (€/MWh)	realistic values		increasing					
				yes	no	≤20%	20-50%	50-100%	100-200%	200-500%
Czech Republic	2	9	45	2	0	-	-	-	-	-
France	1	18	73	1	0	-	-	-	-	-
Germany	2	16	127	0	2	-	1	1	-	-
Greece	1	14	83	1	0	-	-	-	-	-
Hungary	1	12	66	1	0	-	-	-	-	-
Italy	10	13	125	5	5	1	1	1	1	1
Spain	1	7	81	1	0	-	-	-	-	-

CoDG values Member State – Industrial sector
Survey results (4/5)

Natural Gas as Fuel (Intermittent)										
Countries	Respondents	UCM (oil fired boiler) (€/MWh)	UCM (electric boiler) (€/MWh)	realistic values		increasing				decreasing
				yes	no	≤20%	50-100%	200-500%	>500%	≤20%
Austria	1	8	73	0	1	-	-	1	-	-
Bulgaria	1	15	59	0	1	-	-	1	-	-
Czech Republic	1	10	45	1	0	-	-	-	-	-
Denmark	1	45	65	0	1	-	-	1	-	-
Hungary	1	13	69	0	1	1	-	-	-	-
Italy	11	14	129	6	5	2	1	-	1	1

CoDG values Member State – Industrial sector
Survey results (5/5)

Natural Gas as Feedstock										
Countries	Respondents	UCM (€/MWh)	realistic values		increasing				decreasing
			yes	no	≤20%	20-50%	50-100%	>500%	≤20%
Austria	1	613	0	1	-	-	-	-	1
France	1	698	0	1	-	-	-	-	1
Germany	1	1023	0	1	-	-	-	-	1
Greece	1	498	0	1	-	-	-	1	-
Hungary	2	448	0	2	2	-	-	-	-
Italy	6	861	3	3	1	-	1	-	1
Poland	1	556	0	1	-	-	-	-	1
Romania	1	527	0	1	-	1	-	-	-
Spain	1	751	0	1	-	-	-	-	1

Instead of a conclusion

- The study is still ongoing
- We need as many responses as possible both to quantity the CoDG but also to understand specificities and concerns of the various sectors
- We are happy to arrange for an interview at any time of your convenience to further discuss your concerns … starting from now.

Questions ???