Real Time Settlement Methodology (RTSM) Programme – Session 3

Stakeholder Engagement Forum

28th October 2025

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Welcome and Introductions

SGN

Meet the Team

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Expectations for the Sessions

1. RTSM awareness
2. Interactive deep-dives
3. Your insights matter
4. Learn and refine together

Q&A

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RTSM Phase 1

Session 2

WP2

Modelling Solutions

Session 3

WP4

Roadmap for a Demonstration (Pilot)

WP1

Market Research

Session 1

WP3

Feasibility Study and Roadmap for Implementation

Session 3

WP5

Dissemination and Engagement

SGN

Agenda – Session 3

Time	Topic	Lead
14:00 – 14:05	Welcome and Opening Remarks	SGN
14:05 – 14:10	Actions from Previous Meeting	SGN
14:10 – 14:20	Recap of Session 2	Correla
14:20 – 15:00	Work Package 3 (Part 1)	BIP
15:00 – 15:10	Check Point and Break	All
15:10 - 15:40	Work Package 3 (Part 2)	BIP
15:40 – 16:00	Q&A	All

Actions from Previous Meeting

ACTION:

- Publish meeting materials from the previous meeting.

UPDATE:

- The slides were published on the SGN RTSM website.
- Meeting notes & actions issued on 30th September 2025.

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Work Package 2 Recap - Modelling Solutions

Work Pack 2 Aim

- Development of a fit-for-purpose modelling solution(s) that addresses the requirement for application according to the input of the Central Data Service Provider (CDSP) while enabling flexibility for confluence migration between them.

- An overview of the Basis of Design that describes:
    - Current market structures and required amendments in the market structures and connection frameworks.
    - Basic architecture of proposed new systems considering key essential requirements such as the interlink between solutions for a fluid and uncomplicated process for transition.
    - Potential changes in the Uniform Network Code (UNC)and key gas industry regulations.

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How the Central Data Service Provider (CDSP) uses FWACV

- Flow Weighted Average CV (FWACV) values for Local Distribution Zones (LDZs) are calculated by the CDSP, used in CDSP settlement processes and sent to Gas Shippers for calculation of end consumer billing.

- FWACV is a method used to calculate the average calorific value of gas supplied to a charging area. This calculation is weighted by the proportion of the total daily gas flow represented by each individual gas source.

- The CDSP uses the daily LDZ FWACV of gas to ensure accurate billing and energy content measurement for gas transported through the gas network. The CV is used for:
  - Energy Calculation: The FWACV is used to calculate the energy content of the gas for billing to Shippers.
  - Data Reporting: The CDSP collects and reports CV data to various stakeholders, including gas shippers. This data is essential for consumer billing, transparency and regulatory compliance.

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Systems Managed by CDSP Using CV/FWACV - Heat Map

Impact assessment of a modelled CV solution based on the likely level of changes required to systems, data flows plus potential larger volume of data within files & processing required for RTSM.

Low | Medium | High

CMS - Contact Management Service

Raise queries & submit meter point updates

UKLink Portal

Ability for stakeholders to submit data to UKLink

Gemini

Calculate Consumption & energy – Telemetered meter points
Calculate Balancing charges
Calculate daily allocations (Non-Daily Metered)
Calculate Unidentified Gas (UIG)
Validation of energy using the volume and the CV
Publish & submit (via UKLink) CVs & FWACVs

Gas Enquiry Service

Publish meter point, LDZ & read data

Reporting Systems

Display data (Data Discovery Platform) Reporting

UK Link

Record CVs
Calculate & record FWACV
Provide CV values to Gemini & Shippers
Calculate Consumption and Energy - LDZ meter points
Calculate & issue Transportation charges
Calculate & issue Reconciliation charges

Data Flows

Notification of CVs to stakeholders
Receipt of CV data from DNs
Transportation invoices

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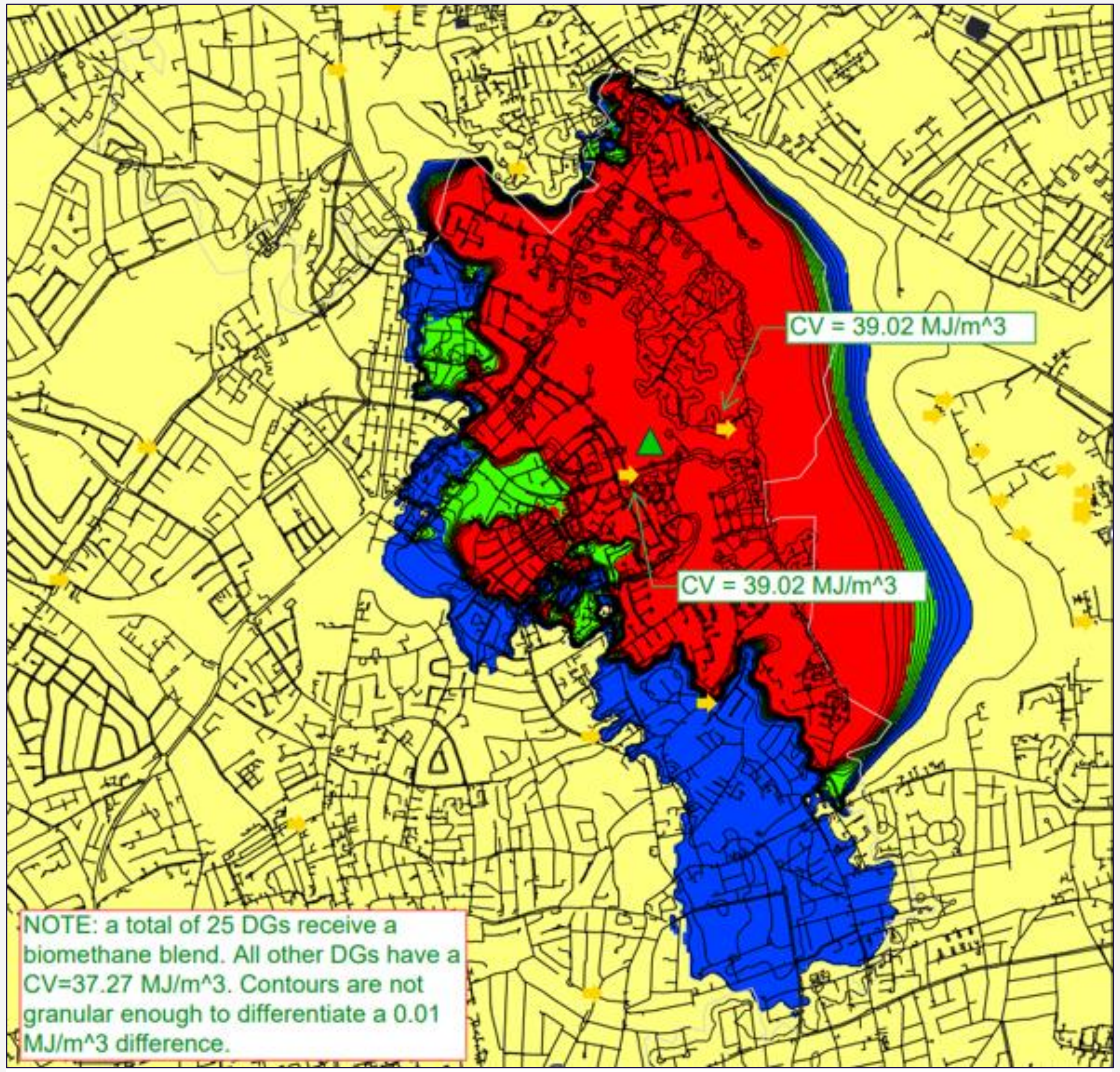
Modelling Analysis - Nodes

- 'Nodes' could be used for assigning a calculated Calorific Value to a particular group of meter points.
- These will largely be determined by the nature of the Gas Distribution network and the location of Meter Points.
- The map on the right shows a snapshot of Calorific Values near a Biomethane plant.
- During the day these contours will change shape as different consumption profiles use more or less of the biomethane (e.g. residential or business areas).
- To ensure energy measurement is accurate and fair, the nodes used in the RTSM system should reflect the actual Calorific Value of the gas consumed during the whole gas day.



The mean average calorific value (CV) of biomethane injected into the IPMP system by the Mitcham Biomthane plant for the month of January 2025 is 39.02 MJ/m^3.

A biomethane and natural gas blend of the noted CV enters the LP system at the indicated District Governors (DGs).

The yellow areas on the map indicate pure natural gas with no biomethane blending, with a CV of 37.26

Legend

Contours

Result Higher Heating Value (MJ/m^3)

- <= 37.26
- 37.70
- 38.14
- 38.58
- >= 39.02

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RTSM Solution Architecture Considerations

- Phased or 'Big Bang' Approach – Meters in range of Biomethane/H_2 plants/all meters
- Granularity of the CV measurement – balancing accuracy with costs/data limitation

- Large and atypical Gas Consumers (Non-Daily Metered sites with non-standard consumption)
- Pipework closures, Interruptions and Leakages

- Compliance – GDPR, Natural Gas Quality Designation ISO, Natural Gas Energy Determination ISO Etc.
- Implementation - User Interface, Training, system usability
- Updating Smart Meter and Prepayment Meter CV information

- Testing and validation, Solution Accuracy – Use of CV monitoring Equipment
- SCADA (Supervisory Control And Data Acquisition) -control and data collection from sensors and devices available within the Gas Distribution Networks' distribution network

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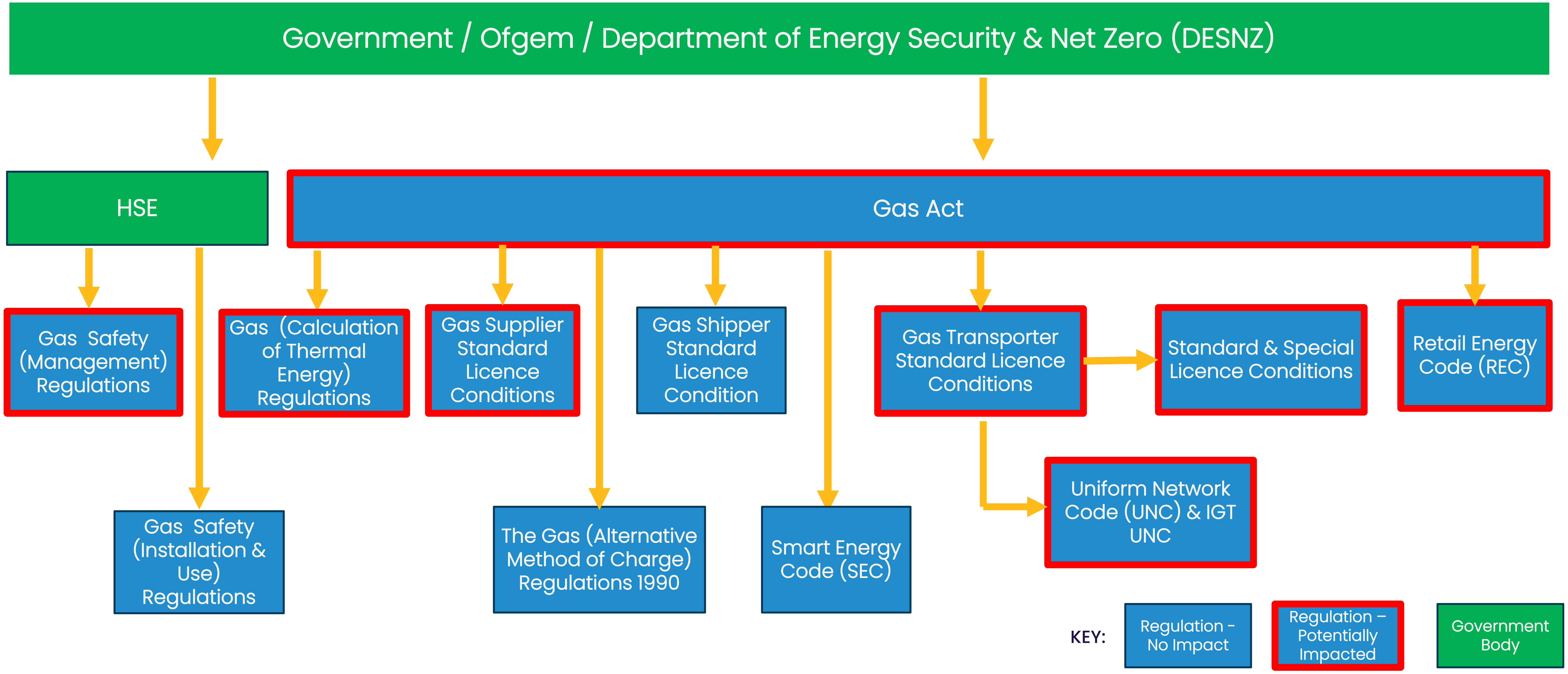
Licence & Contractual Obligation Assessment



Summary of Findings from Work Package 2

An LDZ CV (FWACV) would not work where un-propanated biomethane or blended hydrogen are injected therefore **a lower granularity of CV would be required**.

There is an option to continue with FWACV in part of an LDZ where lower-CV gases do not reach but **as more green gases are injected**, FWACV would need to be **replaced with the Modelling Solution.**

Modelling analysis showed **that more meter points would be affected by green gases on a low demand** day compared to a high demand day

Meter points that could potentially receive the green gas would need to be **mapped to a 'Node'**.

CDSP systems would need to change, particularly UKLink, and updates may be required to Shipper & Supplier systems.

File format changes will be required to accommodate mapping MPRNs to 'Nodes'.

Some **regulations would need to be amended** & changes may be required to UNC.

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Work Package 3 - Feasibility Study and Roadmap

WP3 Objective and activities

1

IDENTIFICATION OF A FEASIBLE SOLUTION

- Definition of the optimal time resolution of the model
- Suggestion of the best approach to node granularity
- Analysis of FWACV regime accuracy
- Assessment of the regulatory impact
- Analysis of the most suitable architecture configuration
- Detailed analysis of a shortlist of software providers

2

RTSM ROADMAP

- Identification of the key project phases
- Identification of the main activities required for the RTSM implementation
- Identification of the RTSM timeline
- Assessment of risks and mitigation strategies

3

RTSM COST ASSSESSMENT

- Identification of the main cost items
- Cost estimation for pilot roll-out
- CapEx and OpEx estimation for the implementation of the RTSM solution

1. Identification of a feasible solution

High level solution overview

Input integration

The model should be integrated with existing software which will provide input data required to perform the simulation

SCADA & Telemetry
- Pressure
- Volumetric flow
- Gas CV

GIS
- Network topology
- Asset location
- Pipe diameter

Gas demand
- Measured volume for daily metered
- Hourly gas demand estimation for NDM customers

CV simulation software

The new software should be able to estimate the calorific value of the gas mixture for each exit point on each distribution network

Software key parameters
- *Time resolution*
- *Node granularity and network segmentation*
- *Accuracy*
- *User*

Settlement & Billing Integration

The output of the model (CVs) should be integrated with the existing billing and settlement processes to account for the energy balance

Settlement
CVs must be provided daily for each charging areas

Billing
Each meter is assigned to a charging area with a specific daily CV

Key requirements

Topology data	The model requires reliable GIS data to replicate the network topology
SCADA & Telemetry data	The model should integrate data from SCADA and Telemetry with the time resolution available
Transparency	As the purpose of the model is settlement and billing, transparency of the result is a key aspects
Accuracy test	The adoption of CV modelling implies the use of a simulated CV instead of a measured CV; accuracy level is therefore a critical factor
Scalability	The model should be able to adapt to network changes (new injection point, new infrastructures, demand variation, etc.)
Billing & Settlement integration	Ultimately, the model should be integrated with the billing and settlement processes

Solution design – key themes

Time resolution
What is the suggested time resolution of the model?

Node granularity
What is the level of detail of network segmentation?

Accuracy
What is the target accuracy of the model?

Architecture & Process
Who will be responsible for CV simulation?

Regulation
What is the impact of CV modelling on regulations?

Vendors engagement
Key insights from software providers

Data availability

The current FWACV regime is based on daily values of gas injected and related CV to compute a daily average CV, which is then used for billing and settlement.

The current regime does not take into account hourly variation in gas injection and consumption patterns.

Data required	1. Measured calorific value and gas composition at injection points	2. Measured network parameters on pressure, volumetric flow	3. Volume consumption at calculation points
Source	SCADA/Telemetry/Shippers	SCADA/GNs	SCADA/Telemetry/ Suppliers
Time resolution	Real-time data collection	Not all data is collected in real-time	DM – Daily/Hourly NDM - Variable
Consideration	Shippers or gas producers communicate volume and CV of gas to be injected (in the future, energy will be required)	Data from SCADA refers mainly to pressure reduction points	It is possible to use the estimated daily demand from CDSP

Suggested time resolution

As SCADA data is collected “almost” real time in the historian, **the model should be able to access real time data** to capture all network variations that could impact the CV; the identification of the most suitable time resolution will be **defined during the implementation based on accuracy**; **the suggested resolution of the output of the simulation is hourly CV value**

The model should be able to access real time data from SCADA

The selection of the best time resolution will be performed with the software provider, based on impact on accuracy, while the **run can be performed at the end of the gas day** or at gas day+n based on data availability

Hourly CV values will be used for billing and settlement

If a lower time resolution is used, CV values will be aggregated into hourly values through a weighted average calculation performed through the software. A lower time resolution will not add significant value

Daily CV can be computed from hourly CVs

Hourly CVs and consumption profiles allow to compute a daily CV for each area, so that it is not required to change the current time resolution used for billing and settlement

Hourly simulated CVs will be used to compute daily CVs which will be shared with Shippers and Suppliers for billing and settlement as of today; are you comfortable with the proposed approach?

a) Yes, the use of daily CVs reduces changes to current processes

b) No, access to hourly CVs would also be helpful to Shippers and Suppliers

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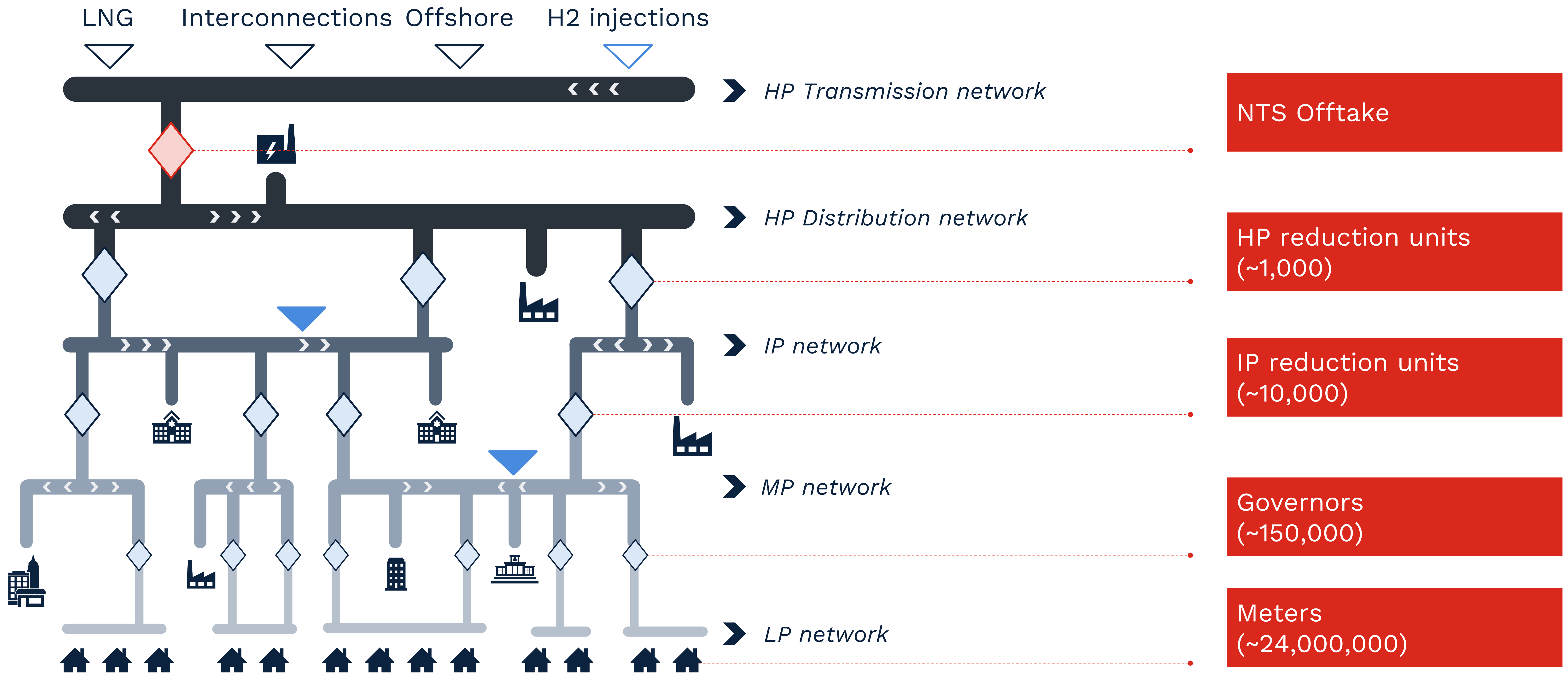
Node granularity - Network segmentation

Currently, the network is divided into **13 LDZ's, which are the level at which the FWACV is computed** for billing and settlement

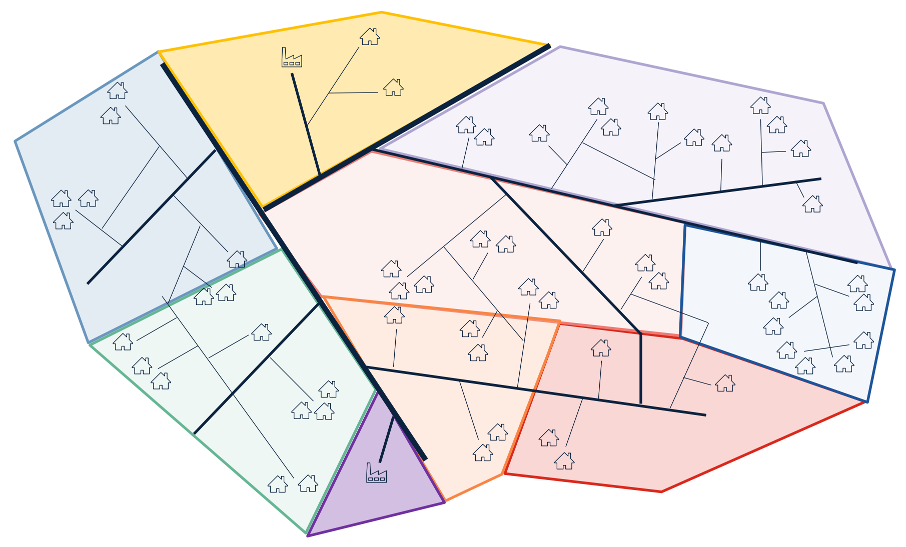
The injection of biomethane and hydrogen in local networks and the adoption of a CV modelling tool will require segmentation of the network beyond the current 13 LDZs; physically, **the network can be further segmented based on the nodes identified at pressure reduction stations located along the network.**



Node granularity – Possible approach (1)

Node granularity refers to determining at which points of the network CV is computed. Two possible approaches can be identified: (1) CV computation at strategic locations or (2) at single meter point with meter aggregation.

1 The CV is computed at **strategic nodes and assigned** to delivery points



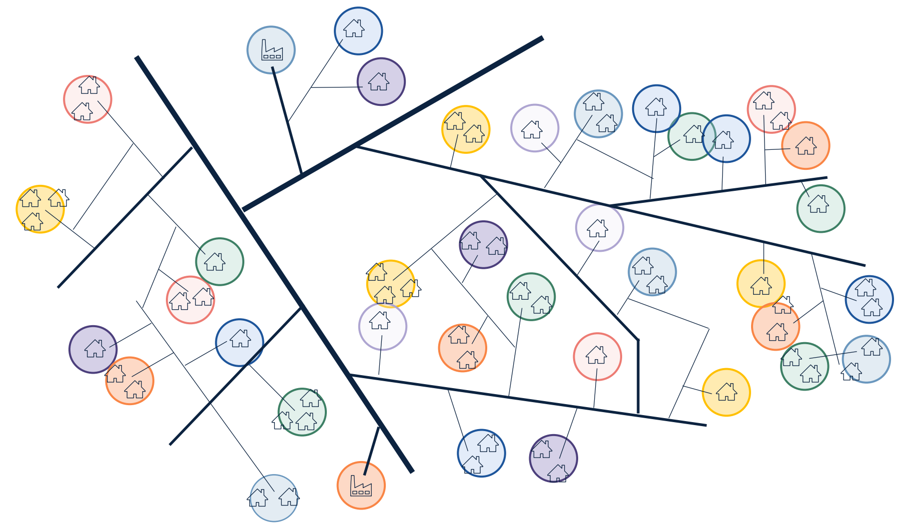
PROs

- Lower number of calculation points; **easier to manage**
- **Lower data volume**, hence lower cloud and integration costs
- **Computational requirements not elevated**

CONs

- The aggregation of nodes and computation of average values **may lead to lower accuracy**
- **Upfront analysis** to correctly define network segmentation

2 The CV is computed at **each delivery point**



PROs

- CVs directly computed for each meter; **no aggregation could result in higher accuracy**
- **No additional analysis** for network segmentation

CONs

- **High volume of data** (20M meters) may lead to higher cloud and integration costs and lower manageability
- **Feasibility for non-AI** powered tools should be further evaluated

Node granularity – Possible approach (2)

Node granularity refers to determining at which points of the network CV is computed. Two possible approaches can be identified: (1) CV computation at strategic locations or (2) at single meter point with meter aggregation.

KEY VARIABLES TO CONSIDER

› **COMPUTATIONAL REQUIREMENTS**

The more the nodes the higher the capacity required; however, software capacity allows 100,000 calculation points

› **DATA MANAGEMENT COMPLEXITY**

CDSP, GNOs and suppliers to report any constraints of moving from 13 CVs to a greater number

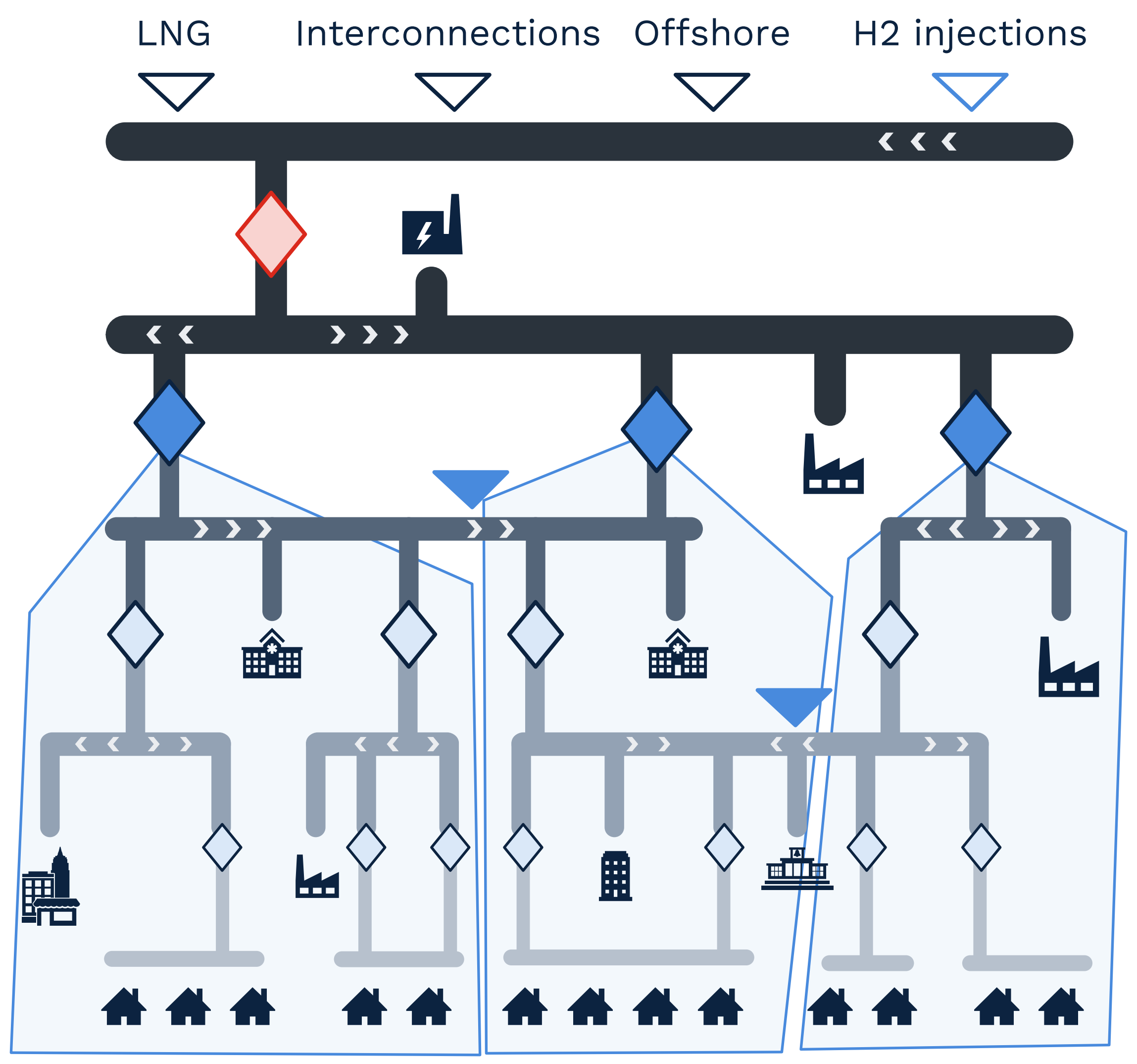
› **ACCURACY**

Greater segmentation results in higher accuracy; to assess the impact on accuracy an online model should be developed and tested

Node granularity – Possible approach (3)

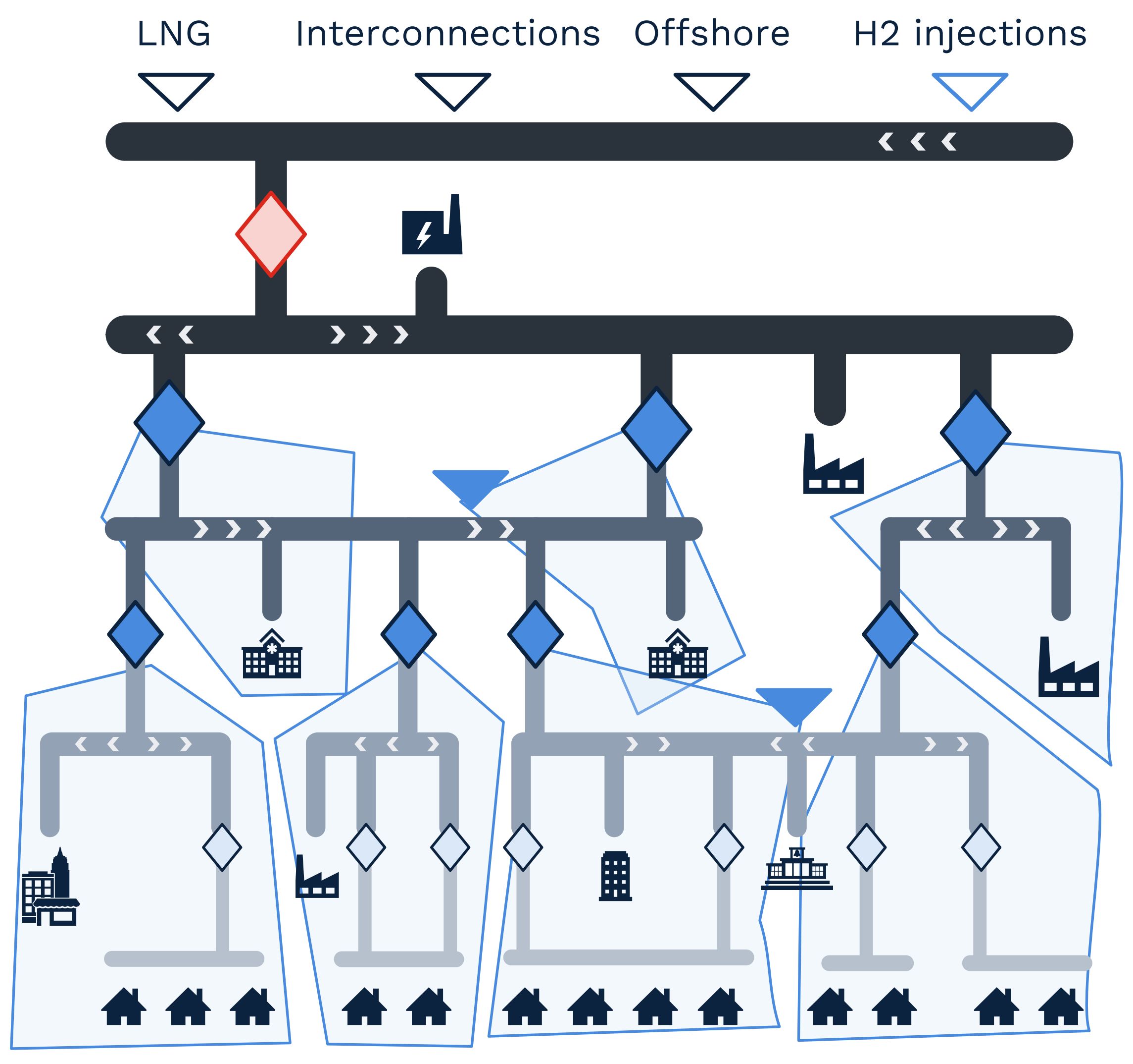
Nodes can be defined based on network topology and as a first approach each single pressure reduction station could be considered a node; the objective is to determine at which level of granularity the network should be segmented and identify a charging area (a group of meters which will be assigned the same CV) for each node

Option A)
CV simulation at PRS level



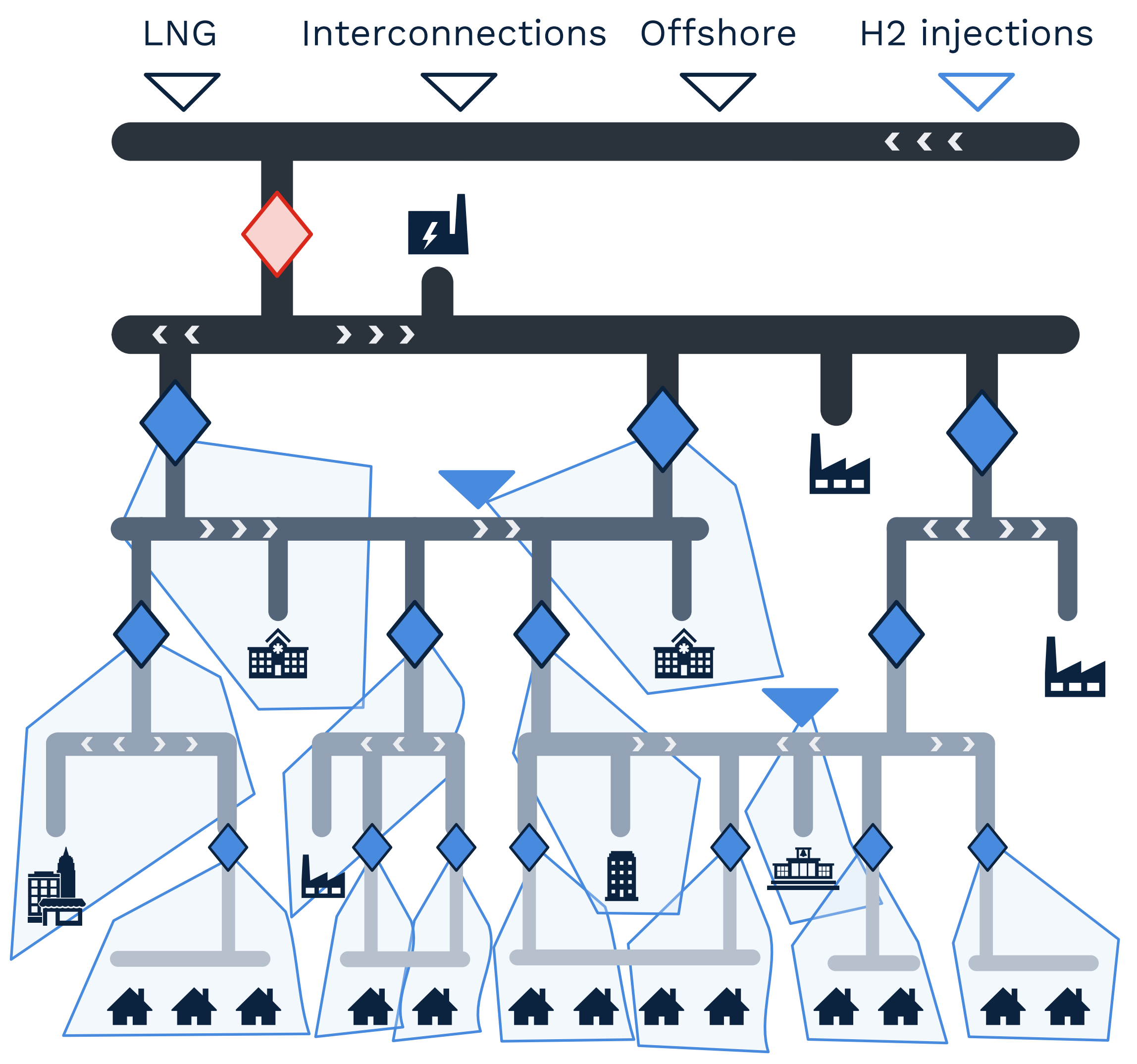
The simulation of CV at PRS could result in the **aggregation of areas which are affected differently by low CV gases**, as injection at IP and MP are not correctly modelled, ultimately reducing accuracy.

Option B)
CV simulation at IP-MP reduction stations



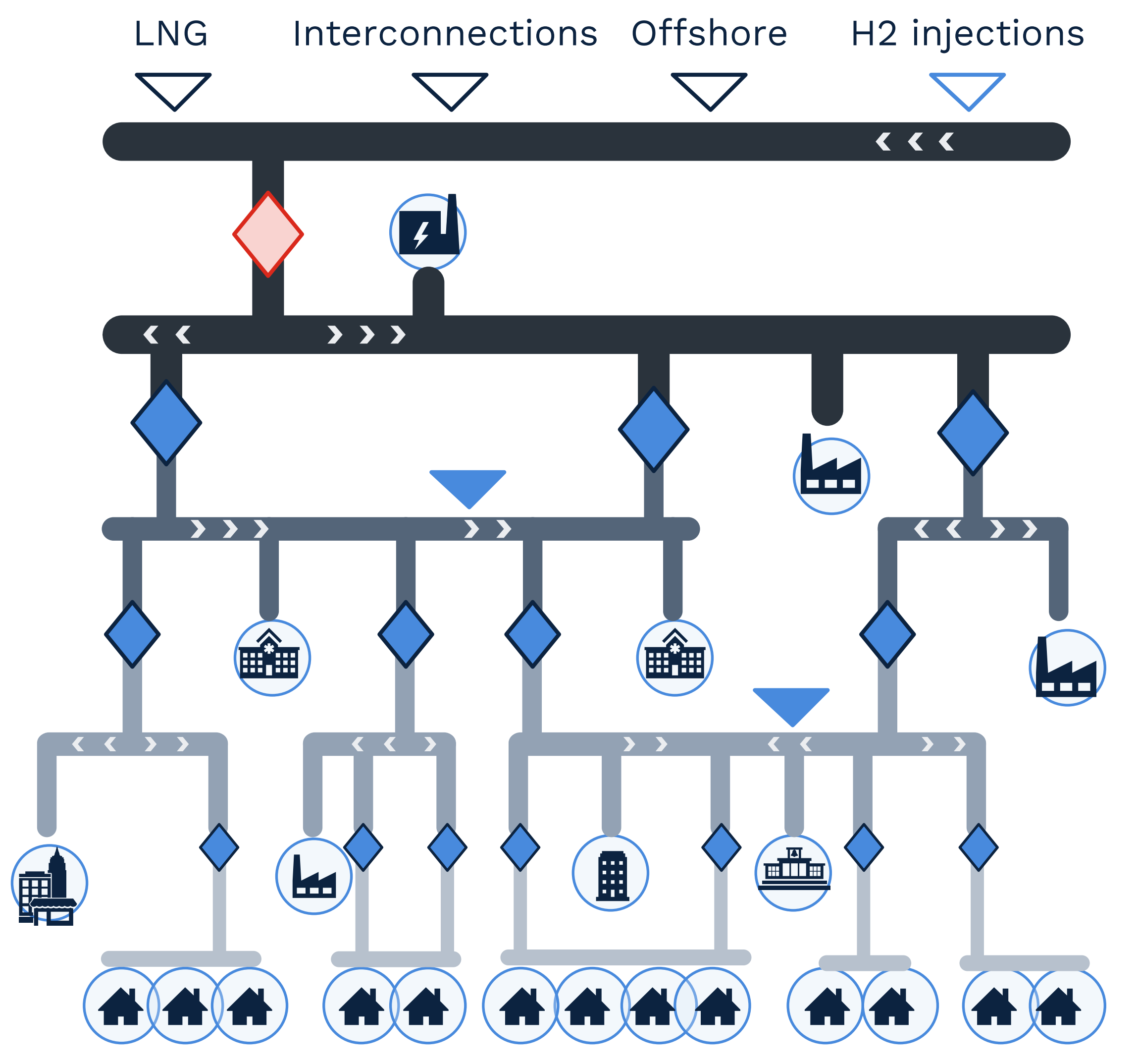
Simulating CV at intermediate pressure reduction units **would allow higher accuracy**, but injections at medium pressure would **not be correctly modelled**.

Option C)
CV simulation at governors' level



As it is highly unlikely that there will be hydrogen or biomethane injection in low pressure networks, this could represent **the best compromise that allows to capture gas CV variation**.

Option D)
CV simulation at meters' level

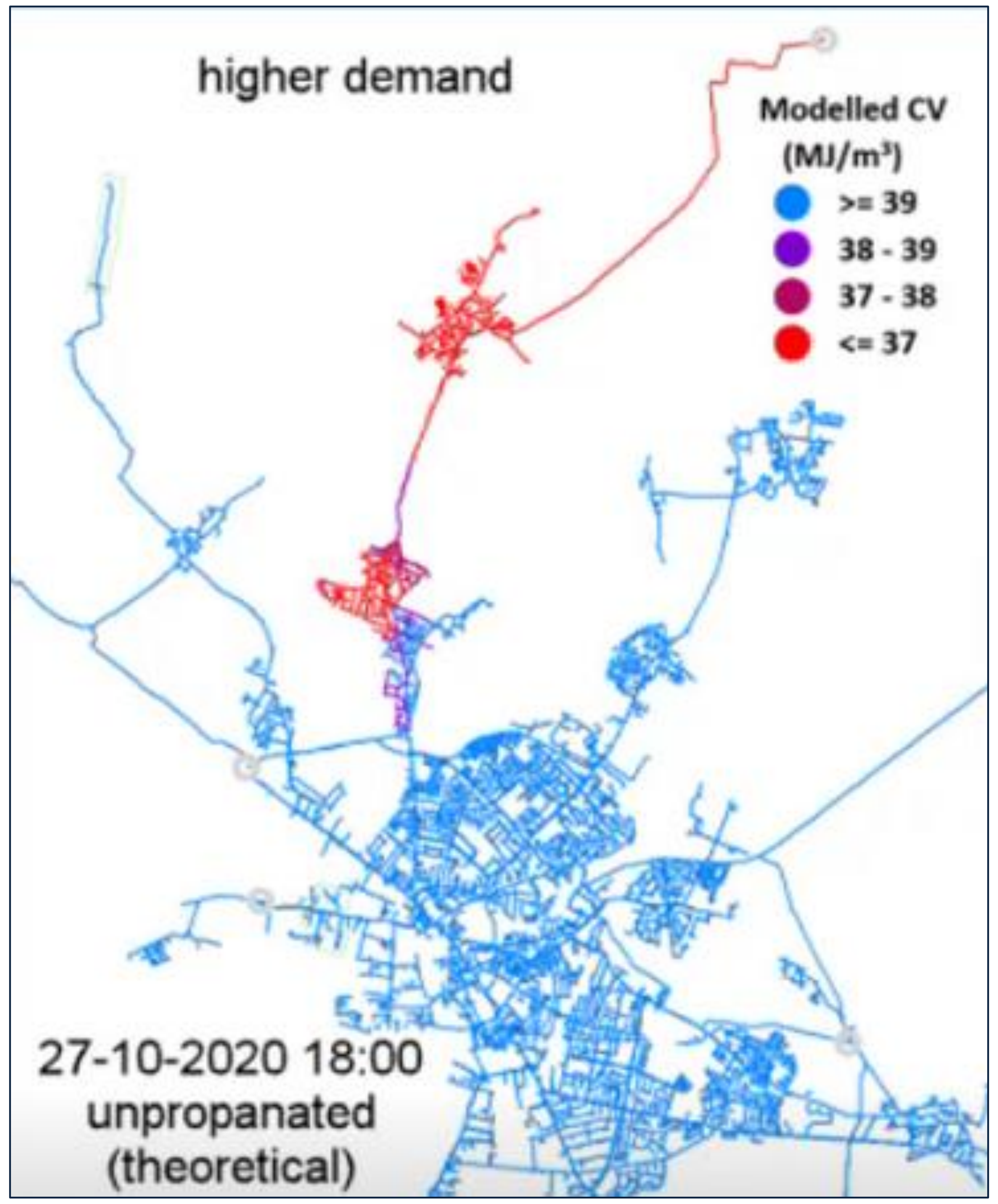


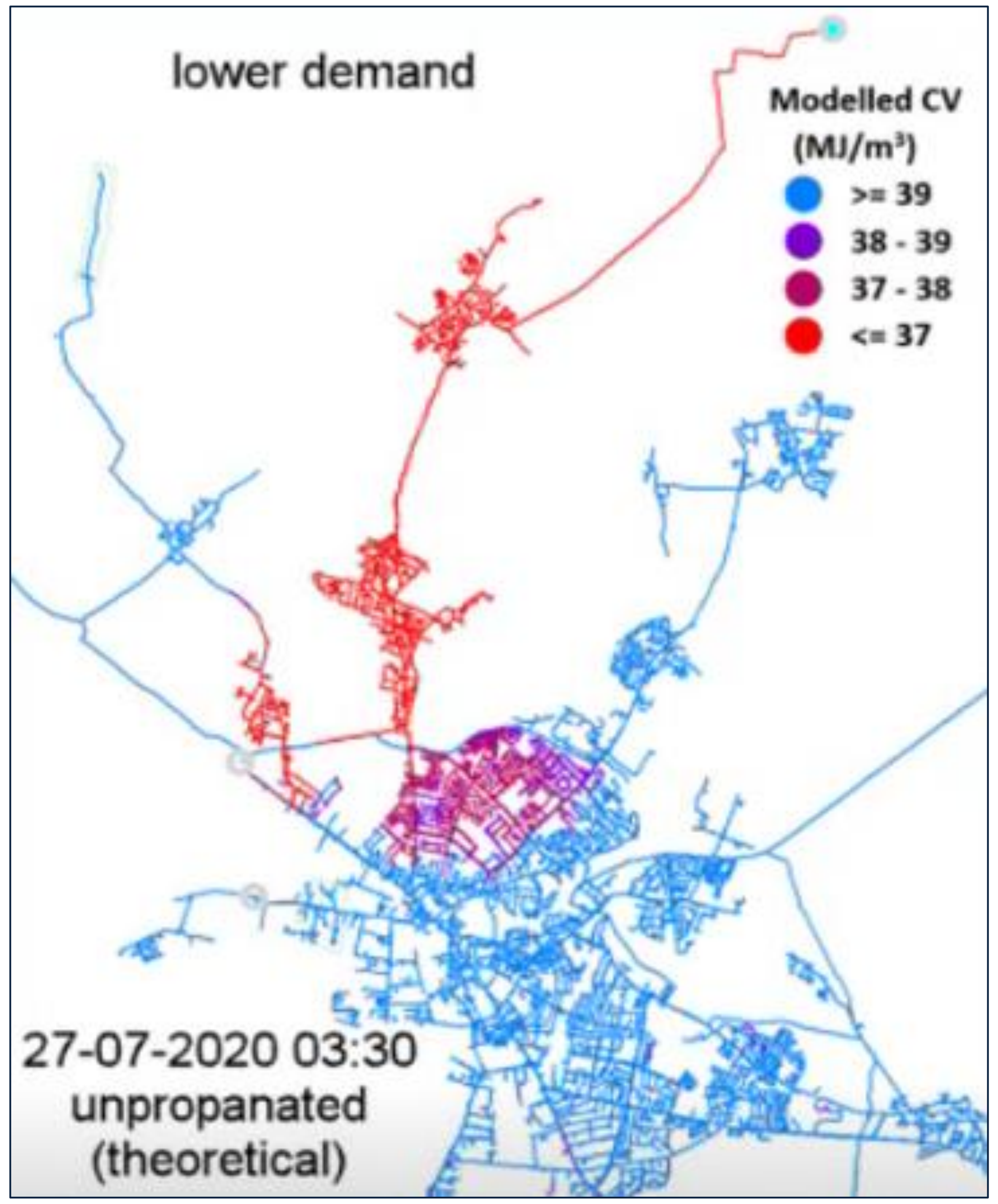
The computation of CV at meter level would allow to **avoid aggregation, which would increase accuracy.**

Node granularity - Intraday and seasonal variations

In case of biomethane and hydrogen injection in the distribution network, particularly in medium pressure, the demand variation highly impacts gas diffusion. If CV will be computed at **meter level, intraday and seasonal variations are not an issue**, as they will automatically be captured by the model itself while if you move to **node concept either you adjust the border of the zones or accept an error**

Intraday variation *of biomethane diffusion based on hourly consumption*





The analysis on this specific subnetwork suggested that the best approach would be the **identification of at least three areas** within it. If the biomethane plant was not present, **the area would be modelled as a single node**

Seasonal variation

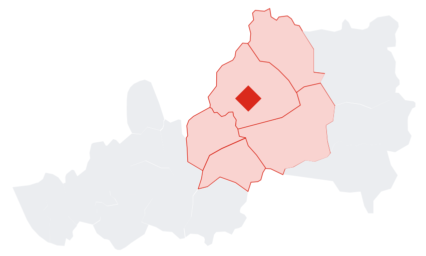
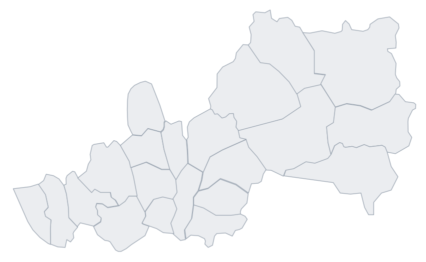
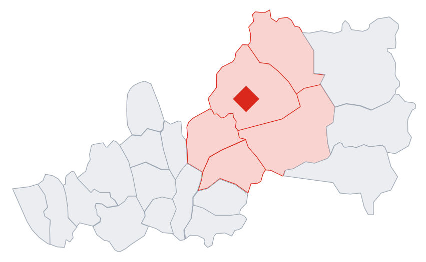
Similar to daily variations, during summer periods the gas demand is lower, hence hydrogen and biomethane diffusion may affect a larger number of customers, with respect to winter season. This variation can be handled with two approaches:

Strategies	**Nodes adjustment**	**Higher granularity** (Suggested approach)
Description	The network segmentation **is adjusted twice a year** to reflect the variations in CV	The network **segmentation is defined based on the worst case (summer**) and kept fixed; during winter period multiple areas could have a very similar CV
Pros	The charging areas match the effective zone of influence of low CV gas	Easier management as there is no need to modify the charging areas during the year
Cons	The adjustment of nodes every 6 months based on seasonality will increase complexity in the management of the solution	Keeping the areas fixed may results in lower accuracy, as the areas could not exactly match the low CV gas diffusion

The analysis on the intraday variation modelling has been recovered from the "Future Billing Methodology" project, delivered by DNV

Node granularity - Node design strategy

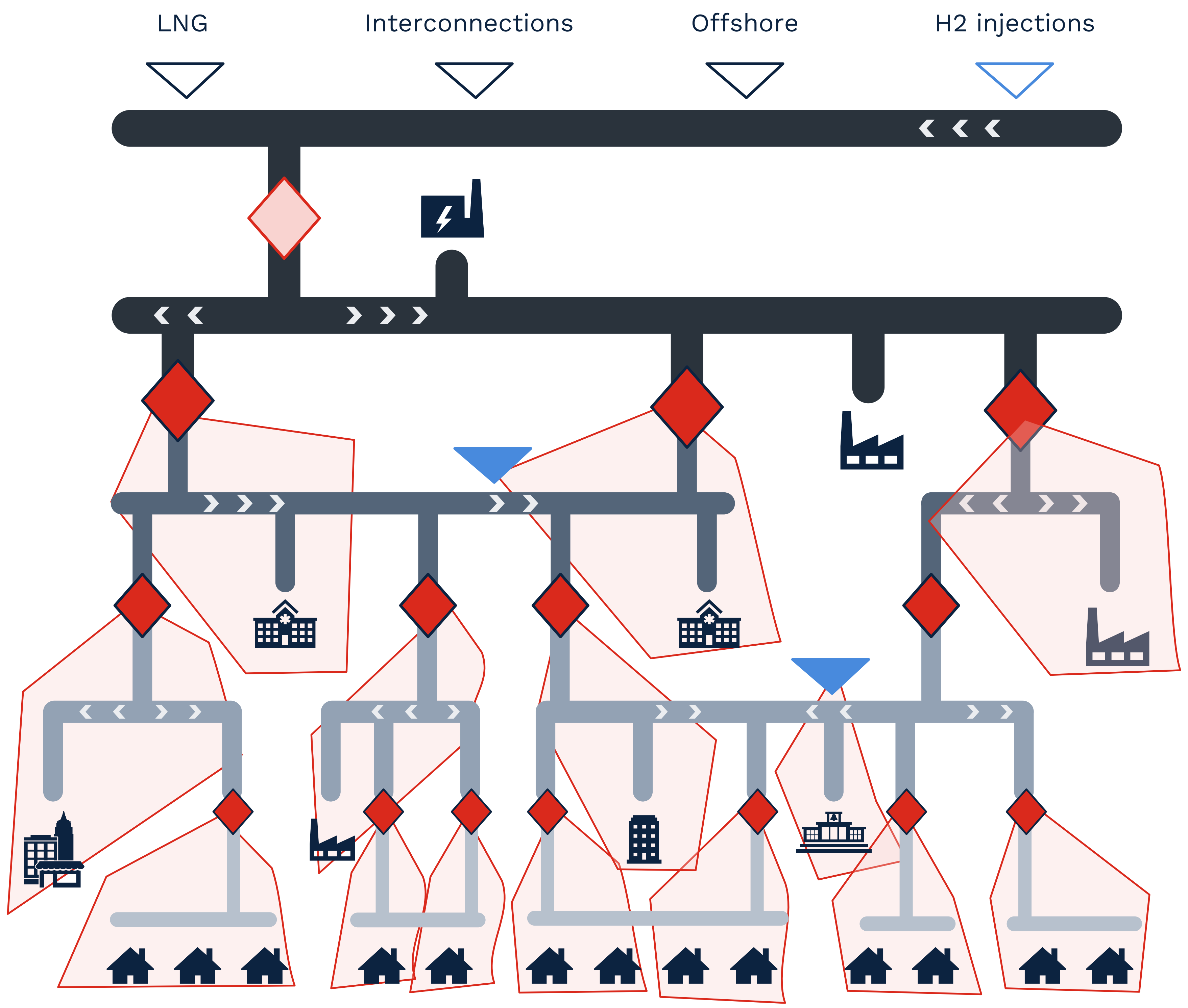
As low CV gases will affect the network differently over time it would be possible to **increase the granularity of the model** over time, based on new injection points; alternatively, **the network could be segmented once, without requiring additional activities when a new injection point arises**

Alternatives		Description		PROs	CONs
1 On demand node design	Nodes are progressively created based on new injection points location	 *Phase 0 – No injection* • 1 unique node • 1 same CV	 *Phase n – injection plant* • 5 nodes • 5 different CVs	• Lower amount of nodes and CVs to be managed during the initial period of the implementation, hence lower complexity • Nodes are created only if necessary	• Need of continuous analysis of the network and design of the nodes • Lower standardisation
2 Upfront node design	Nodes are defined during the design stage independently from biomethane and hydrogen presence	 *Phase 0 – No injection* • n nodes • Same CV within each node	 *Phase n – injection plant* • n nodes • 5 different CVs	• Nodes are defined once during the design and set up phase • Higher standardisation	• Higher effort during the design and set up stage • Few adjustments may still be required during the lifetime of the software solution

Suggested approach

Suggested node granularity – CV calculation

To **avoid the use of standard profiles**, which may lead to inaccuracy and higher data volume, **CV should be simulated at node level**; nodes must be defined through network analysis, however, as first step, **each pressure reduction point can be considered a node**, then additional nodes can be defined near to injection points



CV simulation point, node

Considerations

Hourly demand availability
Hourly demand at meter level for NDM is not available and is not possible to correctly model gas usage at each meter level. The use of standard profiles to model gas consumption and simulate CV at meter level increase complexity and capacity requirements without increasing accuracy

Nodes definition
CV should be modelled at reduction points as real data on volume is available, increasing accuracy of CV calculation.

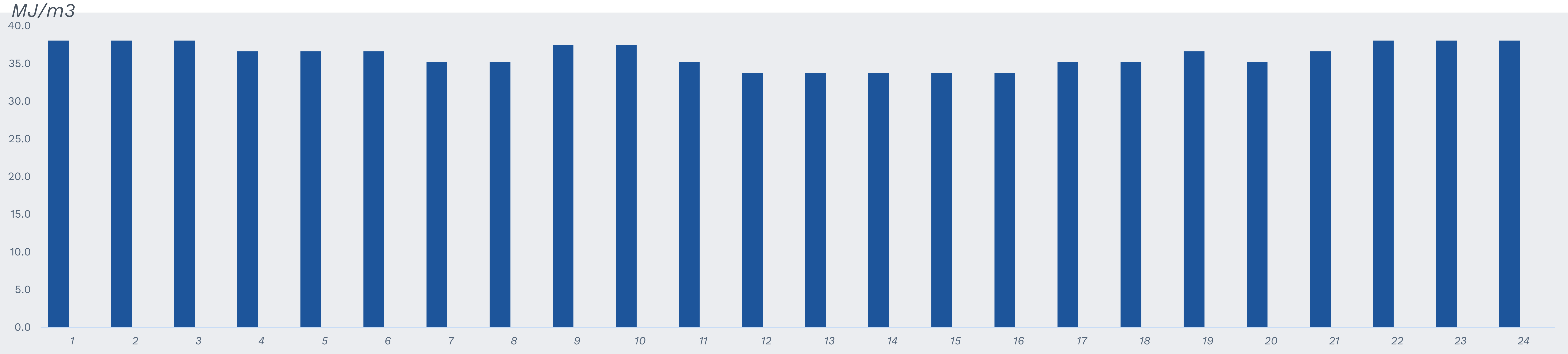
Higher granularity
In the nearest of a biomethane or hydrogen injection plant additional calculation points should be identified to reflect higher CV variations; this will be done through network modelling – a rough estimation suggests 3 additional points for each injection point

Lower Granularity
If it is identified a **node where no significant CV variations is observed** (e.g. only natural gas injection) it is possible to **avoid the modelling** of all the reduction points located “below” that node, if **they are independent from the rest of the network**

Suggested node granularity – CV Assignment

Once hourly CV per node is computed, **a daily average value is determined for each End User Category (EUC) using EUC standard profiles**; this allow to maintain the **same time resolution of current FWACV** for billing and settlement – *hourly CVs could be used for hourly metered users*

Hourly CV Value per node n - *Output of the model*



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Hourly standard profile for each EUC[1]

Also DM users will be assigned to a specific End User Category to model hourly profile

= = = =

Computed daily average CV for each EUC, performed through Gemini and UKLink by CDSP

Daily CV EUC 1 | **Daily CV EUC 2** | **Daily CV EUC 3** | **Daily CV EUC n**

1) Hourly standard profiles are currently not available, and they have to be developed

Key insights - Time and Node Granularity

1

TIME RESOLUTION

The best time resolution will be defined during the setup, but the model should **be able to access real time data from SCADA, while output CV could be hourly**

2

METER LEVEL PROFILES

The use of standard profiles to model gas consumption and simulate **CV at meter level results in higher complexity without increasing accuracy**

3

NODE GRANULARITY

The suggestion is to **simulate CVs at strategic nodes**, which can be identified as the pressure reduction points, and avoid modelling the low pressure

4

NETWORK SEGMENTATION

The nodes definition and network segmentation should be performed by the **GNOs during the set-up phase**

5

DAILY CV CALCULATION

The added value of using EUC standard profiles to compute the **daily CV to be assigned to each meter point** should be tested through **the pilot**

Do you foresee a maximum limit in the number of different charging areas with different CVs?

a) Up to 10,000

b) Up to 100,000

c) No limit, it is a matter of system capabilities

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Accuracy - Approach

Beside software accuracy, the margin of error of the CV tracking tool will depend also on assumption on unknown parameters and the level of network segmentation and meter aggregation; to determine the target accuracy the error of the current FWACV regime has been investigated

Main elements impacting on the accuracy

MARGIN OF ERROR OF THE MODEL ITSELF

Intrinsic error of the software solution. The model identifies a deterministic result with a range of variability.

HOURLY AND DAILY PROFILE ASSUMPTIONS

The use of profiles that do not replicate reality have an impact on the accuracy of the solution.

LEVEL OF NETWORK SEGMENTATION

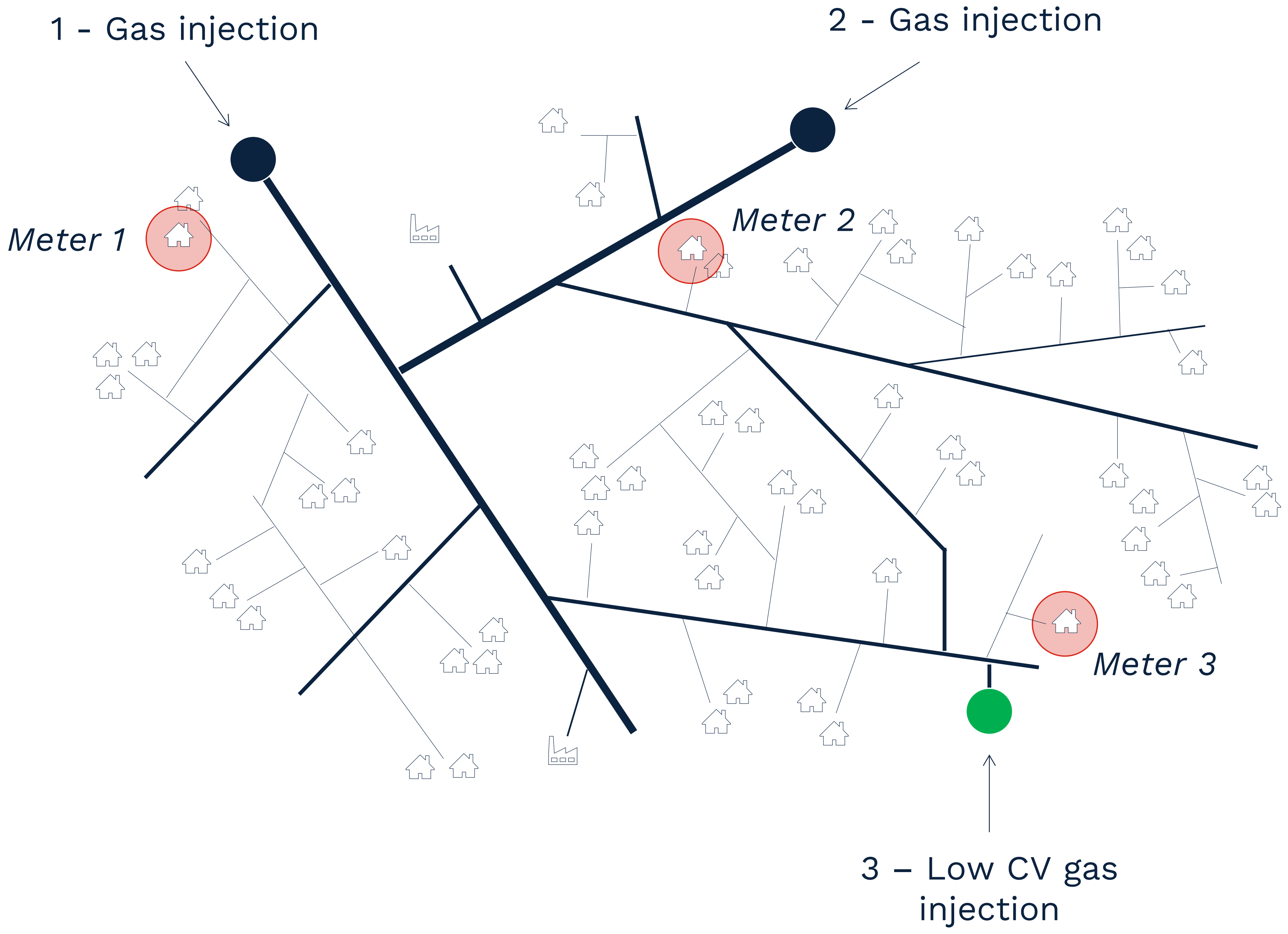
Based on the level of granularity, an averaged CV is assigned to the meters, the higher the granularity the lower the expected error.

The assessment of the accuracy of CV modelling should be performed through a pilot project in the real grid, as no data is currently available to determine the margin of error of the solution

FWACV Regime accuracy - Methodology

Assumptions:

- The analysis is based on the analysis of a single day
- In an LDZ, **three injections points are identified with different gas CV** entering the system
- The three **meters identified are assumed to receive gas at constant CV** from the nearest injection point (no mixing)
- Each meter has the **same energy demand** (300 MJ/day)
- The objective is to assess the **error in the billed energy** for each user in different scenarios



Scenarios		
1	**Propanated biomethane and Cap not activated**	**Propanated biomethane** is injected into the grid, and the difference between the FWACV and lowest source CV is **lower than 1 MJ/m³**, hence CV Cap is not "activated"
2	**Propanated biomethane and Cap activated**	**Propanated biomethane** is injected into the grid, but the difference between the FWACV and lowest source CV is **greater than 1 MJ/m³**, hence CV Cap is "activated"
3	**Unpropanated biomethane**	**Unpropanated biomethane** is injected into the grid and **CV Cap is applied**
4	**20% H2 blend**	**20% H_2 blend** is injected into the grid, hence the difference between the FWACV and lowest source CV is greater than 1 MJ/m³, and **CV Cap is "activated"**

FWACV Regime accuracy - Results

The CV cap protects consumers against overbilling, with a margin of error of ~2.6%; while it works well at current conditions, in future scenarios the CV Cap would result in a significant underestimation of supplied energy, resulting in high system unbalance.

		Scenario 1: Propanated biomethane (No CV capping)			*Scenario 2:* Propanated biomethane + CV capping			*Scenario 3:* Unpropanated biomethane + CV capping			*Scenario 4:* 20% H_2 blend + CV capping		
		Injection 1	*Injection 2*	*Injection 3*	*Injection 1*	*Injection 2*	*Injection 3*	*Injection 1*	*Injection 2*	*Injection 3*	*Injection 1*	*Injection 2*	*Injection 3*
System input	Energy input (GJ)		4.5 M			4.5 M			4.5 M			4.5 M	
	CV (MJ/m³)	38.7	39.0	38.0	39.5	39.0	38.0	39.5	39.0	36.7	39.5	39.0	33.7
	Volume injected (m³)	**56.1 M**	**60 M**	**55.2 K**	**55 M**	**60 M**	**50 K**	**55 M**	**60 M**	**51.7 K**	**55 M**	**60 M**	**56.3 K**
	FWACV (MJ/m³)		**38.8**			**39.2**			**39.24**			**39.24**	
	CV Cap (MJ/m³)		39.0			39.0			37.7			34.7	
	Billing CV (MJ/m³)		**38.8**			**39.0**			**37.7**			**34.7**	
		Meter z1	*Meter z2*	*Meter z3*	*Meter z1*	*Meter z2*	*Meter z3*	*Meter z1*	*Meter z2*	*Meter z3*	*Meter z1*	*Meter z2*	*Meter z3*
Single meter level	Real energy consumption (MJ/day)	300	300	300	300	300	300	300	300	300	300	300	300
	Real CV (MJ/m³)	**38.7**	**39.0**	**38.0**	**39.5**	**39.0**	**38.0**	**39.5**	**39.0**	**36.7**	**39.5**	**39.0**	**33.7**
	Real volume (m³)	7.75	7.69	7.89	7.59	7.69	7.89	7.59	7.69	8.17	7.59	7.69	8.90
	Billing CV (MJ/m³)	**38.8**	**38.8**	**38.8**	**39.0**	**39.0**	**39.0**	**37.7**	**37.7**	**37.7**	**34.7**	**34.7**	**34.7**
	Billed energy (MJ)	301.2	298.9	306.7	296.2	300.0	307.9	286.3	290.0	308.2	263.5	266.9	38.9
	Absolute error (MJ)	**+1.2**	**-1.1**	**+6.7**	**-3.8**	**0**	**+7.9**	**-13.7**	**-10.0**	**+8.2**	**-36.5**	**-33.1**	**+8.9**
	Percentage error (%)	**+0.4%**	**-0.4%**	**+2.2%**	**-1.3%**	**0.0%**	**+2.6%**	**-4.6%**	**-3.3%**	**+2.7%**	**-12.2%**	**-11.0%**	**+3.0%**
System	Error in energy estimation for LDZ		**0.39%**			**0.61%**			**3.92 %**			**11.56 %**	
	Absolute error (MJ)		**17,322,992**			**27,500,000**			**177,051,771**			**522,056,380**	

Worst case scenario in current conditions

Key insights - Accuracy

1

FWACV ACCURACY
With current FWACV regime, the error in overestimation of energy consumption could be around **2.6 % on a single day for a single meter**

2

ENERGY UNDERESTIMATION
Under the current FWACV and CV Cap framework, there’s a **risk of underestimating the overall supplied energy**, resulting in an economic unbalance

3

CONSUMER PROTECTION
Even if the presence of a **CV Cap guarantees that the end consumers are protected**, and billed for an energy which is up to 3% higher than the real one, the **real issue is the underestimation of energy**

System configuration

Identify who would be responsible for using the CV simulation tool and how the different systems will be linked with each other; the design of the detailed architecture will be defined once the software solution is defined

1. Potential Architecture Configurations

Aim: *to provide additional elements to support an informed decision regarding the ownership of the software solution and the responsibility of network modelling*

Option 1: Distributed	Option 2: Centralised
Each GNO will run its own modelling tool for its networks. Data will be shared with the CDSP for billing and settlement	A unique entity like the CDSP would be responsible for simulating CV for the entire GB's network

2. System interaction

Aim: *to provide a high-level representation of the data flows between the different systems and actors*

Main system involved

SCADA	Simulation Software	UKLink	Gemini

Potential architecture configurations

Both solutions require integration and coordination with CDSP and shippers/suppliers for data exchange and network management. GNOs will not be directly linked with shippers and suppliers, as CDSP would remain as the core data exchange facilitator

	Option 1: Distributed		Option 2: Centralised	
1. SCADA data collection		The selected software solution will be **integrated with the SCADA of each GNO,** data from SCADA will feed the modelling		Hourly **SCADA data will be transferred from each GNO to CDSP** through a system integration solution *(high volume of data)*
2. CV computation	GNO 1, GNO 2, GNO n	**Each GNO will simulate the hourly CVs** for each node within its own distribution zone	XOSERVE	**CDSP will simulate the hourly CVs** for the overall GB network
3. CV data transfer	XOSERVE	**CVs are transferred from each GNO to CDSP** through a system integration solution	XOSERVE	**No additional data transfer** is required
4. Billing & Settlement	XOSERVE → Shippers, Suppliers	CDSP is responsible for the transmission of **daily CVs for settlement and billing**	XOSERVE → Shippers, Suppliers	CDSP is responsible for the transmission of **daily CVs for settlement and billing**
5. Model maintenance	GNO 1, GNO 2, GNO n	**Each GNO is responsible for the maintenance** of the model; standard guidelines to be defined	GNO 1, GNO 2, GNO n, XOSERVE	**Coordination mechanism is required between CDSP and GNOs** to guarantee that the model is kept updated

SCADA data | Data repository | CVs computation | CVs values | Model maintenance | Data flow | Cloud based integration

bip.

Distributed vs centralised architecture

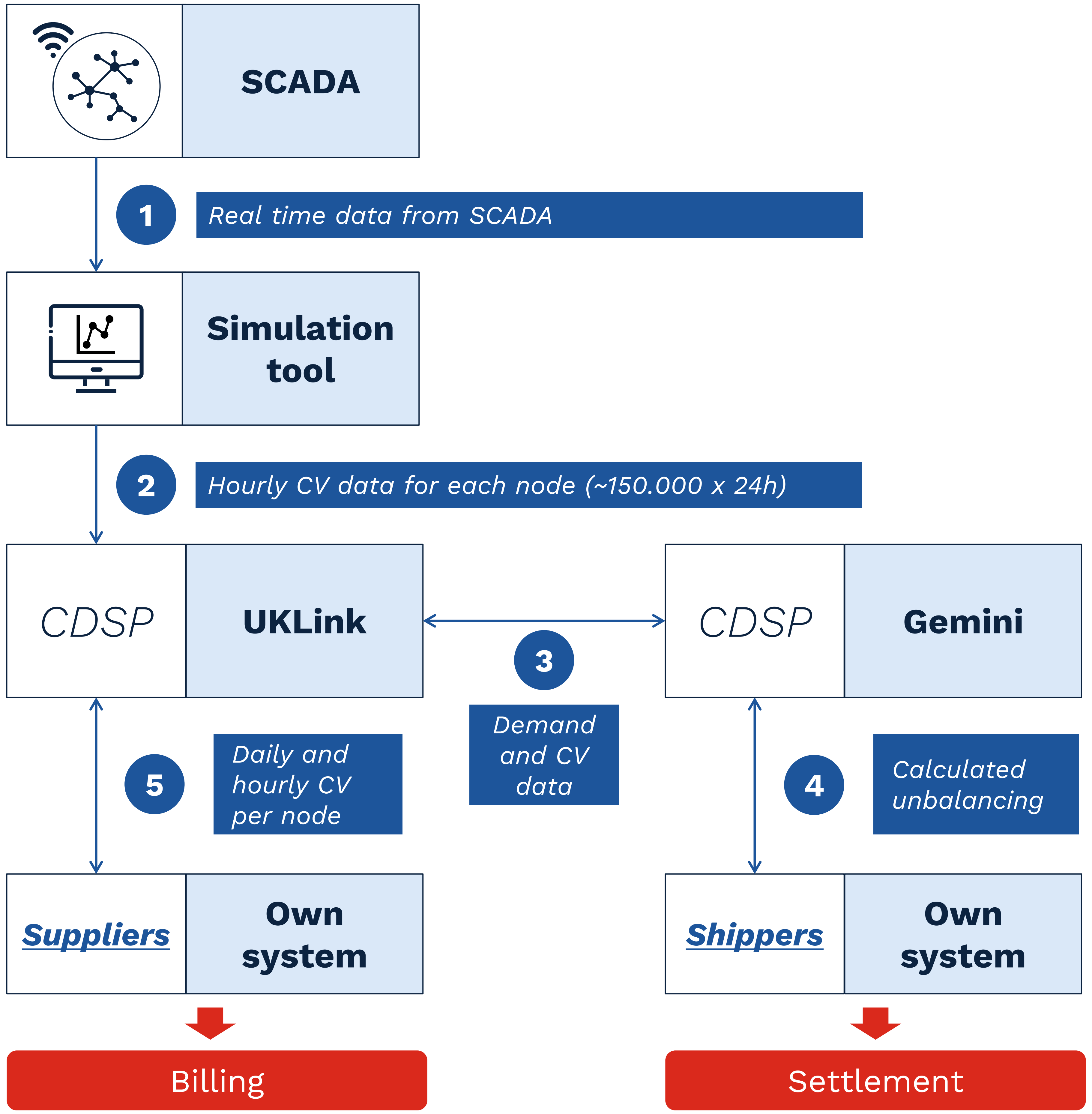
Theme	Relevance	Distributed	Centralised	Considerations
Competence & Synergies	High	Best option	Negatively impacted	Keeping the activities within the GNOs allows for **synergies, less training and less coordination** required
Standardisation & Homogeneity	Med-High	Negatively impacted	Best option	Even if **each GNOs could select a different vendors** all software must guarantee a minimum level of accuracy
Reliability and security	Med-High	Best option	Negatively impacted	A centralised solution could be an easier target for cyber attacks, and the **impact of a failure will be higher**
Vendors competition	Med-Low	Best option	Few drawbacks	Fewer vendors can handle the complexity of a centralised simulation, **reducing market competition**
Licensing and set up cost	Med-Low	Few drawbacks	Best option	**Synergies and less duplication of activities** can be exploited in a centralised configuration
Operational cost	Med-Low	Few drawbacks	Few drawbacks	A distributed configuration results in the **duplication of resources**, while a centralised one implies **additional costs of coordination**
Accountability	Med-Low	Best option	Few drawbacks	In case of a centralised approach, it should be defined **who the accountability for simulated CVs lies within**
Data transfer and system integration	Low	Best option	Few drawbacks	In a centralised solution, the **volume of data is greater compared to distributed** resulting in greater complexity
Data segregation	Low	Best option	Few drawbacks	In case of **centralised approach, data segregation mechanisms** should be identified to protect sensitive data

A distributed solution has several advantages over a centralised one, mainly related to the opportunity to exploit current competences of network modelling within GNOs, also reducing coordination required

Relevance: Low Med-Low Med-High High   Best option Few drawbacks Negatively impacted

Logical flow

The simulation tool would be integrated with SCADA and will deploy real time data for the simulation. The simulated hourly CVs will be shared with CDSP and will be used for billing and settlement through UKLink and Gemini.



Real time data on volume, pressure, and CV is collected from **SCADA** at each location and automatically transferred daily to the simulation tool. Both data collection and transfer processes are fully automated.

GNOs run the software (automated activity) and compute hourly CVs at each node; data is then transferred to the CDSP. No time-consuming activities are required from the operator to share data. The simulation will be cloud-based and results shared through a cloud solution.

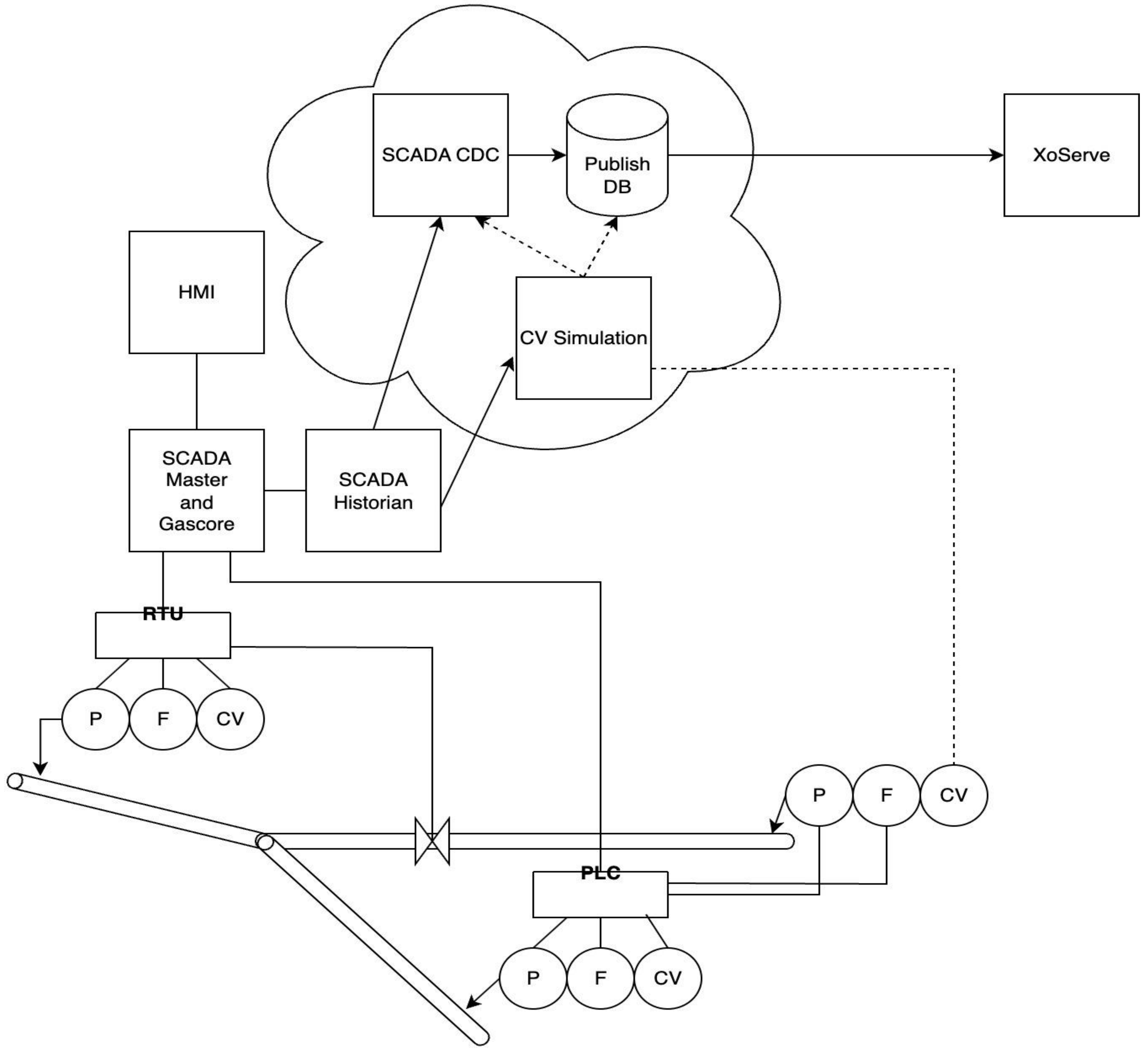
CDSP, via its cloud-based UKLink platform, collects hourly CV data and uses standard profiles defined by Gemini to calculate the daily CV for each EUC at every node. Gemini is then used to compute the energy unbalance. As of today, the primary change lies in the number of areas involved, not in the underlying process.

Shippers receive the energy unbalanced to perform the settlement process and adjust their position

Suppliers collect daily CV per node per EUC to perform a fair billing towards end costumers

Approach for the integration of CV simulation

CDSP will receive real and virtual CV data and flow rates from the Publish DB. The Publish DB is the single integration point for all systems that require real and simulated values for business processes. All lines on the diagram represent a flow of data that have many different possible technologies



P – Pressure meter. F – Flow rate meter, CV – CV Meter. PLC – Programable logic controller, RTU – Remote telemetry unit. HMI – Human machine interface, CDC – Change data capture, PLC – programmable logic controller

- **The historian (PI Historian or similar) stores time series data**. There will be time series data sets that relate to the pressure, flow rate and CV in every location where these are measured.
- The SCADA historian will publish values with a sub second latency. Also published will be controls such as valve actuators and positions. **They can be read by the CV Simulation system and used to populate a live simulation of the gas supply system.**
- **The CV Simulation system will calculate simulated CV** values for additional "virtual CV devices". The CV simulation can be considered as an RTU for the virtual CV meters. **Virtual CV time series are written to a Publish database where the can be accessed by external systems.** Values may be written directly or via the CDC process.
- **A Change Data Capture process reads any additional real device data required by CDSP from the data historian and adds it to the publish Database.**

Key Insights – Architecture & Processes

1

SUGGESTED CONFIGURATION
The distributed approach has several advantages, mainly related to possibility to exploit current competences within the GNOs, while a **centralised approach would face higher complexity**, due to high coordination required and **lower competences**

2

SCADA INTEGRATION
The CV simulation tool will be **integrated with the SCADA historian and will use real time data** to run the network model

3

CDSP INTEGRATION
CDSP will be integrated **with a publish database**; multiple solutions can be exploited for the integration

4

DETAILED ARCHITECTURE
Multiple configurations are suitable for data flow and systems integration; the detailed architecture will be defined during the implementation phase

Based on the proposed solution, what is the preferred approach on how data could be shared with Producers, Shippers and Suppliers to facilitate the overall process?

a) Data automatically sent to Shippers and Suppliers
b) Access through CDSP database
c) Other

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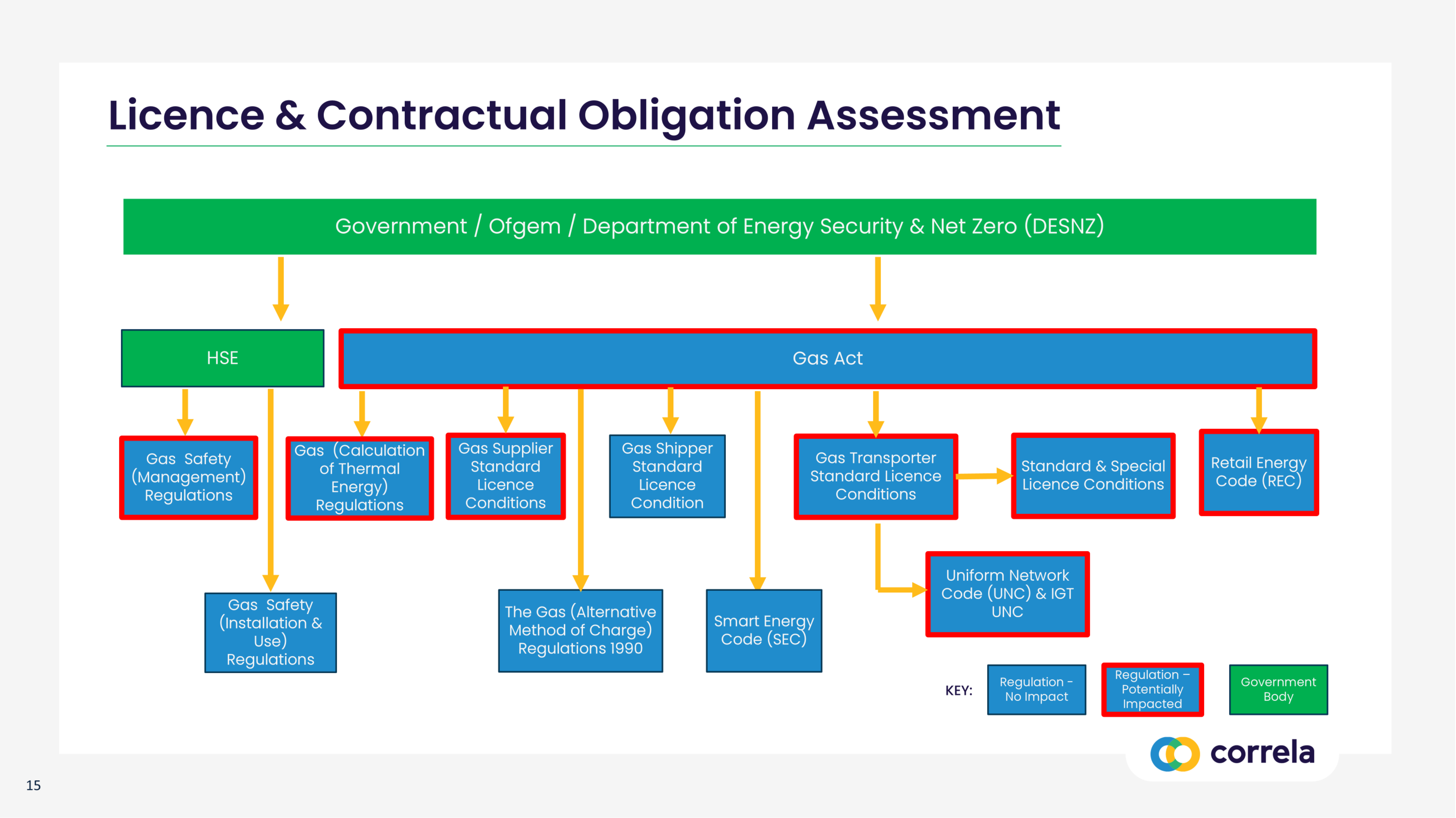
Regulation

During WP3 BIP further analysed the regulatory changes identified in WP2 to evaluate those that has to be addressed in the RTSM and to assess the expected evolution required and the complexity; the WP3 analysis should support engagement with Ofgem



Key outcomes

GSMR changes are not in scope of RTSM	Modification to the GSMR to address gas safety for H2 injection are relevant, but the RTSM is focused on billing and settlement rather than gas compatibility
GCoTER changes should reflect the new CV calculation process	The regulation should include that the CV assigned to meters will be computed through a software simulation, based on entry point CVs and volumes
Multiple UNC variations required	Main changes are required in the General Term section and in the OAD section F, to describe the responsibilities of DNOs and Xoserve in the CV calculation process and reflect that multiple charging areas will be identified for each LDZ
Low complexity changes in other regulations	Changes are required in all the regulations identified in WP2, however complexity is expected to be lower compared to GCoTER and UNC

Key insights

1

OFGEM FEEDBACK

A feedback from Ofgem at this stage is critical to ensure **regulatory impacts are addressed in the correct way**

2

PILOT AMENDAMENTS

The implementation of the pilot **does not require changes in the billing and settlement area**

3

NEXT STEP

Together with Ofgem we should assess the effort, mechanisms and time required to address regulatory changes for full implementation

Overview of software solution shortlist

During WP3 a shortlist of software providers have been actively engaged to present their solution to the steering group members and provide a demonstration of their software capabilities to model a real network.

Key discussion topics

Capabilities to model "complex" networks	All software solutions showed that they are able to perform network simulation at distribution level.
Node granularity	While vendors did not report any significant constraint to model the network at meter level, some of them argue whether it would be useful or not to simulate the low-pressure tiers.
Accuracy	General feedback from almost all software providers is that the main driver impacting accuracy is the quality of input data; however, few comparable projects have been developed to provide an expected margin of error.
Data import, export and visualization	All data imported from SCADA would be automated, and the output can be exported in multiple formats; some vendors rely on interfaces which are more user friendly than others.

Test simulation – description

The objective of this exercise was to evaluate the software solutions' capability to model gas distribution networks and simulate gas quality (CV) for a representative gas distribution network (<7bar), which has been provided by SGN, across multiple scenarios

Task

The goal of the test was to:

- **Replicate the gas distribution network model** using the vendor's modelling solution;
- **Simulate CV at 6 specified locations, determined by SGN;**
- Evaluate the network's response **under 3 defined operational scenarios.**

The following **gas types and blends** have been included in the simulation:

- *Natural Gas: UK National Grid typical gas composition*
- *Biomethane: Unpropanated biomethane*
- *Hydrogen Blend: 20% Hydrogen / 80% Natural Gas by volume*

Scenarios

Scenario 1

Standard Summer Profile (Low demand)

- Fully supply availability
- All assets operational

Scenario 2

Standard Winter Peak (Peak demand)

- Fully supply availability
- All assets operational

Scenario 3

Summer emergency scenario (Disturbance)

- Added gas supply interruption or unplanned maintenance event

Output

For each scenario, vendors have provided the following outputs:

- CV values at the 6 locations;
- Gas composition at each monitoring point;
- Pressure profile across the network;
- Flow rates in all pipelines.

Software results have been compared with the results from the current simulation tool accepted by Ofgem.

The comparison could give additional insights into software capabilities and accuracy.

Key insights – Vendors Engagement

1	**CV TRACKING** All software solutions are **able to perform CV tracking** in “complex” network
2	**ACCURACY** All vendors agreed that **accuracy will mainly depend on data quality**; results of the test will give additional insights
3	**COMPARISON** Vendors mainly differentiate for their **requirements to integrate data for the simulation and for parameters representation**
4	**TRAINING** **GNOs are already familiar** with the use of CFD simulation software however the adoption of a new solution will require **training**
5	**WP3 – NEXT STEP** WP3 has not been structured as a software selection. A **software selection phase is required to ensure competition** and competitive prices

RTSM Roadmap

Steps for Implementation

Phase 0
(2024)

Initial Engagement

Six virtual sessions with key stakeholders

Phase 1
(2024-25) - NIA

Methodology development

- Identify solutions
- BoD for the solution
- Feasibility study
- Roadmap for the pilot and implementation
- Dissemination and engagement (Monthly stakeholder Forum)
- Regulatory changes to accomodate the pilot

Phase 2
(2026) - NIA

FEED for pilot

Execution strategy for the pilot in Phase 3

- Design
- Cost
- Risks
- Mitigation plans
- Engagement
- Additional Sub-projects to support the solution

Phase 3
(2026-27) - Re-opener

Pilot Roll-out

Test the RTSM solution:

- Solution set-up
- CVDD installation
- Community and stakeholder engagement
- Final selection of software solution

Key decision
(2027)

Go/No-go & Trial Analysis

Decision on full implementation based on Pilot's results

- A detailed deisgn and assessment process will precede the trial to ensure readiness

Trial
(2028)

Live Trial

- Trial in a controlled environment
- Integration with CDSP, shippers/suppliers, GNs, producers and others
- Regulatory amendments
- Ensure seamless transition for customers

GO live

Risk and risk mitigation

	Risk	Probability	Severity
1	**LONGER TIME TO SELECT A PROVIDER FOR THE PILOT** Longer time required to select a provider as multiple organizations may have different preferences, and because the decision-making people from each organization are not involved in process		
2	**COMMUNITY ACCEPTANCE** Protest from citizens located in the area of the pilot		
3	**REGULATORY AMENDMENTS** Difficulties in obtaining regulatory amendments in time for pilot roll-out		
4	**REGULATORY CONSTRAINTS** Regulatory constraints could require to re design the pilot project		
5	**ADDITIONAL CV DEVICES FOR PILOT** To reach the desired accuracy, CV metering device could need to be installed, significantly increasing the cost of the pilot		
6	**GO/NO GO DECISION** Multiple discussion sessions could be required to align all the actors and define a common strategy to address CV tracking, increasing time for implementation		
7	**DATA QUALITY** Higher complexity due to low data quality, low data homogeneity and lack of data		

	Risk	Probability	Severity
8	**SOFTWARE PROVIDERS SELECTION FOR THE TRIAL** Longer time required to select a provider as multiple organizations may have different preferences, and because the decision-making people from each organization are not involved in process		
9	**ADDITIONAL CV DEVICES FOR IMPLEMENTATION** To reach the desired accuracy, an unknown number of CV metering device could need to be installed, significantly increasing the cost of the RTSM implementation		
10	**SOFTWARE INTEGRATION TIMELINE** Time required for software integration is an estimation and may have a longer duration, depending on effort required		
11	**NETWORK SEGMENTATION** Network segmentation could be more complex than expected and require higher effort from GNOs teams		
12	**LEGISLATIVE AMENDMENTS** Risk that legislative amendments are delayed (e.g. GCoTER changes) resulting in a delayed of the allowance to apply the RTSM methodology for billing and settlement		
13	**REGULATORY UPDATES** Regulatory updates may require additional time to be discussed and validated by all the industry players		
14	**PARALLEL TESTING** It should be schedule a period where both the CV simulation tool and the FWACV regime are operational; this could require to perform adjustments to the network model		

Key insights

1	**PILOT STRATEGY** Two strategies can be defined for the pilot: software selection and **single vendors** or **run the pilot as a software selection phase**
2	**PILOT ROLL OUT** The pilot should allow the **simulation of the network in different scenarios**, and it is not expected to start before 2027
3	**GO / NO-GO DECISION** Enough time should be scheduled to reflect the **effort required to engage all gas industry players and compare alternative solutions** for CV tracking
4	**FULL IMPLEMENTATION** In a distributed configuration, **each GNO is responsible for software implementation** on its own system; hence **timeline may differ**
5	**PARALLEL TESTING** Once the solution is fully implemented, it should be scheduled a period where both the CV simulation tool and the FWACV regime are operational

RTSM Cost Assessment

Full implementation cost

The cost reported referred to the **deployment of the software solution within a single GNO**.
Additional costs for CV metering devices will be required.
While the cost of scaling up CDSP systems is difficult to estimate at this stage, initiatives like project Trident will support the required update.

Cost item	Description	Basis of estimation	Cost estimation
Cloud set up	CapEx cost for the set-up of the cloud service	Similar delivery of cloud foundation for pilot projects	**80k – 100k £**
Project engineering	Cost from software providers to set up the simulation tool	Estimation from software providers insights on the expected pilot cost	**200k – 300k £**
SCADA integration	Cost to integrate SCADA and SCADA historian with the new tool to automatically collect data	Estimated based on similar projects. Cost assumes that a SCADA historian is already in place.	**70k – 90k £**
Network set up	Cost of the resources responsible for building the network model on the new tool	2 FTE for two month	**60k – 100k £**
System integration	Integration between SCADA historian and CDSP systems	Estimated based on similar projects	**50k – 70k £**
CV metering devices[1]	Installation of additional CV metering devices to reach the desired simulation accuracy	Unknown number – possible zero. *The requirement of additional CV devices may significantly increase the cost*	**- £**
Fixed cost ~ 460k – 660k £			
Licence	Annual licence to run the software	Estimation from software providers insights	**90k - 110k £/year**
Cloud resources and support	Annual cloud service costs	Compute intensive servers at 2.000 £/month and 1 FTE resource for support	**180k - 200k £/year**
HA SQL server	Cost to set up and maintain the database	2 HA enterprise SQL server with backup at 1.900 £/month	**40k – 50k £/year**
Annual cost ~ 310k – 360k £/year			
CDSP cost	Cost to scale up capacity of UKLink and Gemini and develop additional functionalities	The cost it's highly variable and has to be determined after a detail assessment of UKLink and Gemini	**200k - 400k £**

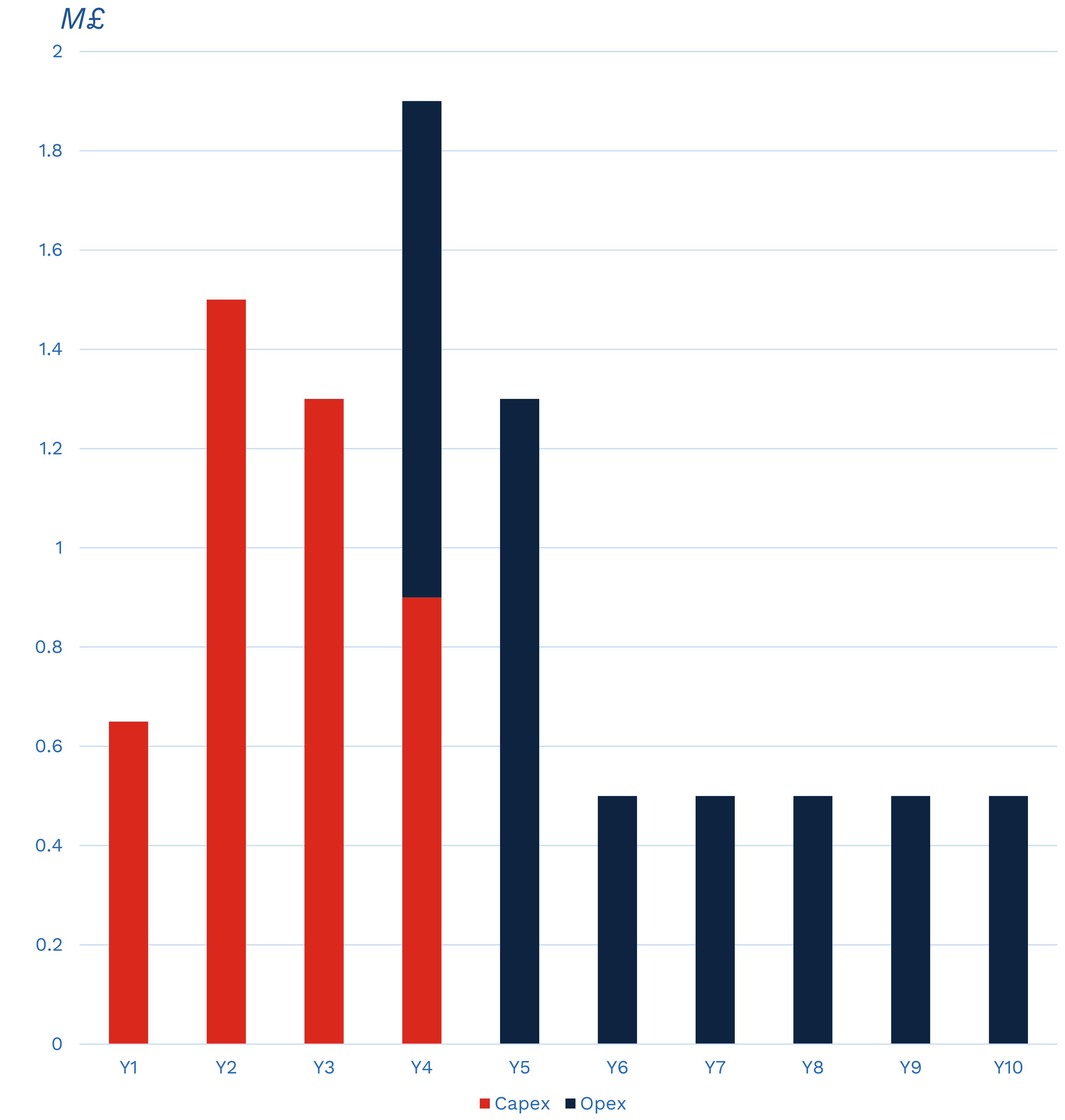
1) The cost for a CV metering device may vary within the range 30k-100k £

Cost roll out

The main cost items impacting on the 10 years plan cost of the RTSM solution are related to the annual simulation software cost and the potential cost required for CV metering installation; additional cost for CDSP and Shippers & Suppliers systems are considered not highly impactful

		Capex	Opex
Pilot cost[1]	As described above	**0.65M £**	**-**
GNOs Full implementation cost	Cost described multiplied by each GNOs (x5)	**3.3M £**	**1.8M £/year**
CV metering devices installation[2]	Additional cost for CV metering devices could be required to increase software accuracy	**n.a.**	**n.a.**
Daily operation	1,5 FTE for daily activities: model maintenance, supervision, result checking…	**-**	**0.5 M £/year**
CDSP software cost	CDSP cost for software update (no differential cost for daily activities)	**~0.4M £**	**-**
Shippers & Suppliers cost	Shippers & Suppliers cost	**n.a.**	**n.a.**

10-years plan cost **9.15M £**



1) Pilot's cost will be presented more in detail following WP4
2) The cost for a CV metering device may vary within the range 30k-100k £

Key insights - Costs

1 **FULL IMPLEMENTATION FIXED COSTS**
The two main cost for the set up of a CV tool are the **project engineering** and the effort required for **network analysis and segmentation**

2 **OPEX**
Annual license and operational cost for **cloud support** and **daily activities** are the main costs

3 **INDUSTRY COST**
From a gas industry perspective, additional investments are required also from **Shippers and Suppliers, but these are expected to have limited impact overall**

4 **CV METERING DEVICES**
The need for **additional CV metering devices** can't be defined at this stage and **may significantly affect the overall cost**

5 **COST ALLOCATION**
Costs for the **simulation solution will be allocated to GNOs**, as well as any additional **infrastructural element** required; update to **CDSP systems** would likely be funded by Xoserve, while **own system update** costs would be allocated to gas industry players

Key evidence from WP3 analysis

The model should simulate **hourly CV at node level**, down to LP governors; **daily CV** aggregation occurs at chargin areas, **ensuring continuity in time resolution compared to the current billing and settlement process**

Each **GNO will be responsible for the deployement and usage of the simulation tool**, which will be **integrated with SCADA** and will be accessible from CDSP through a **published database**

All software solution showed they are capable to simulate CV in complex network; the definition of the **strategy for software selection and pilot roll out is a key decision** that has to be discussed in WP4 to expedite the pilot setup

It is expected at least a **5 year timeline** to perform the pilot test and build the CV simulation tool, with an **expected investment cost of *4M £* at national level** (of which *2M £* related to the software solution itself)

Q&A
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Next Session

25th November 14:00 – 16:00

WP4: Roadmap for a Pilot

SGN bip. correla

Additional Materials

Risk and risk mitigation (1)

Phase	#	RISK	Probability	Severity	Mitigation strategy
Software selection	1	**LONGER TIME TO SELECT A PROVIDER** Longer time required to select a provider as multiple organizations may have different preferences, and because the decision-making people from each organization are not involved in process			Involvement of decision-making people from each stakeholder and development of an evaluation scheme agreed between all the parties to facilitate the vendor selection
Pilot Roll-out	2	**COMMUNITY ACCEPTANCE** Protest from citizens located in the area of the pilot			Community engagement activities will be developed to inform citizens about the ongoing initiatives and that their energy bill will not be impacted
	3	**REGULATORY AMENDMENTS** Difficulties in obtaining regulatory amendments in time for pilot roll-out			As for current pilot planning, additional time could be exploited during the pilot set up to obtain regulatory amendments
	4	**REGULATORY CONSTRAINTS** Regulatory constraints could require to re design the pilot project			Ofgem has been engaged in the early stage of pilot definition, to assure that the pilot design is compliant with regulations
	5	**ADDITIONAL CV DEVICES FOR PILOT** To reach the desired accuracy, CV metering device could need to be installed, significantly increasing the cost of the pilot			Additional CV metering devices can be exploited for the full implementation of CV tracking, “reducing” the impact on the pilot
Analysis and go / no go decision	6	**GO/NO GO DECISION** Multiple discussion sessions could be required to align all the actors and define a common strategy to address CV tracking, increasing time for implementation			Definition of a stakeholder engagement strategy which takes into account also other projects on alternative approaches to CV tracking
Full Scale deploy	7	**DATA QUALITY** Higher complexity due to low data quality, low data homogeneity and lack of data			The set-up will start from a single GNOs which would allow to learn from the implementation and speed-up the roll out for the other GNOs.
	8	**SOFTWARE PROVIDERS SELECTION** Longer time required to select a provider as multiple organizations may have different preferences, and because the decision-making people from each organization are not involved in process			An evaluation scheme should be predefined and agreed between all the parties to facilitate the vendor selection
	9	**ADDITIONAL CV DEVICES** To reach the desired accuracy, an unknown number of CV metering device could need to be installed, significantly increasing the cost of the RTSM implementation			The installation of additional CV metering device should be evaluated over a longer time horizon, as with few injection points few CV devices may be required

Risk and risk mitigation (2)

Phase	#	RISK	Probability	Severity	Mitigation strategy
Full Scale deploy	10	**SOFTWARE INTEGRATION TIMELINE** Time required for software integration is an estimation and may have a longer duration, depending on effort required			Software set up will be done firstly for a single GNO and then for all GNOs, this allows to learn from mistake and guarantees additional time if required
	11	**NETWORK SEGMENTATION** Network segmentation could be more complex than expected and require higher effort from GNOs teams			Preliminary activities of network segmentation can be developed on current modelling tool used by GNOs
Regulatory updates	12	**LEGISLATIVE AMENDMENTS** Risk that legislative amendments are delayed (e.g. GCoTER changes) resulting in a delayed of the allowance to apply the RTSM methodology for billing and settlement			Involvement of Ofgem and DESNZ from preliminary stages to get insights on the process and timeline for legislative changes and support from ministers
	13	**REGULATORY UPDATES** Regulatory updates may require additional time to be discussed and validated by all the industry players			FWACV regime will remain active until regulatory updates are not completed and parallel testing will be performed for CV tracking
Parallel testing and go live	14	**PARALLEL TESTING** Results from parallel testing could require to perform adjustments to the network model			Parallel testing for the first GNO will start before the full implementation and would allow to get feedback and reduce adjustment for the other GNOs

Probability score

Low – Risks that can be "controlled" and anticipated

Medium – Risks that can't be tackled to reduce probability

High – Risks that are likely to happen and/or can't be controlled by the RTSM

Severity score

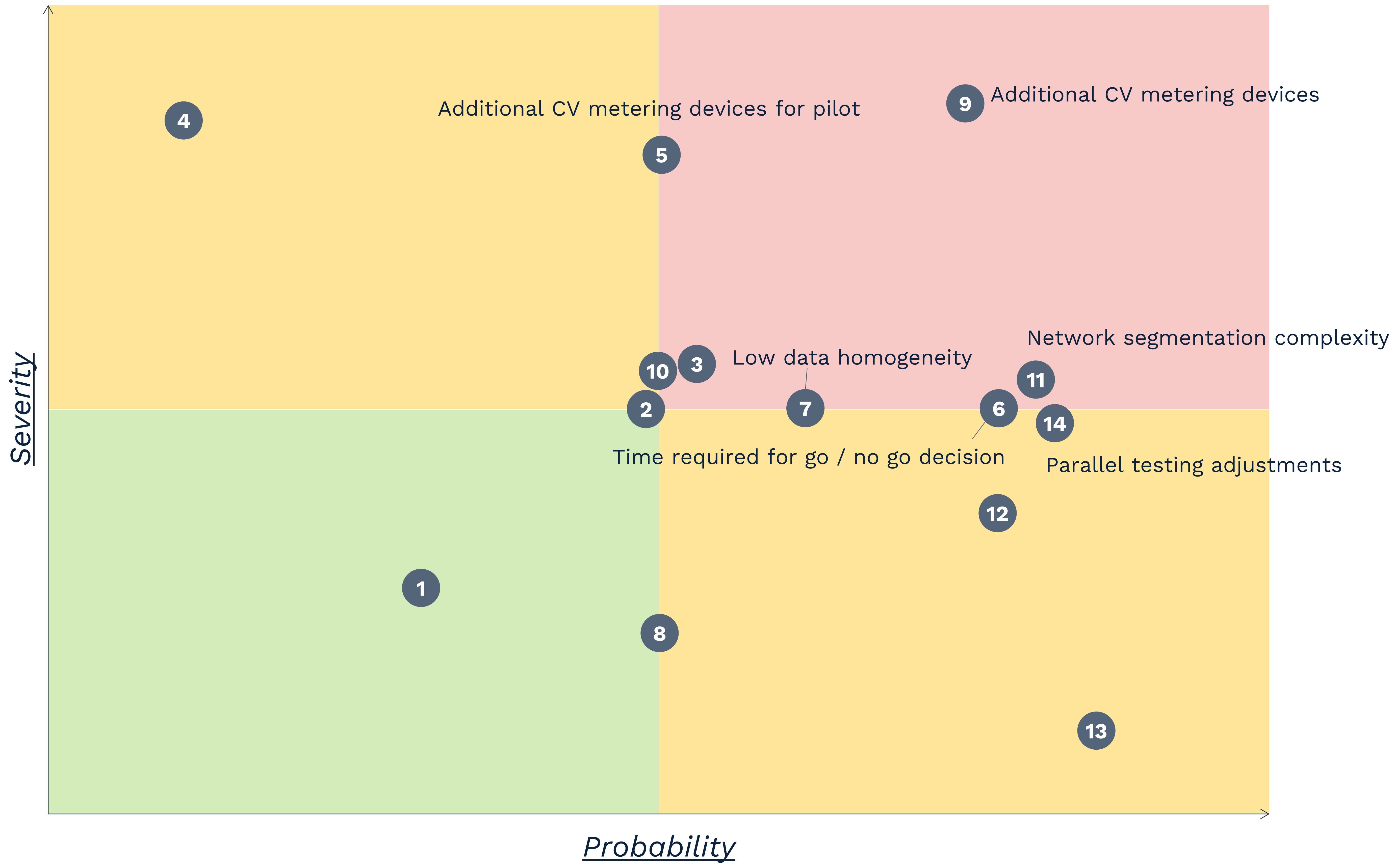
Low – No significant impact on time and costs associated to the RTSM

Medium – Impact on the timing of the RTSM, but mitigation strategies reduce implications

High – Relevant impact on cost and timing of the RTSM

Risk matrix

The main risks refer to additional costs due to the need of additional CV metering devices to reach the desired accuracy and to the increase of the implementation time due to network complexity, data heterogeneity, and testing.



While **mitigation strategy could be put in place to reduce the impact of risks on the increase time** required for the RTSM implementation, it is **not possible to determine at this stage the need for additional CV metering devices**, which could significantly impact on costs.

However, it is expected that few CV metering devices will be required at early stage of RTMS implementation.

Risks to address

Risks to monitor

Risks not to focus on