2nd SJWS on CBA methodology

Implementation of the concept

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Introduction – SJWS 2

Introduction

> Implementation of the concept
  - Infrastructure indicators
  - The role of indicators in identification of the impacted countries
  - Quantitative analysis as an input for monetization and quantitative reflection of the impact
  - Quantitative analysis- case study
  - Saved cost approach- case study
  - Quantitative analysis- conclusions
  - Qualitative assessment- conclusions

I. Infrastructure indicators

Infrastructure Indicators – PS CBA

Daily peak exposure – DPE

> The indicator reflects the capability of local infrastructure to cover peak demand, seen as difference between high daily demand and average demand.

$$EXP = \frac{NP + UGS + LNG - (D_h - D_a)}{(D_h - D_a)}$$

$$EXP' = \frac{Q_{alloc} + NP + UGS + LNG - (D_h - D_a)}{(D_h - D_a)}$$

> The objective is to assess how local infrastructure covers Dh-Da. If covered, additional volumes can be dispatched to connected systems (cross-border impact).

> Inputs defined:

- Q_{alloc}: Flow allocated from originator country (country A) used in the second step of application
- NP: National Production – daily capacity
- UGS: UGS daily withdrawal capacity
- LNG: LNG daily withdrawal capacity
- D_h: High daily demand situation
- D_a: Average daily demand situation

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Infrastructure Indicators – PS CBA

Daily peak exposure – DPE

> <u>Assumptions:</u>
- Indicator assumes, that Da is covered by IMP pipelines
- Dh demand situation is assumed – short term reflection
- Better control is assumed over local infrastructure in Dh situation, then on IMP

> The indicator could be improved in order to better reflect the realistic capacity distribution between the coverage of Dh and Da.

Infrastructure Indicators – PS CBA

Daily peak exposure – DPE

> <u>Application</u>

- PS-CBA
- All types of projects
- The indicator will be used to assess a new projects' potential capability in 'helping' another country to reach the target value of the indicator, thus to define the most impacted countries after a project is commissioned
- To determine the most impacted countries and allocation of flows as input in the monetization
- **Can be used for transmission projects as well, to determine whether a new infrastructure or infrastructure upgrade enables neighbouring countries to access residual volumes in D_h situation – to be explained on the following slides (algorithm)**

Infrastructure Indicators – PS CBA

Offered reverse flow capacity - RFC

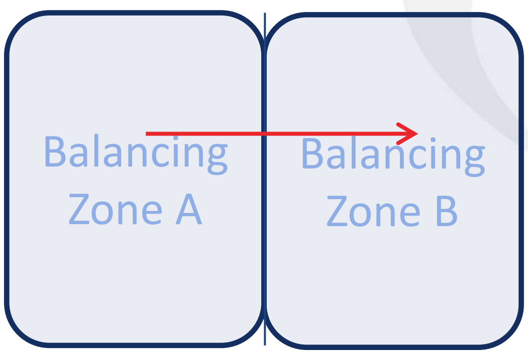
> Aims to assess the offered reverse flow capacity, as a specific type of pipeline infrastructure investment.

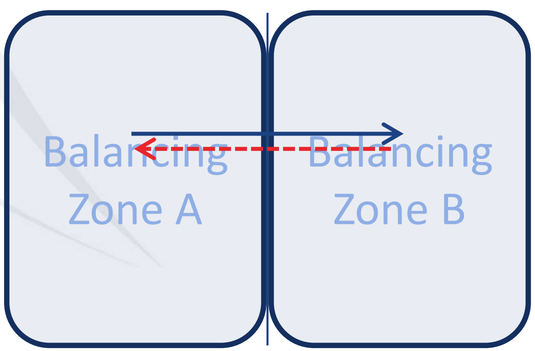
> Aims to capture the specificities of reverse flow pipeline projects

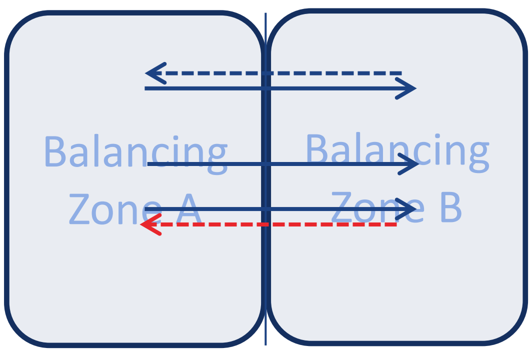
> Questions:

> Reverse flow investment shall mean only adding reverse flow capacity to a mono-directional IP/increasing reverse flow capacity of an existing bidirectional IP or also creating a completely new bidirectional IP?

> The assessment of a reverse flow project shall focus only on the single investment location (single IP) or the evaluation shall be extended to aggregated IP level, meaning the whole border between the corresponding zones?





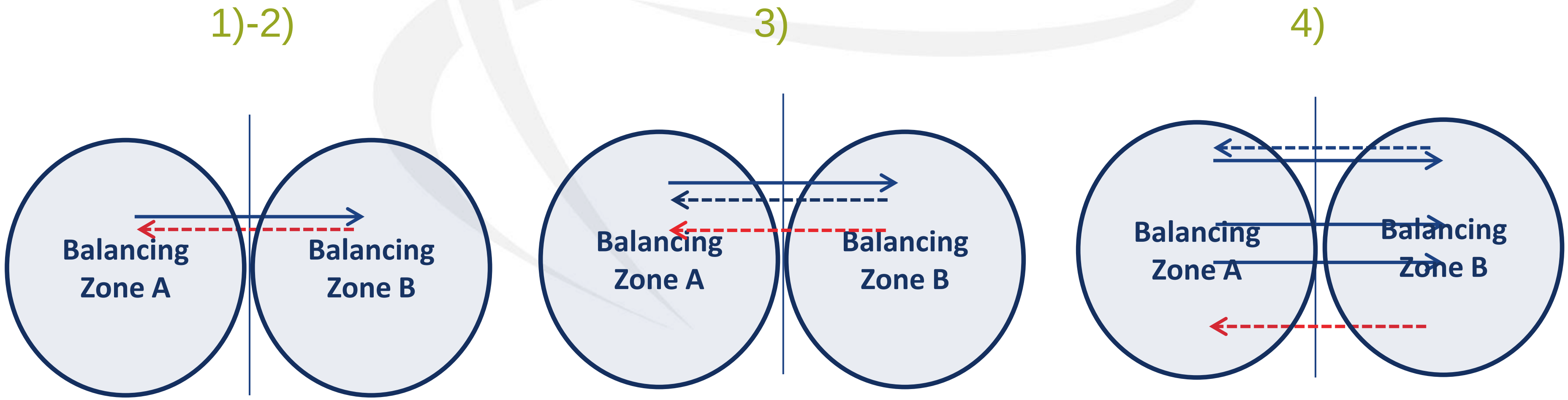


Infrastructure Indicators – PS CBA

Offered reverse flow capacity – RFC

> Suggestion:

1) construction of a new bidirectional pipeline
2) single direction IP upgraded to be able to flow in either direction
3) Increasing capacity of existing bi directional IC
4) Increasing in aggregate existing pipeline capacity across MS's interconnects balancing zone borders so that the effect is an increase in bi directional capacity (even if the pipelines' can only physically flow in one direction)



Infrastructure Indicators – PS CBA (2)

N-1 Indicator

- Applicability for PS-CBA:
  - N-1 at country level:
    - Identification of the availability/ need/country to take benefits from a new project
    - Identification of the impacted countries
  - N-1 at Regional level
    - Identification of the Regional impact (as defined within the Joint Risk Assessment by MSs)
- Pros:
  - Required by the Regulation on regional level
  - Applicable for all types of projects
  - N-1 data are provided by MSs or Competent Authorities
- Questions:
  - N-1 at country/regional level:
    - How to reflect the changes within the time horizon of the analysis for the PS-CBA, if applied on country level?
    - If there are different perspectives regarding the « regional level » between PS-CBA and MSs joint risk assessment, how shall it be handeld?
    - How to reflect within the sensitivity scenarios, the possible change of the single largest infrastructure throughout the time horizon?

Infrastructure Indicators – PS CBA (1)

$$N\text{-}1 = \frac{EPm + Pm + Sm + LNGm - Im}{Dmax} * 100 \geq 100\%$$

> Where:
- EP_m: sum of technical capacity of all border entry points capable to supply gas to calculated area (other than NP, LNG, UGS)
- P_m:maximal technical production capability (mcm/d)
- S_m: maximal technical storage deliverability (mcm/d)
- LNGm: maximal technical LNG facility capacity, considering all critical elements (offloading, ancillary services, temporary storage, and re-gasification of LNG, technical send –out capacity
- I_m: technical capacity of the single largest infrastructure (in mcm/d)
- D_{max}:total daily gas demand of the calculated area durindg a day of exceptionally high gas demand occuring with a statistical probability of once in 20

N-1 at Regional level

> Calculated area shall be extended to the appropriate regional level, as determined by the MSs

> The single largest gas infrastructure in the Region, as defined in the Joint Preventive Action Plan

Infrastructure Indicators – ESW CBA/PS-CBA

Import dependence index – IDI <1

> The objective of the indicator is to reflect the vulnerability of a country to import. The lower the value of the index, the lower the vulnerability.

$$IDI = \frac{1}{1 + (\text{National Production } share) + \frac{UGS\ share}{2}}$$

$$IDI' = \frac{1}{1 + Q_{alloc} + (\text{National Production } share) + \frac{UGS\ share}{2}}$$

> Where:

- Qalloc: Flow allocated from originator country (country A) used in the second step of application
- National Production *share*: aggregated shares of NP deliverability (share of the average daily demand (Da) of a zone)
- UGS *share*: aggregated shares of UGS deliverability (share of the Da of a zone)

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Infrastructure Indicators – ESW CBA/PS-CBA

Import dependence index – IDI <1

> <u>Assumption:</u>
  - 0.5 factor considered for the UGS, as the storage has a neutral balance over the year
  - Da situation is assumed – medium term reflection

> Source of data information: TYNDP

> <u>Application:</u>
  - PS-CBA: To determine impacted countries
  - ESW-CBA: To analyse the impact of the group of PCI projects on a European level

Infrastructure Indicators – ESW CBA

Import route diversification index – IRD

> The objective of the indicator is to reflect the concentration of the aggregated Entry capacities and the positive impact of a new Entry capacity.

$$\sum_{l}^{x\ border}\left(\sum_{k}^{IP}\%IP_k Xborder_l\right)^2+\sum_{j}^{Source}\sum_{i}^{IP}\left(\%IP_i from\ source_j\right)^2+\sum_{m}\left(\%LNG\ terminal_m\right)^2$$

> <u>Where:</u>

- Aggregated values are used directly for IP between European zones
- Import points for non-EU gas are considered individually

Infrastructure Indicators – ESW CBA

Import route diversification index – IRD

> Application:

- ESW-CBA/ PS -CBA
- All types of projects
- Incremental approach (comparison between « without/with the project scenarios)- the lower the value, the better the diversification

> Pros:

- Capacity based indicator assessing the diversification of routes
- Substituting HHI at capacity level
- Reflects ability of a Zone to substitute one route by another one when facing disruption

Infrastructure Indicators – ESW CBA

Remaining flexibility at zone level (Infrastructure Resilience assessment)

> The objective of the indicator is to identify investment gaps based on the level of remaining flexibility:
- <5% under Reference case
- <1% under supply stress (when part of the flexibility has been used to face the Supply stress)

$$RemFlex = 1 - \frac{\sum Entering\ Flow}{\sum Entry\ Capacity}$$

> Where:
- The indicator at zone level considers both the gas staying in the zone to face demand and the gas exiting to adjacent systems

> Application:
- All types of projects
- ESW-CBA
- Based on modeling

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Infrastructure Indicators – ESW CBA

Supply Source Dependence
(Supply Source Dependence assessment)

> The objective of the indicator is the identification of zones whose balance depend strongly on a single supply source over the year
- Carried out under 1-day average situation to identify the dependence on a single supply source by
- Full minimization of each supply source separately and replacement of corresponding volumes by the remaining sources
- Reflects the ability of the remaining source to replace a specific supply source

> <u>Application:</u>
- All types of projects
- ESW-CBA
- Based on modeling

Infrastructure Indicators – ESW CBA

Infrastructure Adaptability (Assessment of Infrastructure Adaptability to supply evolution)

> Objectives:

- Reflects the European infrastructure's ability to face very different supply mixes as resulting from short-term signals or long –term trends
- Assessment carried under 1- day Average demand situation, in order to identify the ability to balance every zone under a maximum Potential Supply or Mimimum Potential Supply scenarios
- Limited factor is identified when no flow pattern enables to reach the potential supply scenarios

> Application:

- All types of projects
- ESW-CBA
- Based on flow pattern modeling

Infrastructure Indicators

Supply Source Diversification
(Supply Source Diversification assessment)

> The objective of the indicator is to assess the benefits of projects enabling access to new supply source.

> Methodology:
- Aims to determine the ability of each zone to access each identified supply source
- It is based on simulations to test the supply reach in all directions at the level of 5% and 20% share of total supply (including indigenous production) in each zone

> Application:
- All types of projects
- ESW-CBA
- Based on flow modelling

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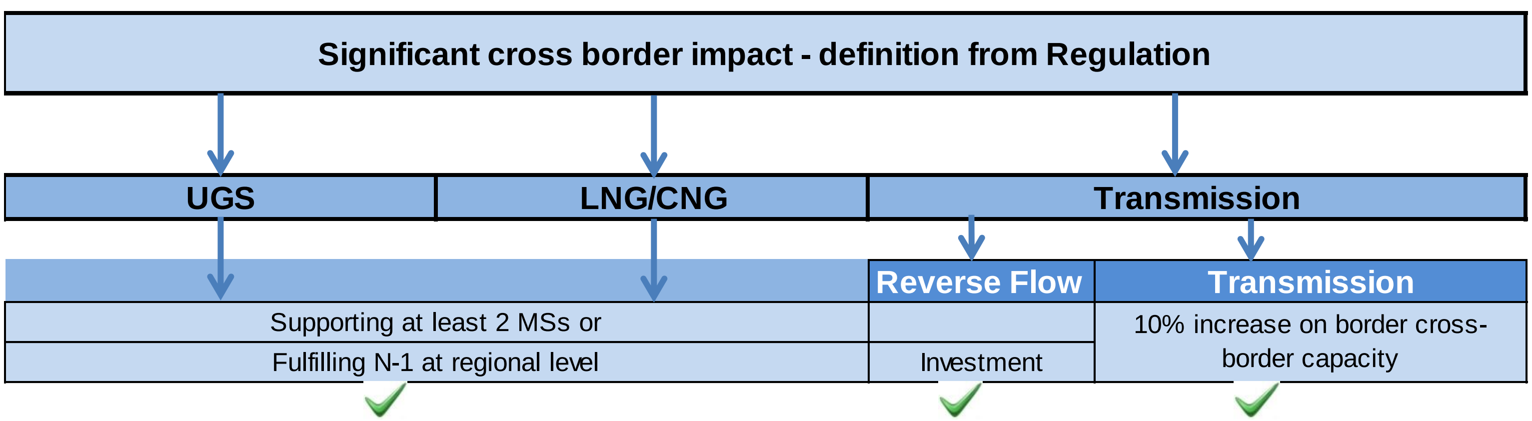
II. Role of indicators

Role of indicators

Definition from Regulation 347/2013

> Determining significant impact(Annex IV 1 c,d)
- Reverse flow projects
- UGS/ LNG/CNG projects
- Gas transmission projects

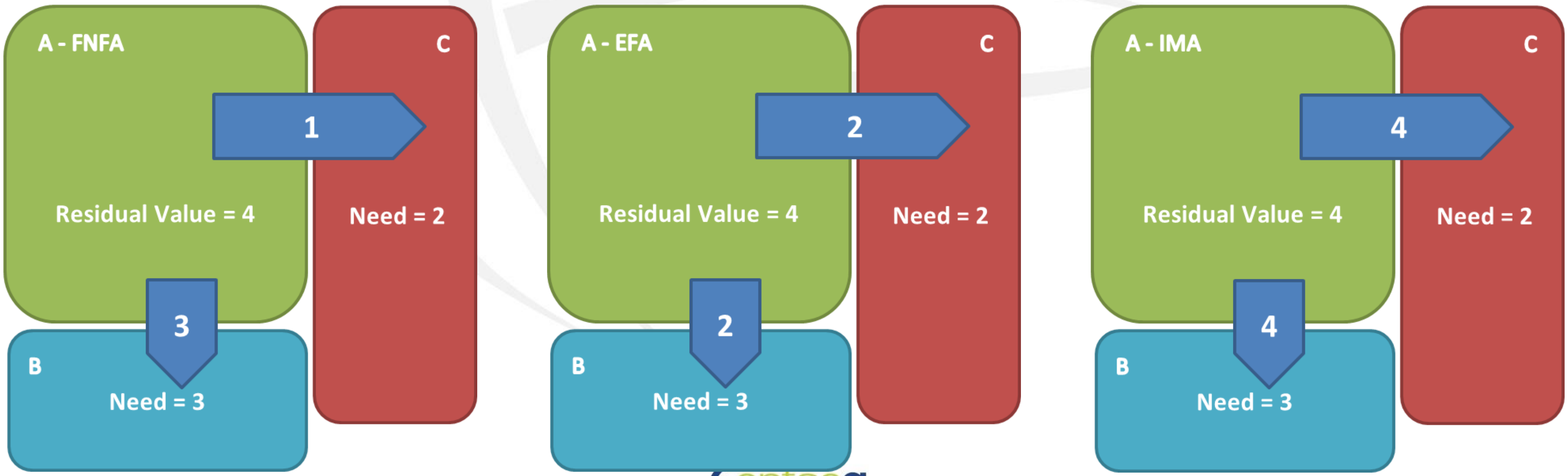
Legislation Checklist



Role of indicators

Area of impact as an output of quantitative analysis

- Algorithm for defining region of impact as input for monetization
- Distribution of flow (alternatives):
  - A) Provided by the modelling tool in ESW
  - B) Defined based on the algorithm
    - First in Need First Allocated (FNFA)
    - Equally Allocated Flow (EAF)
    - Indicator Maximization Allocation (IMA)



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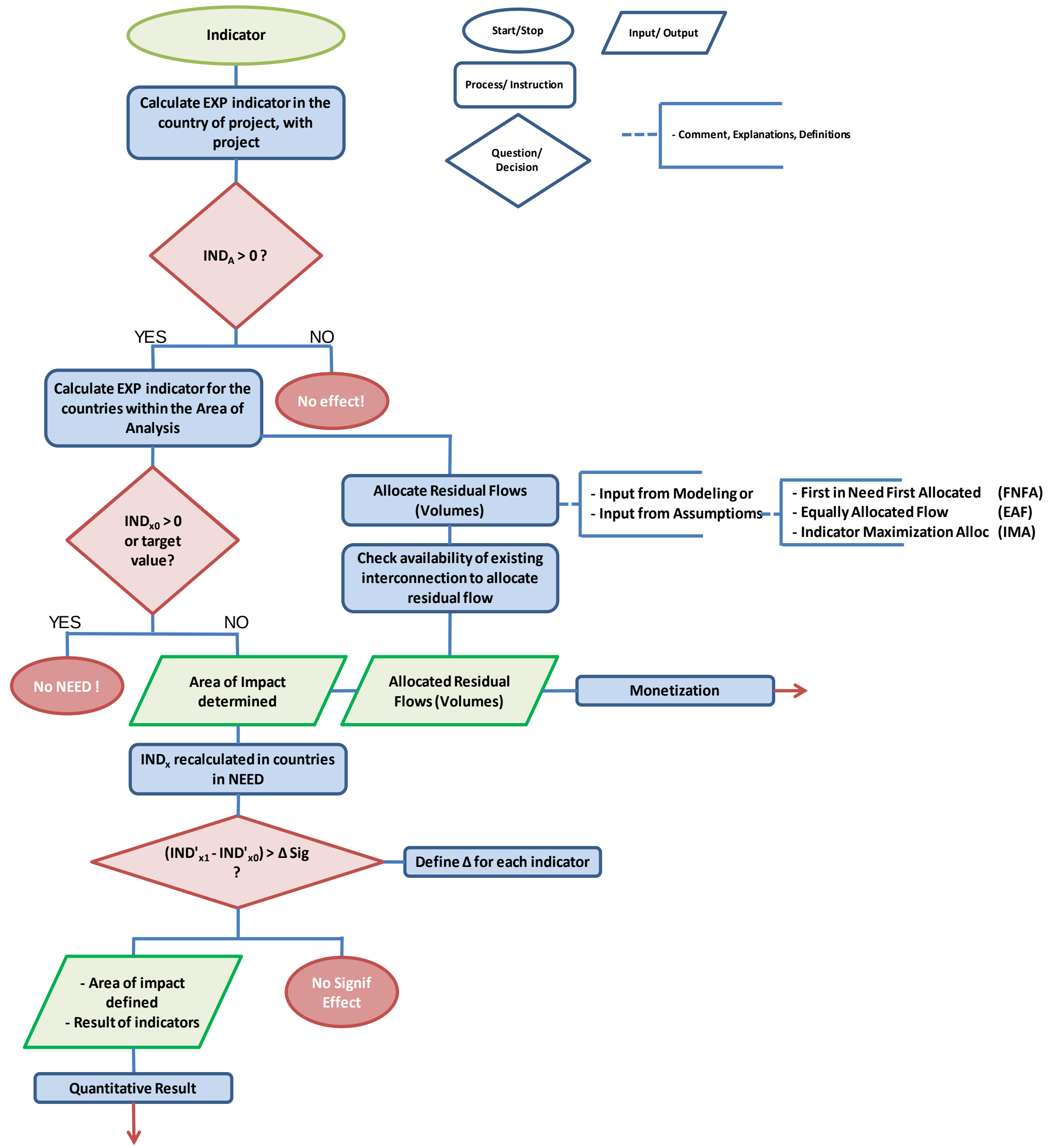
Role of indicators

Graphical Representation –
Area of impact

Algorithm for applying indicators to determine the most impacted countries

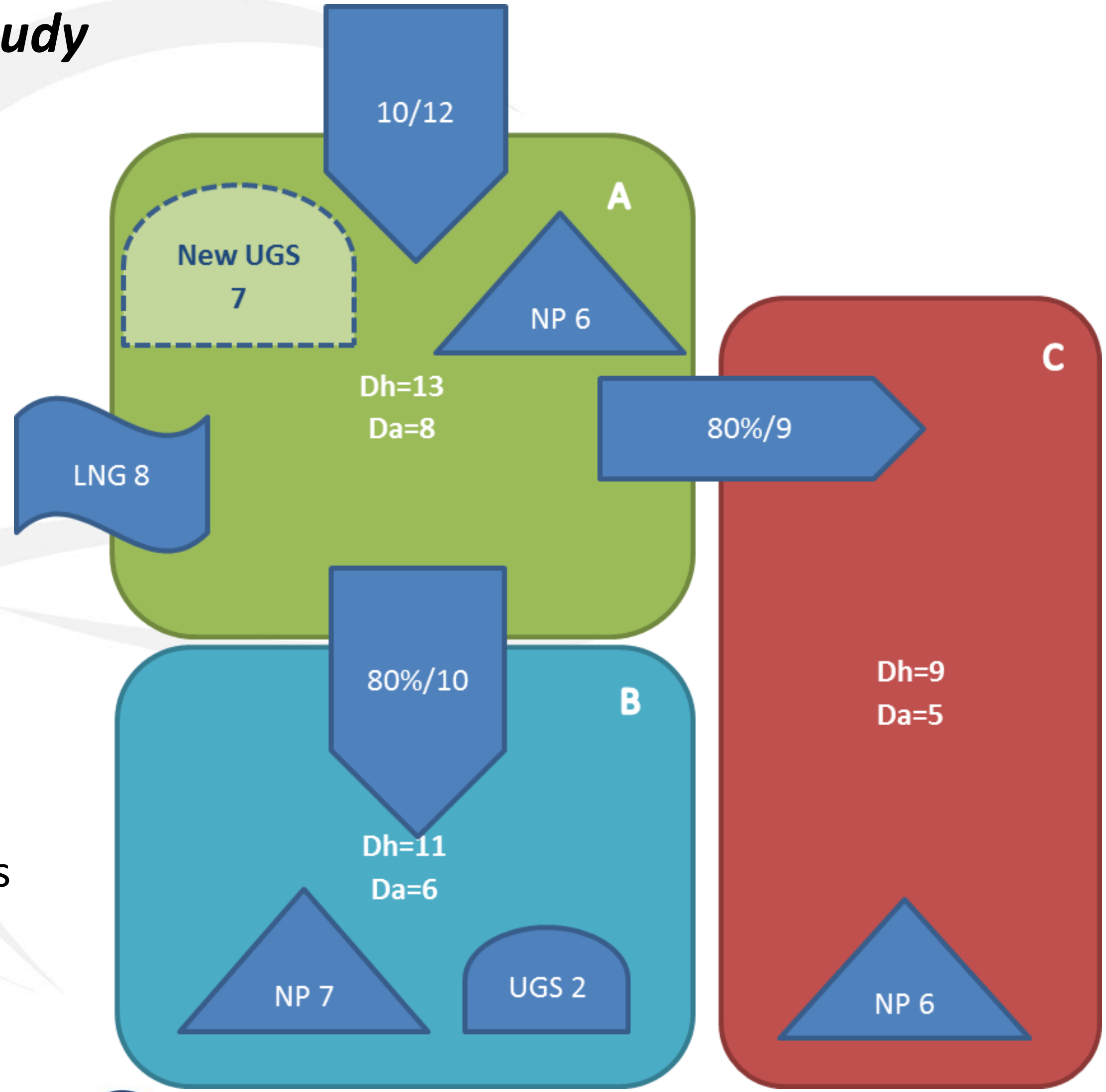


III. Case study

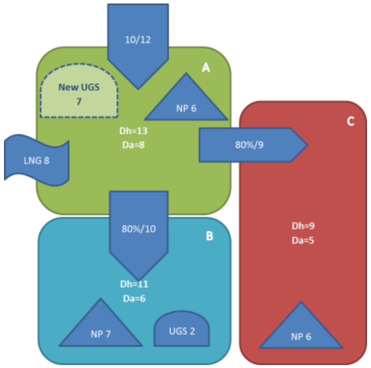
Case study – Defining the Area of Impact

Assumptions for the Case Study

- Da is covered from IPs
- It is assumed, that local infrastructure (UGS, LNG, NP) is used to cover the difference between average day and high daily demand conditions
- To value the potential benefit of the project, SoS scenario high daily demand is assumed
- It is assumed, that the new infrastructure can deliver benefits to the adjescent systems under Dh conditions



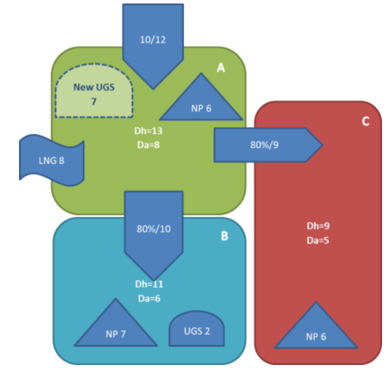
Case study – Area of impact



The input data

	Country A		Country B	Country C
	w/o	**w**	**w/o**	**w/o**
Dh	*13*	*13*	*11*	*9*
Da	*5*	*5*	*6*	*5*
Dp	8	8	5	4
UGS	0	7	1	0
LNG	8	8	0	0
NP	6	6	5	3,5
EXP	**0,75**	**1,625**	**0,2**	**-0,125**
			NEED	**NEED**
Target Value of the Indicator >			**0,2**	

Case study – Area of impact



Results in different allocation scenarios

FNFA	Country A		Country B		Country C	
	w/o	w	w/o	w	w/o	w
Dh	*13*	*13*	*11*	*11*	*9*	*9*
Da	*5*	*5*	*6*	*6*	*5*	*5*
Dp	8	8	5	5	4	4
UGS	0	7	1	1	0	0
LNG	8	8	0	0	0	0
NP	6	6	5	5	3,5	3,5
Allocated				**0,050**		**1,3**
Check				OK		OK
Remaining	10,050					
EXP	**0,75**	**1,625**	**0,2**	**0,21**	**-0,125**	**0,2**
Change				0,01		0,325

> Calculation is made, so that the value of the indicator in Country A, does not decrease below the target value.

> Different target values could be possible for Country A and the others.

EAF	Country A		Country B		Country C	
	w/o	w	w/o	w	w/o	w
Dh	*13*	*13*	*11*	*11*	*9*	*9*
Da	*5*	*5*	*6*	*6*	*5*	*5*
Dp	8	8	5	5	4	4
UGS	0	7	1	1	0	0
LNG	8	8	0	0	0	0
NP	6	6	5	5	3,5	3,5
Allocated				**5,700**		**5,7**
Re-Allocated				**2,000**		**1,8**
Check				Not OK		Not OK
Re-Check				OK		OK
Remaining	0,000					
EXP	**0,75**	**1,625**	**0,2**	**1,34**	**-0,125**	**1,3**
Re-EXP			**0,2**	**0,6**	**-0,125**	**0,325**
Change				1,14		1,425
Re-Change				0,4		0,45

RTVA	Country A		Country B		Country C	
	w/o	w	w/o	w	w/o	w
Dh	*13*	*13*	*11*	*11*	*9*	*9*
Da	*5*	*5*	*6*	*6*	*5*	*5*
Dp	8	8	5	5	4	4
UGS	0	7	1	1	0	0
LNG	8	8	0	0	0	0
NP	6	6	5	5	3,5	3,5
Allocated				**0,050**		**1,3**
Re-Allocated						
Check				OK		OK
Re-Check				OK		OK
Remaining	10,050					
EXP	**0,75**	**1,625**	**0,2**	**0,21**	**-0,125**	**0,2**
Re-EXP			0,2	0,2	-0,125	-0,125
Change				0,01		0,325
Re-Change				0		0

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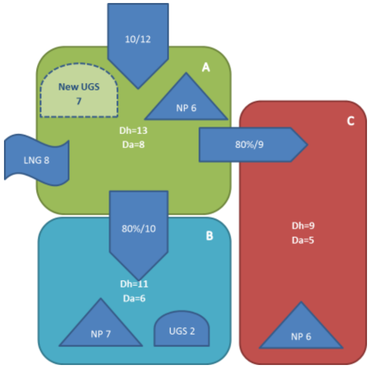
Case study – Area of impact



Final results – input for monetization

> Input for Monetization

> Result for Quantitative Analysis

RESULTS							
		Country B			Country C		
Allocated Volumes		**w/o**	**w**	**Δ**	**w/o**	**w**	**Δ**
	FNFA		**0,05**			**1,3**	
	EAF		**2**			**1,8**	
	RTVA		**0,05**			**1,3**	
Indicators							
Peak Exposure	*FNFA*	0,2	0,21	**0,01**	-0,125	0,2	**0,325**
	EAF	0,2	0,6	**0,4**	-0,125	0,325	**0,45**
	RTVA	0,2	0,21	**0,01**	-0,125	0,2	**0,325**

IV. Saved cost approach

Structure of the economic flow

Saved cost approach- Structure of the economic flow

			Time horizon						
No	Explanation	Source of information	n	n+1	n+2	n+3	n+4	n+	n+20
A	**Input data**								
I	**Total costs**								
1	Investment costs	**Financial analysis**	-	-	-	-			
2	Operating costs						-	-	-
3	Other costs (decommissioning)							-	
4	Residual value								+
II	**Total Economic benefits**								
1	Saved costs in country A	**Quantitative analysis Country specific data**					+	+	+
2	Saved costs in country B						+	+	+
3	Saved costs in country C						+	+	+
III	**Social discount rate (SDR)**								
B	**Output data**								
(IV =II-I)	**Net economic benefits (if ∑Economic benefits>∑Costs)**		-	-	-	-	+	+	+
V	**Performance economic indicators**								
1	**ENPV (>0)**								
2	**EIRR (>SDR)**								
3	**B/C (>1)**								

Case study – Saved Cost Approach

Case study- economic flow for the sustainability criteria (1)

> Constant input data:

Input data	Sensitivity
Calorific values/fuel	No
Emission factors/fuel	No
Thermal efficiency (power generation)	No
Structure of the energy market	Yes
Market share of alternative fuels	Yes
Fuel price scenarios	Yes
CO2 price scenarios	Yes
Social Discount Rate	Yes

> Variable input data

Input data	
Project specific	Investment cost
	O&M costs
	Replacement costs
	Residual value
Quantitative analysis	Distribution of volumes

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Case study/ saved cost approach

Assessment of sustainability criteria

Microsoft Excel Worksheet

> Assumptions:
- An infrastructure project built in country A:
  - Period of construction 4 years
  - Commissioning: 2017
  - SDR: 5,5%
- The incremental gas volumes have the potential to replace some other fuels (higher CO_2 emissions and costs)
- Area of analysis: country A, B, C (interconnected countries)
- Countries impacted based on quantitative analysis: A, B
- Project specific input data:
  - CAPEX: 320 mEUR
  - OPEX: 3% of CAPEX
  - Residual value: 160 mEUR – NPV is calculated from it
  - Discounted cash flow is based on constant values

Case study/ saved cost approach

Please note:

- The case study aims to describe the methodology and enhance comprehension. It is not based on real project and does not include real figures or values.
- The approach of the methodology is based on assessing the potential benefits of each type of infrastructure.
- Sensitivity analysis applied along the critical variables can lead to different results.
- The results of the analysis are highly sensitive to the following inputs:
  - Structure of the energy market – energy mix
  - Fuel/CO_2 price scenarios
  - Social Discount Rate
  - Distribution of volumes based on the quantitative analysis
  - Cost of the project
  - Etc.

V. Quantitative analysis

Quantitative analysis

Possible approaches to highlight and use the results of the indicators

> Matrix of indicators (alternative presentation)

A. Reflection of impact for the year of commissioning only
B. Reflection of impact for certain years (n+5; n+10; n+15; n+20)
C. Reflection of impact for each year, starting with the year of commissioning

> Considerations

- During the 20-year time horizon a number of projects can come on stream.
- Scenarios might change, thus the result of the indicators is to change.
- The results are more robust if based on multiple years and multiple indicators.

VI. Qualitative Analysis

Qualitative Analysis

Integrated analysis

> Steps
  - Define target value for the variation in the value of indicators in the scenarios with and without the project. (e.g. Δ<0%; 0%<Δ<5%; 5%<Δ)
    - Average (Δ) of the variations along the time horizon
  - Matrix of indicator results over the time horizon of 20-year of operation.
  - Checklist of criteria (General and Specific)
    - General criteria are a precondition
    - Benefits can be reflected within the checklist
    - Checklist proves overlapping between the criteria and the way each criteria is defined by the indicators (one indicator reflects more criteria)
    - The checklist to be filled out based on the same rules, related to the value of the Δ.

Qualitative Analysis

Possible reflection of the Quantitative and Qualitative Analysis

> Under development

Country A — **w/o -** without project — **w -** with the project

Indicators	Target value	Time horizon	Impacted country A		Specific criteria											
					MI			Comp			SoS			Sustain.		
		/ImpactYear	w/o	w	High	Medium	Low	High	Medium	Low	High	Medium	Low	High	Medium	Low
I_1	1	1	1,2	1,4												
		2														
		3														
		4														
		5														
		6														
		7														
		……														
		20														
I_2		1-20														
I_3		1-20														
I_x		1-20														

Country B

Indicators	Target value	Time horizon	Impacted country B		Specific criteria											
					MI			Comp			SoS			Sustain.		
		/ImpactYear	w/o	w	High	Medium	Low	High	Medium	Low	High	Medium	Low	High	Medium	Low
I_1	1	1	1,2	1,4												
		2														
		3														
		4														
		5														
		6														
		7														
		……														
		20														
I_2		1-20														
I_3		1-20														
I_x		1-20														

Questions

Questions to the SJWS II

- Do you consider that the algorithm is applicable for the determination of impacted countries?
- Which could be the most applicable alternative for the distribution of volumes?
  - A. Consider as reference case the FNFA and the other alternatives for the sensitivity cases?
  - B. Consider other alternative
- Do you consider that the output of the algorithm is a relevant input for the monetization based on saved cost approach?
- Do you consider that the algorithm should be applied along the whole operational time horizon in order to have a robust distribution of volumes between countries?
- Reverse flow investment shall mean only adding reverse flow capacity to a mono-directional IP/increasing reverse flow capacity of an existing bidirectional IP or also creating a completely new bidirectional IP?
- The assessment of a reverse flow project shall focus only on the single investment location (single IP) or the evaluation shall be extended to aggregated IP level, meaning the whole border between the corresponsing zones?

Questions

Questions to the SJWS II

- Considering the sensitivity of the ENPV to the change in the SDR, do you agree with applying a single discount rate for all the PCIs, to ensure comparability?
- Do you consider that the project promoter should apply the N-1 indicator based on the available data and considering the Area of Analysis; or the N-1 at country level as defined by the MS should be considered applicable by default?

Thank You for Your Attention

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