cerre Centre on Regulation in Europe

THE ACTIVE DISTRIBUTION SYSTEM OPERATOR (DSO) AND HOW TO FACILITATE IT – AN INTERNATIONAL STUDY

Public Presentation

27 September 2022

REPORT OBJECTIVES AND STRUCTURE

- We set out to investigate the ***role of the DSO*** in:
  - Co-ordinating public EV charging points and renewable gas refuelling stations;
  - Decarbonising gas supply in their area;
  - Optimising local energy storage assets and coping with flexibility requirements;
  - Indicative energy planning;
  - Promoting bottom-up innovation in the area of system integration.

- We do this in ***three ways***:
  - via a survey of European DSOs;
  - examination of case studies from California, New York, Australia and Quebec;
  - investigation of European case studies.

Previous CEERE Report

DEFINING THE ACTIVE DSO

- ***Future role of active electricity and gas distribution system operators*** (DSOs) in the energy transition and system integration at local level.
- Can define ***active (or responsive) DSO*** as one which has moved from being a passive operator of a lower voltage network or a lower pressure gas network to a DSO which engages in active grid management and facilitation in the face of rising amounts of distributed energy resources and demands.
- We attempt to ***define the different phases of "activation" of the DSO***, as well as potential indicators that help assess the degree to which a DSO is active (demand, potential for RES, history, enabling investments) - and the incentives it faces.

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EVOLUTION TOWARDS THE ACTIVE DSO

	1st Phase *(Efficiency stage)*	2nd Phase *(Responsive stage)*	3rd Phase *(Active stage)*
All DSOs	Decreasing SAIDI / SAIFI Decreasing OPEX Rising CAPEX and RABs Decreased time to connection Separate E/G development plans E/G delivery focus Closed top-down system Limited functional coordination with TSOs	Stabilized SAIDI/SAIFI Stabilized OPEX Stabilized CAPEX and RAB Preparing for decarbonization Opening to other actors (e.g. ECs)	Market-based interruption mgmt. New OPEX profile Optimized CAPEX Stabilized time to connection Integrated E/G planning Coordination w/ 3rd parties for optimized decarbonization Integration of innovative solutions from outside Active engagement with TSOs and other DSOs
Electricity DSOs	1st gen SM deployment Centralized unidirectional flows No relevance of transport No viable storage options Classic energy efficiency Hard investments focus Energy distribution	2nd gen SM deployment PVs prosumers connection Connected EV chargers Use of V2G option Emerging BESS on grid DR piloting NWA Piloting Data and bi-directional flows added	SM integration & data flows PV prosumers active mgmt Integrated energy mgmt Integrated energy mgmt Integrated energy mgmt Increased integration of NWA System operation matching supply and demand at distribution level
Gas DSOs	Improved management of gas quality (chemical proprieties) Reduced variation in gas pressure networks Reduced incidents, leaks, and accidents Single-gaseous-hydrocarbons utilization No hydrogen storage No RNG injections Low SM penetration Hard investments focus	Hydrogen blending piloting Hydrogen storage piloting RNG injection piloting Increased Gas SM penetration NPA Piloting	Hydrogen blending integration Hydrogen storage (electrolyzer-fuel cell) RNG injection at DSO level Gas SM integration & data flows Higher integration of NPA

MEASURING THE ACTIVE DSO

- To measure the Active DSO one needs to distinguish the elements outside of the operators' control (potential) from the ones they can influence (actual).

Active DSO	
Potential	**Actual**
Transport	
Share of EVs in total car and van fleet Share of Electric Buses in bus fleet	Number of public/private EV charging points
Share of NGV and RGV in car and van fleet	Number of private / public NGV refuelling stations
Share of NGV/RGV Buses in bus Fleet	Number of private / public H2 refuelling stations
Gas decarbonisation and heating	
Target for Hydrogen blending	No of homes with hydrogen heating
Target for Biomethane injection	Share/Amount of hydrogen production and injection
	Amount of distributed hydrogen storage
	Share of Biomethane injection/Amount of biomethane
	Amount of distributed biomethane storage
	Amount of methanation from hydrogen and captured CO2
Share of gas connected homes	Existence of dual fuel heating offer
Share of all electric homes	Share/amount of dual fuel connections / hybrid heat pumps
	Number of heat pumps

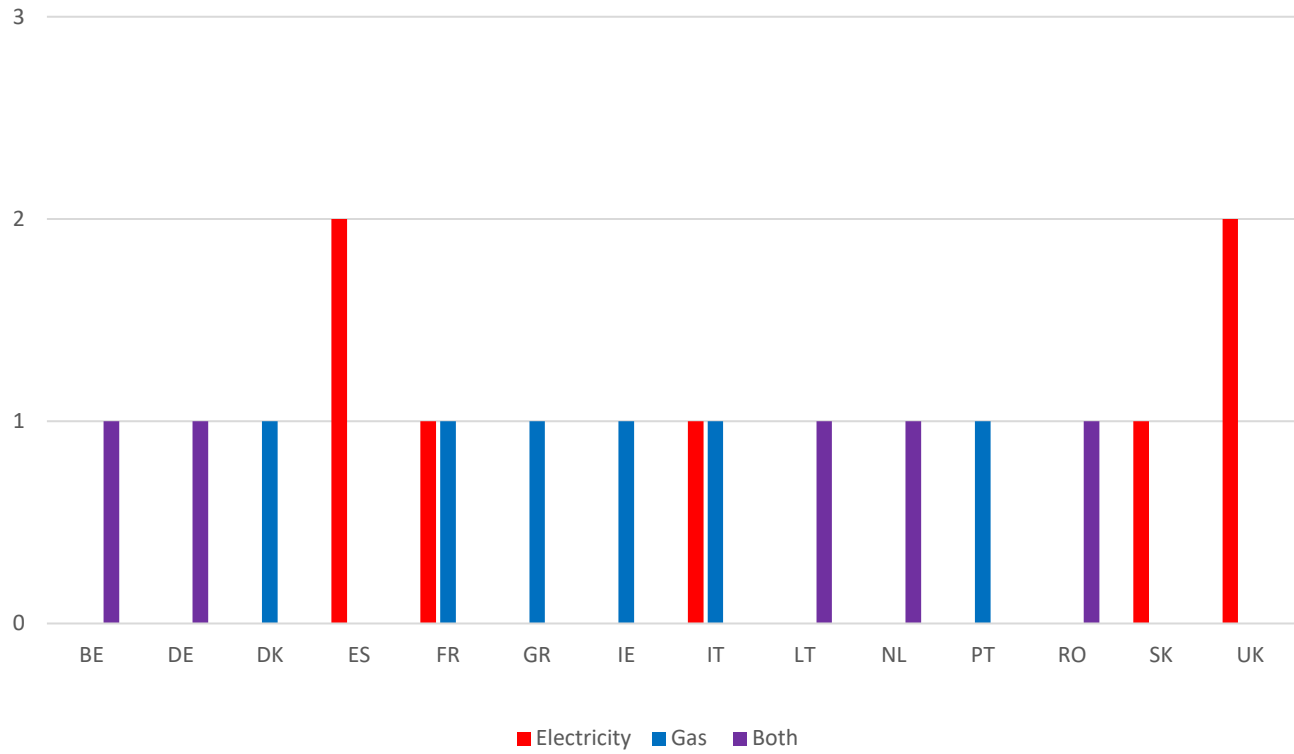
Flexibility and storage	
Share/Amount of distributed generation (DG)	Reduced connection times for DERs
	Number of reverse flow points between DSO and TSO
	Amount of Distributed Power Storage
	Amount of DSO level Demand Response
	Creation of system operation function within DSO
Target of smart electricity/gas meters	Share of electricity/gas smart meters
	Existence of smart distribution level tariff
	Amount of DSO level procured constraint management (MW)
	Amount of DSO level procured reactive power (MVar)
	Provision of real time information on where and when to connect/inject/withdraw MWs
Integrated planning	
Integrated E+G planning process at the level of the jurisdiction	DSO level integrated plan with focus on synergies
Innovation	
Target recognised expense on innovation	% of OPEX spent on innovation
Other relevant factors	
Highest pressure level at which DSO operates	Share of unconventional demand/revenue
Highest voltage level at which DSO operates	
Number of energy communities	

RESULTS FROM SURVEY OF EUROPEAN DSOs

- ***Responses from 18 DSOs*** over March-June 2022, covering 14 European countries, ¼ of European electricity and gas customers.
- We find ***varying levels of engagement*** with external stakeholders in the five focus areas.
- DSOs report very high or high levels of engagement with national and local authorities; less engagement with other energy companies, energy communities and civil society.
- By way of contrast, the highest levels of engagement are reported on the issue of ***indicative planning*** and the lowest in the area of ***promotion of bottom-up innovation***.
- In general, DSOs indicate that engagement levels could be higher across the board and that significant ***regulatory & financial barriers*** to further engagement on decarbonisation remain.

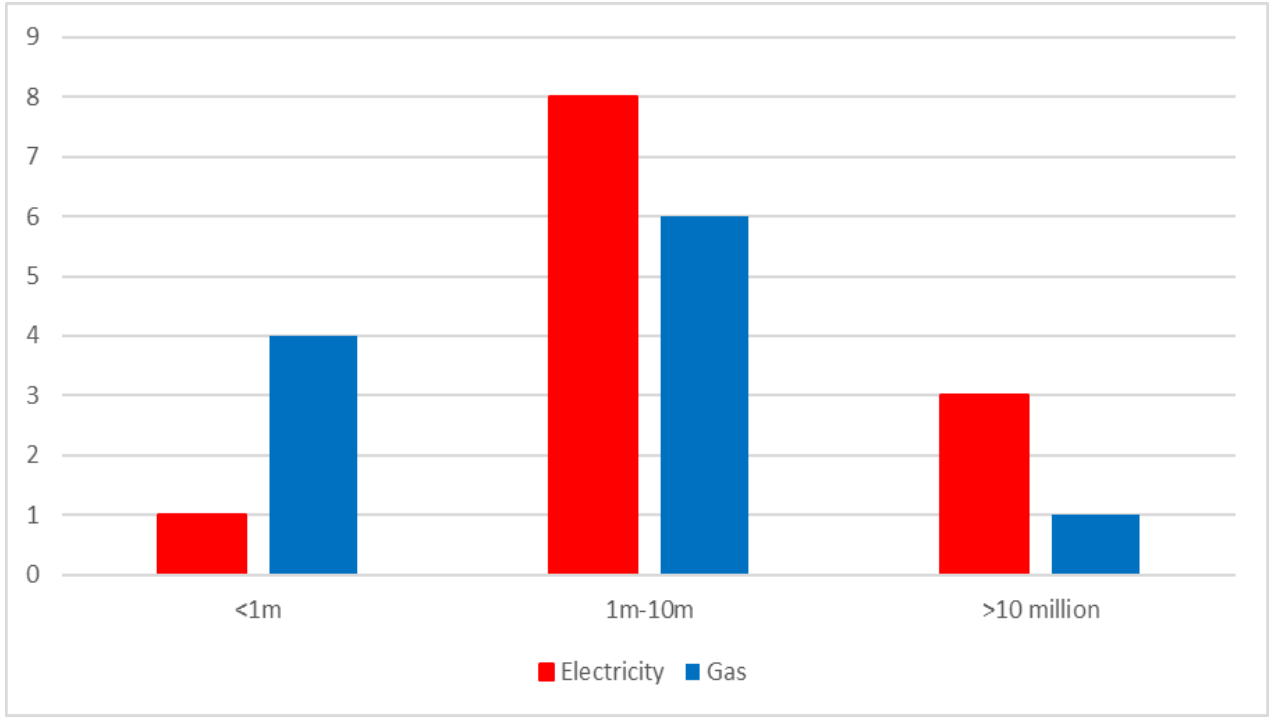
RESPONDENTS BY COUNTRY AND SECTOR

- Respondents from ***14 European countries***.
- Similar number of companies operating in ***electricity, gas and both sectors.***



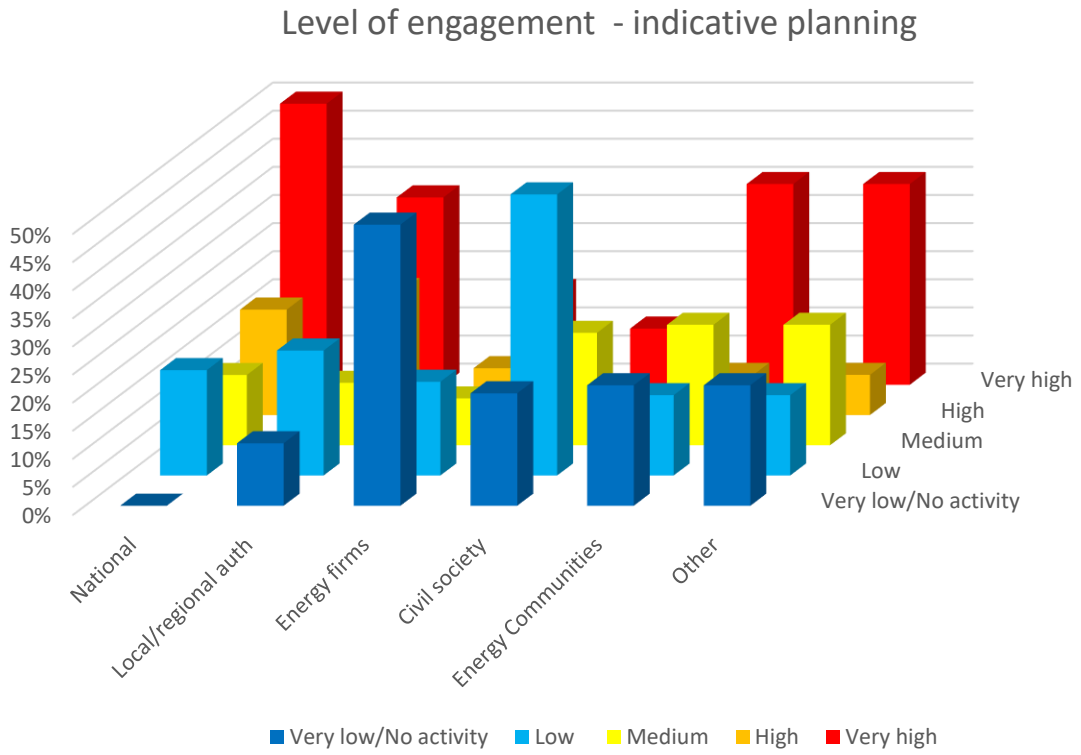
RESPONDENTS BY NUMBER OF CUSTOMERS

- Majority of respondents have ***between 1-10 million*** electricity and/or gas ***customers***.
- 5 DSOs publicly owned, 2 mixed ownership, 11 privately owned.
- Overall serve about ***120 million electricity customers, 30 million gas customers***



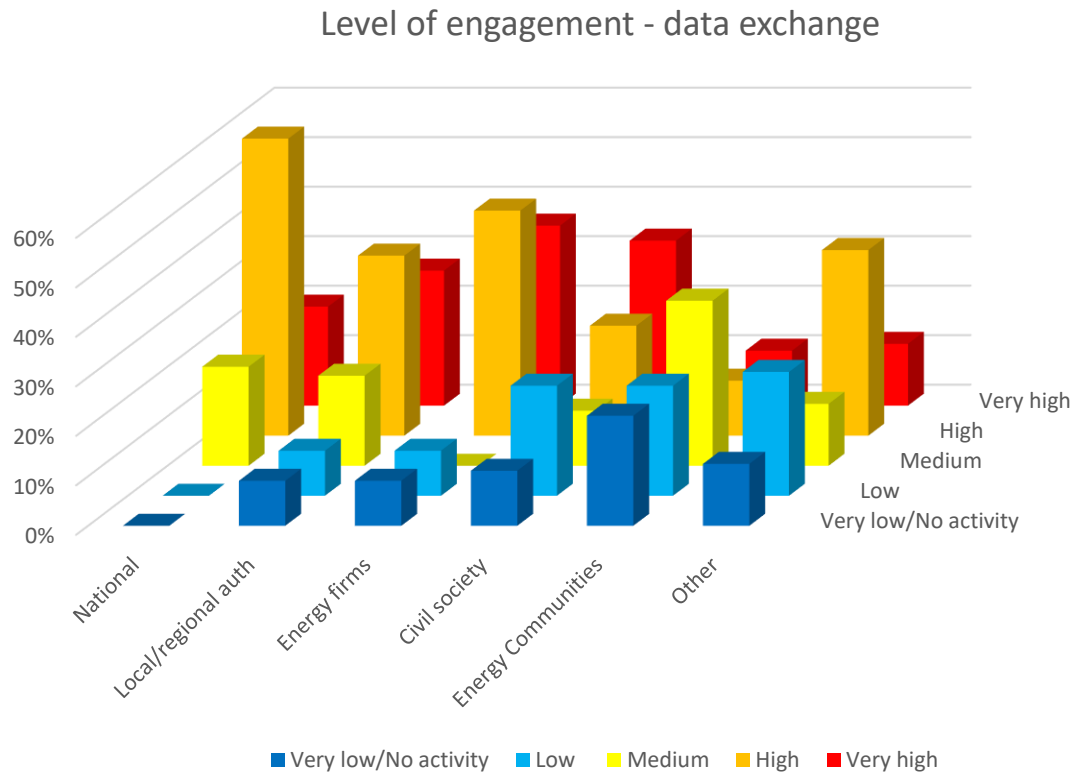
ENGAGEMENT WITH LOCAL ACTORS (1/2)

- ***Local EV charging points and gas refuelling stations***: relatively high levels of activity, with exception of civil society and energy communities.
- ***Electricity and gas system decarbonisation***: Highest level of engagement with public authorities.
- ***Optimising the use of local flexibility sources and development of indicative planning***: high level of engagement with public authorities, very low with other energy companies.



ENGAGEMENT WITH LOCAL ACTORS (2/2)

- ***Data coordination and exchange***: several respondents report a high to vey high level of engagement with different actors in this area.
- ***Promoting bottom-up innovation and other R&D activities in the area of system integration***: low to very low levels of engagement across all different actors.
- Examples involving national and local authorities relate to legislation, permits and specific projects.
- Barriers to engagement include procedures to obtain permits and the legislative framework more generally.



CONCLUSIONS FROM SURVEY EVIDENCE

- ***Higher engagement with national/local authorities,*** less strong with civil society or energy communities.
- ***Statistically significant positive correlation*** between ***average level of engagement and large companies and those operating in the electricity sector*** especially involving ***R&D activities related to system integration***.
- Only few projects have become ***business-as-usual***; these include ***e-mobility*** and ***flexibility projects*** in electricity & green and virtual pipelines in gas.
- Generally ***positive view*** of the support provided by ***NRAs*** for the development of innovative activities.
- Regulators can help to promote innovation with ***better support for investment in innovative activities*** and ***better definition of role and responsibilities in newly developed or emerging areas of activity***.

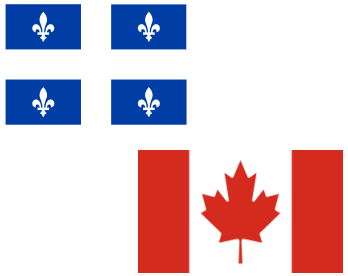
LESSONS FROM NON-EUROPEAN CASE STUDIES (1/2)

- Innovative ***cap and trade system*** on the average emissions of fuels + ***low carbon fuel standard*** have supported RNG cars and trucks. Various policy-supported pilot projects, particularly in the dairy farming sector, have come to market.

- California invested in network of ***public hydrogen (H2) stations*** with oil and gas firms → increase in fuel cell vehicles. Other uses for H2 also piloted with promising applications in electricity storage in homes, through local electrolysers and fuel cells, and ambitious vision for dedicated green hydrogen grid connected to industrial and shipping customers.

- ***Alternative to wires model*** becoming widespread in US after success of ConEd BQDM programme in New York. Success is linked to regulator openness towards new remuneration models + partnership of DSO with various flexibility providers. Similar approach being implemented for gas grids.

LESSONS FROM NON-EUROPEAN CASE STUDIES (2/2)



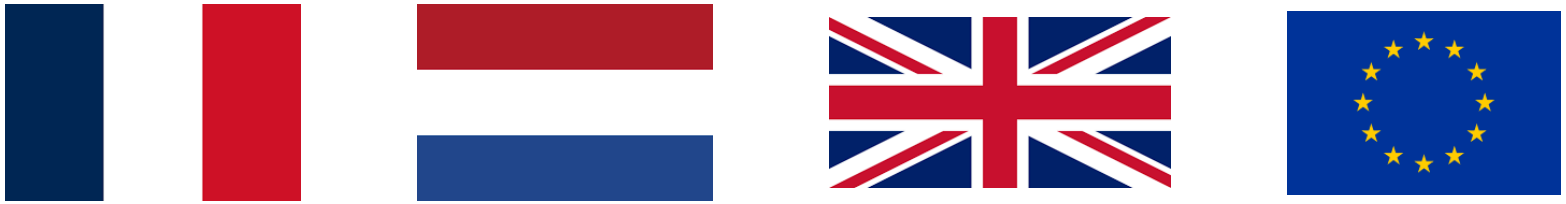
- Attempt to manage Quebec's peak electricity demand/gas consumption for heating led to technical/commercial innovation at utility level: ***dual-energy system***. By prioritising electric heating systems, while also ensuring gas heating back-up, Quebec has called for innovative commercial pilot offers. Utility company's criteria for clustering customers allowed creation of innovative new tariffs, the basis of a new business model with commercial/social benefits.

- ***Grid flexibility and storage*** for decarbonising energy systems: in Australia, long transmission lines are reaching limits to match geographically spread generation and demand. Two major storage facilities are already operational. An increased number of applications for similar projects have been recorded.

LESSONS FROM EUROPEAN CASE STUDIES (1/3)

Seven promising case studies: each addresses important set of issues in joint decarbonisation of current energy demand for electricity, gas and transport.

- Represent different types of projects and involve a wide range of project partners.
- All of them financed by public authorities or the DSOs themselves, with the DSO mostly being the innovation driver.
- Projects are at different stages, though most are at early commercial and business as usual.
- We also looked at overall innovation context in which electricity and gas DSOs sit.



LESSONS FROM EUROPEAN CASE STUDIES (2/3)

- Progress in ***road transport decarbonisation is well supported by DSOs***: promising area of system integration and multi-stakeholder engagement. Electricity DSOs can facilitate provision of charging infrastructure (ElaadNL, Netherlands). Gas DSOs can also provide biomethane on large scale (Île-de-France Mobilités, France).

- Demonstrated ***ability to blend H2 with methane*** in gas distribution grid and to ***repurpose parts of existing gas distribution grid*** to 100% H2. ***Need to demonstrate blending can be done at scale using H2*** (up to 20% by volume) to meet their entire demand, and ***that large sections of networks can be repurposed or built*** to carry pure H2.

- ***Innovative system flexibility solutions at DSO level are work in progress***. Short-term electricity trades to manage constraints are often small and use of gas distribution grid to provide short-term flexibility to electricity network is not adequately incentivised.

LESSONS FROM EUROPEAN CASE STUDIES (3/3)

- ***DSOs can play important role in indicative planning*** through provision of better network information. Regulators and industry participants need to collaborate to provide better information to industry stakeholders.
- ***Clearer benchmarking of electricity DSOs*** progress with producing a smarter/cleaner grid, but ***absence of international benchmarking of gas DSOs*** with respect to innovation. We suggest the ***creation of a public index of gas DSO performance*** to promote sharing of best practice and friendly competitive rivalry.
- Projects impressive from technical point of view, but ***poor information available about the cost-benefit analysis*** of the technological solution on an ongoing basis.
- Case studies illustrate the ***role of larger DSOs and of DSOs acting together nationally in the promotion of innovation***.

Source: SPgroup Smart Grid Index

CONCLUSIONS (1/2)

- ***For charging points and gas refuelling stations***: ***key roles for effective subsidies, private sector and co-ordinated action between DSOs*** to support local authorities.

- Case studies show ***DSOs are capable of taking a lead on many decarbonisation projects***, especially where they are large or integrated with other stages of production. We find good evidence of cross-working between electricity and gas DSOs in Europe.

- Evidence of ***significant progress with unlocking of economically viable flexibility in electricity DSO networks***, and of how ***additional flexibility can be provided to the electricity network from the gas network***.

- The ***development of indicative network plans is a promising area***. Excellent survey examples of improvements in the provision of information that aids effective planning.

- Many ***European DSO case studies benefited from public funding***. Public support for these ***innovation projects*** has had an ***effect in boosting supported utilities' rankings*** in innovation indices.

CONCLUSIONS (2/2)

- DSOs face considerable challenges arising from the need to integrate new sources of renewable production and incorporate additional sources of demand. The ***encouragement of joint working across electricity and gas DSOs to achieve deep decarbonisation is important***.

- *The* ***Active DSO remains in its early stages***. While ***progress is being made,*** it ***remains slow for most and significant regulatory barriers remain in place*** for gas DSOs and must be addressed. Some existing EU policy proposals aim at (partly) addressing these barriers.

- Regulation should not only focus on individual obligations and put an ***important emphasis on DSO associations and group initiatives***. ***Possibility that small DSOs will struggle*** to support deep decarbonisation. This ***may yet require flexibility with respect to unbundling requirements and the possibility of derogations*.**

- ***DSOs must be incentivised to collect and share real time data*** that can be used to facilitate active management of the network and interaction of third parties providing services to / across the network.

ADAPTATION OF EXISTING REGULATION TO PROMOTE THE 'ACTIVE' DSO (1/2)

- 'Gas Package' envisages separate H2 grids, makes provision for standardising blending rules → ***regulatory provisions need to be properly implemented at the national level*** to complete groundwork for 2030.

- ***Biomethane = key driver for gas decarbonisation in some countries → regulation needs to be adapted for the promotion of biomethane at scale*** in existing gas networks, and combined with ***significant subsidies*** to achieve that scale. Certain countries (e.g. France) show that this is possible.

- H2 blending has been given a key role up to 2030 → ***use of H2 in the existing gas grid requires regulatory standardisation and network upgrades across Europe***, as well as ***substantial funding***.

- Apparent inconsistencies/gaps in treatment of network planning and requirements to cooperate between Electricity Directive (2019/944) and Gas Package → ***If Europe is serious about 'sector coupling', need for further requirements to promote joint planning, electricity/gas collaboration, and active gas DSO.***

ADAPTATION OF EXISTING REGULATION TO PROMOTE THE 'ACTIVE' DSO (2/2)

- ***Regulators need to insist on better financial analysis of innovation projects***. This information should be made available as part of the final reporting of the projects so it can be clear what the economic issues are behind scaling up.

- Once long-term feasibility can be established, incentives to scale up are an essential part of moving a project to business as usual**.** ***If governments want to promote a more active DSOs there needs to be adequate financial incentives in place***. It is in jurisdictions where this is the case that the more active DSO is emerging.

- Key lesson from outside Europe: genuine innovation can come from non-utility actors. The ***regulatory system must put obligations on DSOs to respond to third-party initiatives***, potentially beyond the current requirements to co-operate with each other and TSOs.

THE ROLE OF THE NEW EU DSO ENTITY(IES)

- Current EU DSO Entity only represents electricity DSOs. Proposed inclusion of gas DSOs in new draft Gas Regulation should ***give 'balanced representation' to both gas and electricity distribution system operators*****.** An ***alternative proposal to ensure such representation is to create a separate EU Gas DSO Entity.*** This might better ensure a clear voice for gas DSOs and reduce the proposed scale of the combined Entity.

- We ***strongly encourage the DSO Entity(ies) to emphasise and promote learning on DSO participation in the energy transition and system integration among its members***. Strategic thinking is also required on how scale can be achieved in many of the areas we have highlighted, and on how successful projects undertaken in one country can be replicated in another.