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# **2<sup>nd</sup> Technical Workshop: Gas Market Design and Natural Gas Transmission Grid Codes**

## **Key Assumptions and Inputs Driving Optimized Infrastructure Planning**

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# TSO Plans:

## EU References



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## Review of TSO Plans and Consistency with ENTSOG TYNDP Common/Standard Inputs and Outputs

According to a 2016 comparative Review carried out by ACER, common/standard inputs and outputs of national TSO TYNDP are:

### Inputs

- Stakeholder consultations
- Gas scenarios:
  - Demand
  - Supply
  - Price
  - Infrastructure Capacity

### Outputs

- Estimated target capacity
- Investment Gaps
- List of planned projects



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## Review of TSO Plans and Consistency with ENTSOG TYNDP Analytical Methodology

According to the Review, analytical methodologies employed by TSOs can be assessed and compared under the following criteria:

- Market and network studies
- Availability of cost data
- Use of CBA and monetization
- Economic evaluation of SoS (and other qualitative variables)



# Review of TSO Plans and Consistency with ENTSOG TYNDP Market and Network Studies

## Market Studies (projections of market fundamental data)

Use of market studies	NRA responses	%	NRA's
Yes	15	60%	AT, BE, CY, GR, HU, IE, LT, LV, NL, PL, SI, SK, UK-N. Ireland, UK-GB, RO
No	10	40%	BG, CZ, DE, EE, ES, FR, HR, IT, LU, PT
<b>Total</b>	<b>25</b>	<b>100%</b>	

## Network Studies (hydraulic simulations)

Use of network studies	NRA's responses	%	NRA's
Yes	17	71%	AT, BE, CZ, DE, ES, FR GR, HR, HU, IE, LV, PL, PT, RO, SK, UK-N. Ireland, UK-GB
No	7	29%	BG, EE, IT, LT, LU, NL, SI
<b>Total</b>	<b>24</b>	<b>100%</b>	

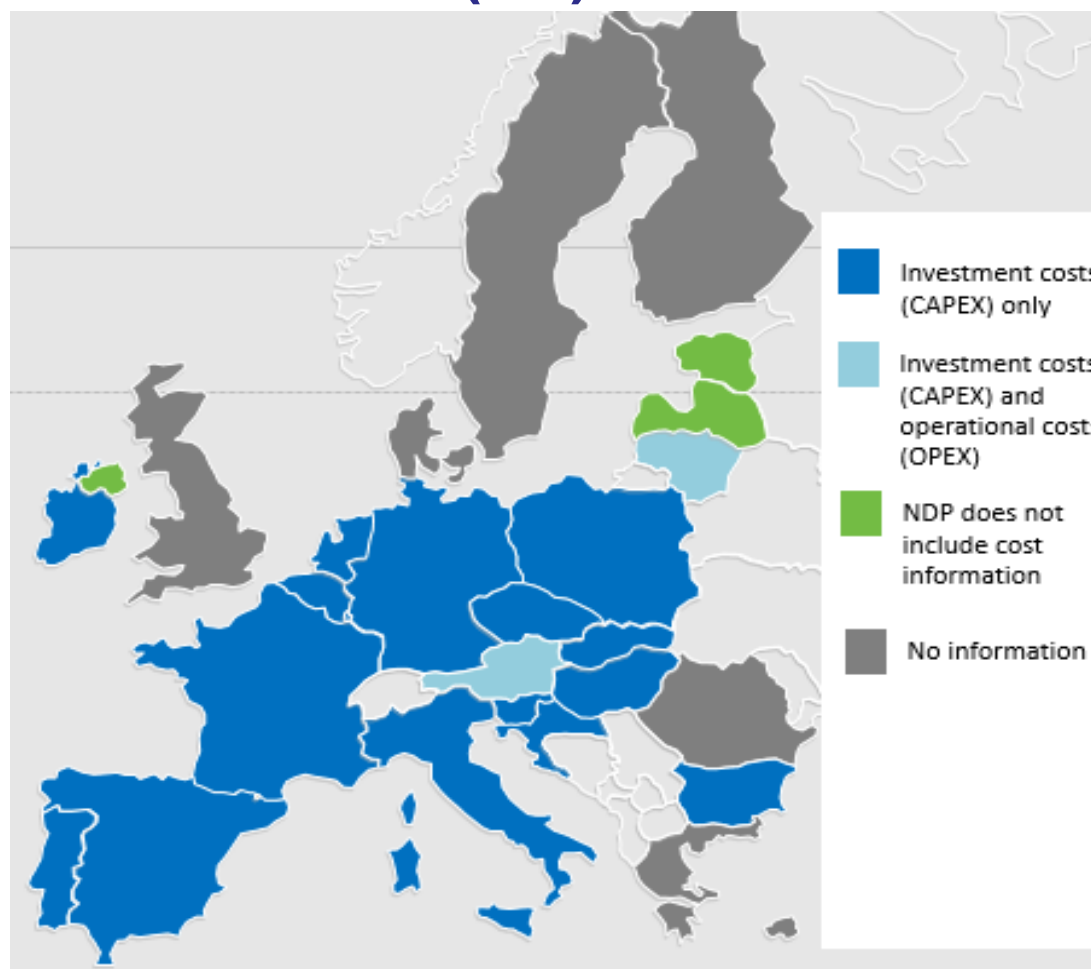


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# Review of TSO Plans and Consistency with ENTSOG TYNDP Availability of Costs and Benefits (1/2)



Source: ACER, 2016





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## Review of TSO Plans and Consistency with ENTSOG TYNDP Availability of Costs and Benefits (2/2)

Availability of costs in NDPs	NRA responses	%	NRA's
No response	3	13%	GR, RO, UK-GB
Investment costs (CAPEX)	16	67%	BE, BG, CZ, DE, ES, FR, HR, HU, IE, IT, LU, NL, PL, PT, SI, SK
Investment costs (CAPEX) and operational costs (OPEX)	2	8%	AT, LT
The NDP does not include cost information	3	13%	EE, LV, UK-N. Ireland
<b>Total</b>	<b>24</b>	<b>100%</b>	





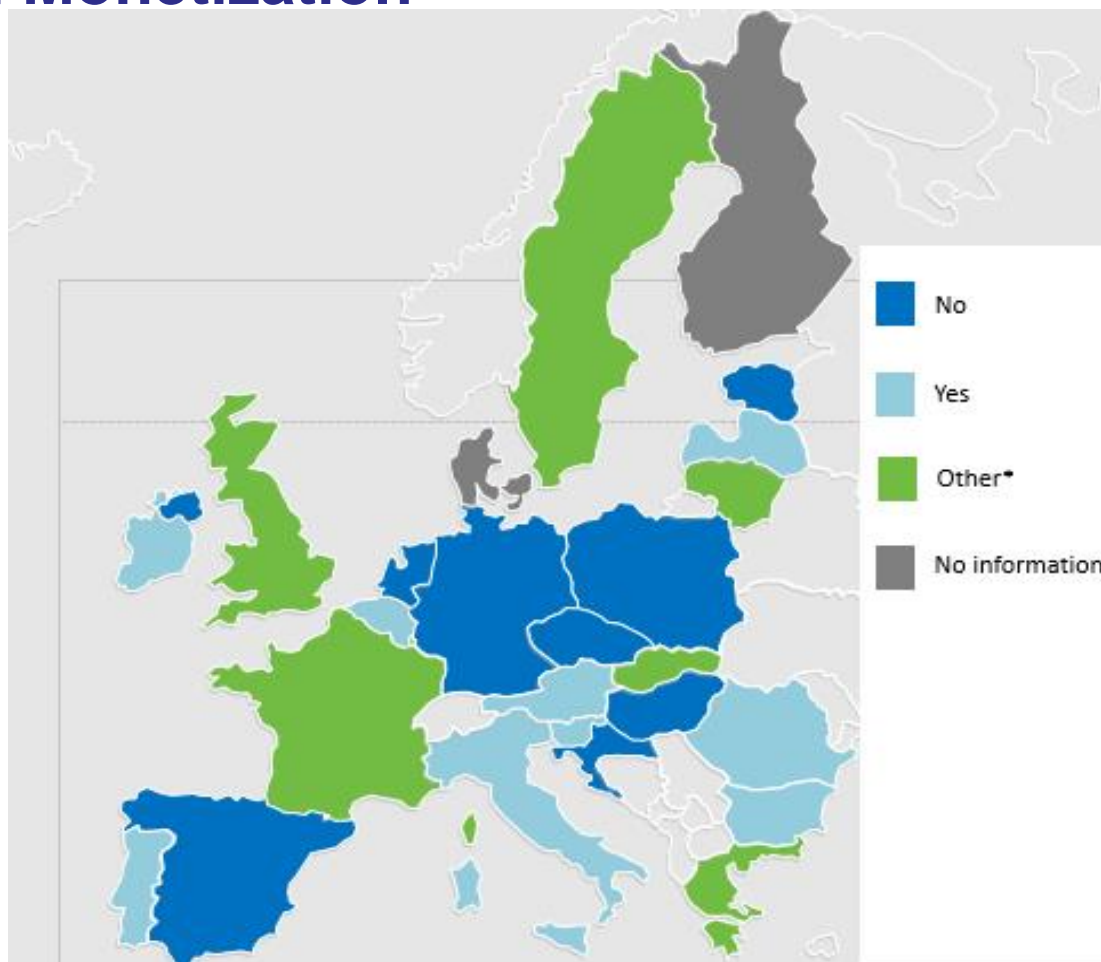
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# Review of TSO Plans and Consistency with ENTSOG TYNDP

## Use of CBA and Monetization



\* e.g. National Grid (GB) uses a “WLP” matrix



# Review of TSO Plans and Consistency with ENTSOG TYNDP

## Use of CBA and Monetization

Use of CBA in NDPs	NRA responses	%	NRAs
No	9	38%	CZ, DE, EE, ES, HU, NL, PL, UK-N. Ireland
Other	7	29%	FR, GR, HR, LT, LU, SK, UK-GB
Yes	8	33%	AT, BE, BG, IE, LV, PT, RO, SI, <b>(IT)</b>
<b>Total</b>	<b>24</b>	<b>100%</b>	



## Review of TSO Plans and Consistency with ENTSOG TYNDP Economic Evaluation of Security of Supply

SoS economic evaluation in NDPs	NRAs responses	%	NRAs
No	19	79%	AT, BE, BG, CZ, DE, EE, ES, FR, HR, IE, IT, LU, NL, PT, RO, SI, SK, UK-N, Ireland, UK-GB
Yes	3	13%	HU, LT, LV
No response	1	4%	GR
Not able to assess / respond	1	4%	PL
<b>Total</b>	<b>24</b>	<b>100%</b>	



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## Review of TSO Plans and Consistency with ENTSOG TYNDP Summary Remarks (1/2)

- Gas Demand Scenarios (multiple, sensitivity analysis) seen as very relevant at EU level, not given the same importance at national level
- Gas Demand Disaggregation included in the majority of NDPs with sufficient details
- Infrastructure Capacity Demand (i.e. capacity to serve domestic demand and transit under peak situations) usually identified as the key parameter for network development



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## Review of TSO Plans and Consistency with ENTSOG TYNDP Summary Remarks (2/2)

- CBA carried out in approx. 1/3 of the cases;
- Various categories of benefits (e.g. SoS, market integration, competition, etc.) generally not monetized;
- Other circumstances:
  - a) CBA not used systematically, but before deciding on specific investments requests (F, LT, SK) or only for specific asset investment (GR);
  - b) National Grid Gas (GB) uses a “Whole Life Prioritisation” matrix which take into account the cost, benefits and sustainability of the considered options.



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# National TSOs:

An illustrative reading  
of Snam's TYNDP





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## Main Reference Source Considered

Snam Rete Gas (Italy)







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## Mandatory Content of National TSO TYNDPs

According to NRA Resolution 351/2016/Gas, TSO plans must include at least:

- a) Detailed description of the transmission network and ancillary facilities;
- b) A number of gas scenarios;
- c) Coordination measures with other TSO/facility operators (national and foreign);
- d) List of planned infrastructure to be built or enhanced (indicating priorities) over the next 10 years;
- e) All investment decided or planned for the next 3 years (full details: financial, economic and technical);
- f) **Full CBA (with monetization) for investments under e) and simplified CBA for infrastructure under d).**



## CBA Methodology Used by Snam

- The CBA methodology used by Snam is coherent or, at least, compatible with the “Energy System Wide Cost-Benefit Analysis”, developed by ENTSOG and approved by the Commission in February 2015.
- This methodology implies financial, economic and qualitative analysis.
- Financial analysis is not carried out in Snam TYNDP, since TSO’s (allowed) revenues are determined by the national legal and regulatory framework.
- As a consequence, we’ll focus on:

Economic Appraisal

Qualitative Appraisal



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## Economic Analysis: key characteristics (1/2)

- Economic analysis is based on the following indicators:
  - NPV: Net Present Values
  - IRR: Internal Rate of Return
  - C/B: Ratio Benefits-costs
- Snam carries out a (partial) monetization of the expected benefits deriving from the planned projects, which include: SoS, market integration, competition, sustainability.
- Project Costs are the sum of CAPEX and OPEX.
- Economic analysis is conducted since the first year of project expenditure up to 20 years after the first year of availability of the new infrastructure.



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## Economic Analysis: NPV details (2/2)

NPV is calculated as follows:

$$NPV = \sum_{t=f}^{c+19} \frac{R_t - C_t}{(1 + i)^{t-n}}$$

C = first full year of operation

R<sub>t</sub> = benefit for the national network  
calculated as decrease of delivery cost due  
to gas flow enhancement

C<sub>t</sub> = cost, CAPEX + OPEX

i = discount rate, 4%

n = year of analysis

f = first year of benefit



## Qualitative Analysis: key characteristics (1/3)

- Of the two categories of indicators developed and used by ENTSO-G, i.e:
  - Capacity based: transport capacity at interconnection points
  - Modelling based: availability of gas flows (model-computed)Snam uses only those of the first category, namely:
  - **N-1**
  - **IRDI: Import Route Diversification Index**
  - **BPI: Bidirectional Project Index**
- In addition, Snam uses two other capacity indicators:
  - **IDI: Import Dependence Index**
  - **RF: Remaining Flexibility**



## Qualitative Analysis: capacity indicators

(2/3)

- **N-1 (SoS)**: capacity of the system to meet peak demand in case of disruption of the main import/supply infrastructure (high demand with probability once in 20 years).
- **IRDI (SoS)**: same logic of Herfindahl-Hirschman index, measures the degree of concentration of gas supply sources and import capacity.

$$IRDI = \sum_i^{xborder} \left( \sum_k^{IP} \%IP_k * border_i \right)^2 + \sum_j^{source} \sum_i^{IP} (\%IP_i fromsource_j)^2 + \sum_m^{LNG} (\%LNG_{terminalm})^2$$

- **BPI (market integration)**: measures the percentage of the overall counter-flow capacity over the prevailing flow.

$$BPI = \min\left(1; \frac{Capacità\ exit}{Capacità\ entry}\right)$$



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## Qualitative Analysis: capacity indicators (3/3)

- **RF (market integration)**: assesses the capacity not involved in the day of maximum demand. The higher the remaining capacity, the greater the flexibility for users:

$$\text{RemFlex} = 1 - \frac{\sum \text{Entering flow}}{\sum \text{Entry capacity}}$$

- **IDI (SoS & competition)**: measures dependence on imports and ability to meet daily demand from storage and indigenous production.

$$IDI = \frac{1}{1 + NP + UGS * 0.5}$$





# Results from Economic and Qualitative Analysis

## National Network Development Projects

PROJECT CODE	PROJECT DESCRIPTION	NPV [M€]	B/C	IRR [%]	SECURITY OF SUPPLY	MARKET INTEGRATION	COMPETITIVITY	SUSTAINABILITY'
RN_01	SUPPORTO MERCATO NORD OVEST E FLUSSI BIDIREZIONALI TRANSFRONTALIERI	328	1,5	7,3	X	X		
RN_02	INTERCONNESSIONE CON SLOVENIA	11	3,1	19,2				
RN_03	LINEA ADRIATICA	354	1,3	6,2	X			X
RN_04	POTENZIAMENTI IMPORTAZIONI NORD EST	330	2,0	12,0	X		X	X
RN_05	ULTERIORI POTENZIAMENTI A SUD	-488	0,7	1,9	X			X
RN_06	GALSI	-171	0,8	2,5	X			X

Excerpt from  
Snam's TYNP  
2016-2025

- Expected benefits are only partially monetized
- Apart from reduced delivery cost, economic factors taken into consideration:
  - Market value of avoided interruptions;
  - Hub price reduction;
  - Cost of Co2



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## Concluding Remarks

- Despite the persistence of significant diversity among TSO NDPs and a limited degree of inconsistency with ENTSOG TYNDP, a trend toward harmonization of assumptions, inputs and analytical methodologies is clearly visible.
- Refined CBA, project cost data and monetization techniques are becoming more common in planning practice.
- Significant progress in terms of case-specific economic and market tests; greater TSO coordination still to be achieved.



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**Thank you for your attention.**