Cost-benefit analysis:

- Calculation of Grid Transfer Capability
- Clustering of Projects

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entsoe

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Grid Transfer Capability: Definition

- The Grid Transfer Capability (GTC) reflects the **ability of the grid to transport electricity across a boundary**, i.e. from one area (bidding area, area within a country or a TSO) to another. It depends on the considered state of consumption, generation and exchange, as well as the topology and availability of the grid, and accounts for safety rules.

- The GTC is **oriented**, which means that across a boundary, there may be two different values. A boundary may be fixed (border between states or bidding areas), or vary from one horizon or scenario to another.

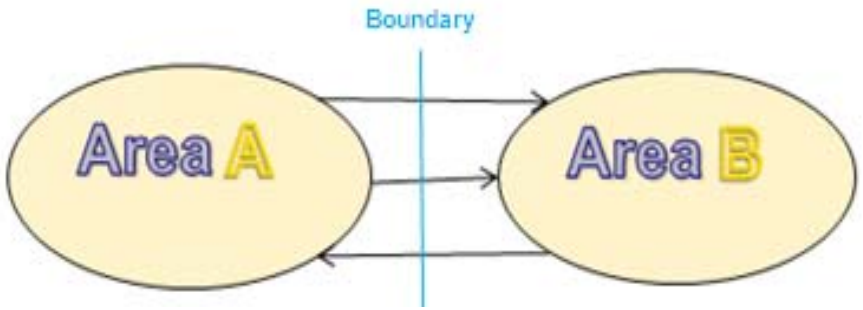
- Grid projects provide an increase of GTC that can be assessed in MW.

Grid Transfer Capability: Calculation (1)

The GTC is evaluated with a static analysis in safe network conditions. For all cases the valuation method of project assessment indicators will consider a starting condition with all projects in service, with the steps comprising:

Step 1. ***Load flow calculation in the reference cases***

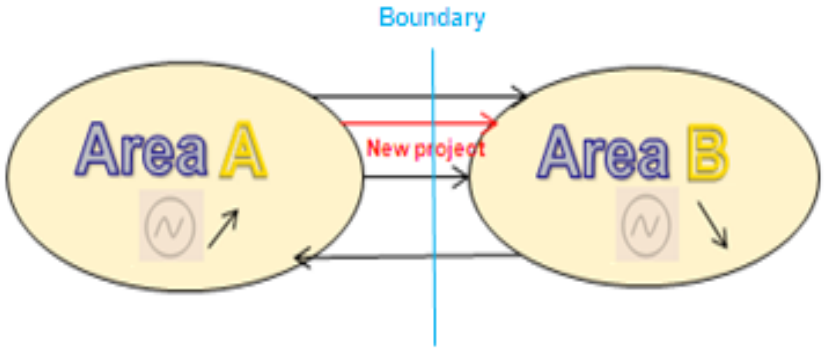
GTC is calculated by summing the flows of active power, taking account of flow direction, in all of the circuits that cross the boundary between the two areas being considered.



	∑ active flows	Direction
Planning Case 1	100 MW	A → B
Planning Case 2	200 MW	A → B
...		
Planning Case n	-100 MW	B → A

Grid Transfer Capability: Calculation (2)

Step 2. ***Maximum grid transfer capability*** across a boundary between two areas is found, with and without the project in a certain direction, assuming that the flow is to be maximised in the direction of the net flow across the boundary in the reference condition.



	Direction	Max GTC without project	Max GTC with project
Planning Case 1	A → B	500 MW	1000 MW
Planning Case 2	A → B	700 MW	1400 MW
...			
Planning Case n	B → A	-300 MW	-500 MW

Grid Transfer Capability: Calculation (3)

Step 3. ***The total benefit for each project and indicator is obtained*** combining the benefit for each planning case according to the formula:

$$Benefit = \sum_{i=1}^{TC} Benefit_i * Hours_i$$

where: TC = number of planning cases that represent the horizon

$Benefit_i$ = Benefit for each planning case calculated as the difference of maximum benefit with and without the project

$Hours_i$ = the total number of hours that the planning case represents /8760

	Direction	Benefit	Weight in hours
Planning Case 1	A → B	500 MW	2000 hours
Planning Case 2	A → B	700 MW	500 hours
Planning Case 3	A → B	900 MW	500 hours
Planning Case 4	A → B	1500 MW	10 hours
Planning Case 5	A → B	600 MW	5000 hours
Planning Case 6	A → B	200 MW	750 hours

→ Total weighted benefit : 567 MW

Grid Transfer Capability: Categories

Three different categories of Grid Transfer Capability have been considered:

- generation accommodation capability ;
- security of supply capability ;
- exchange capability between bidding areas (NTC).

Values of GTC provided:

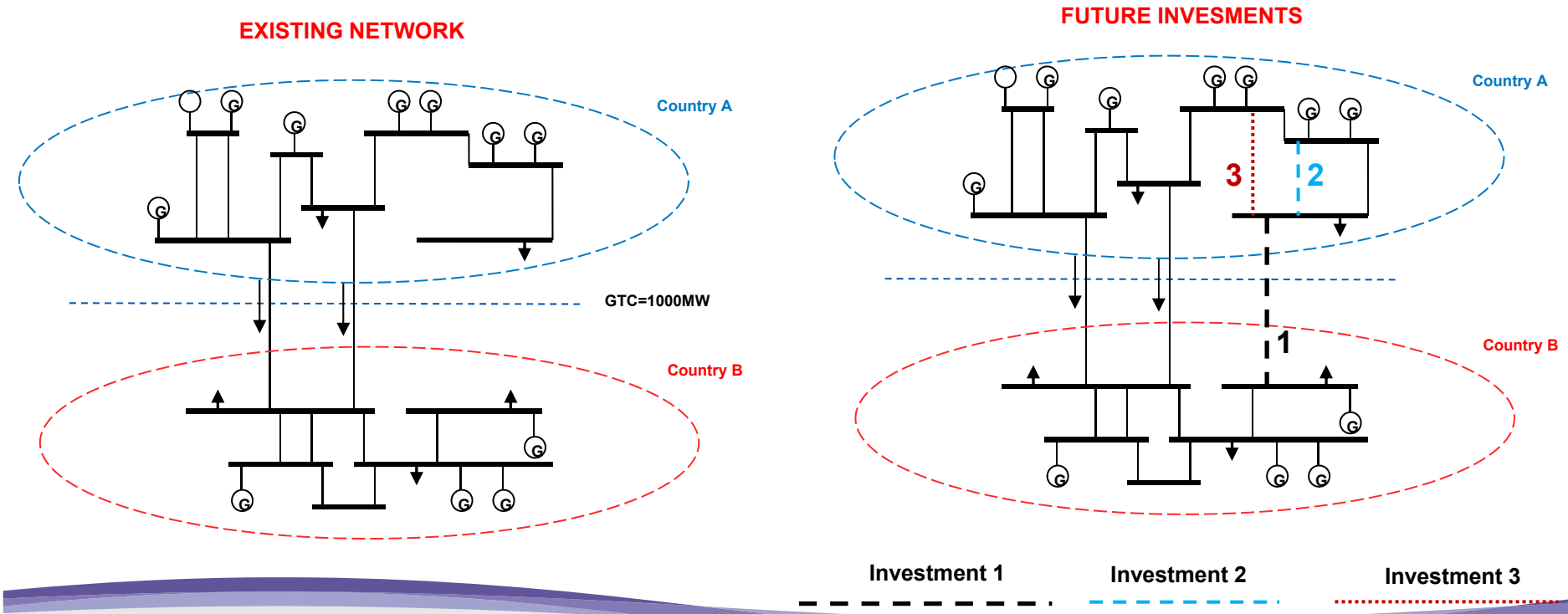
- Maximum
- Annual average
- Representative value existing i.e. 30% of the year
- Full range + suggested mean value

Clustering of Investments: Definition

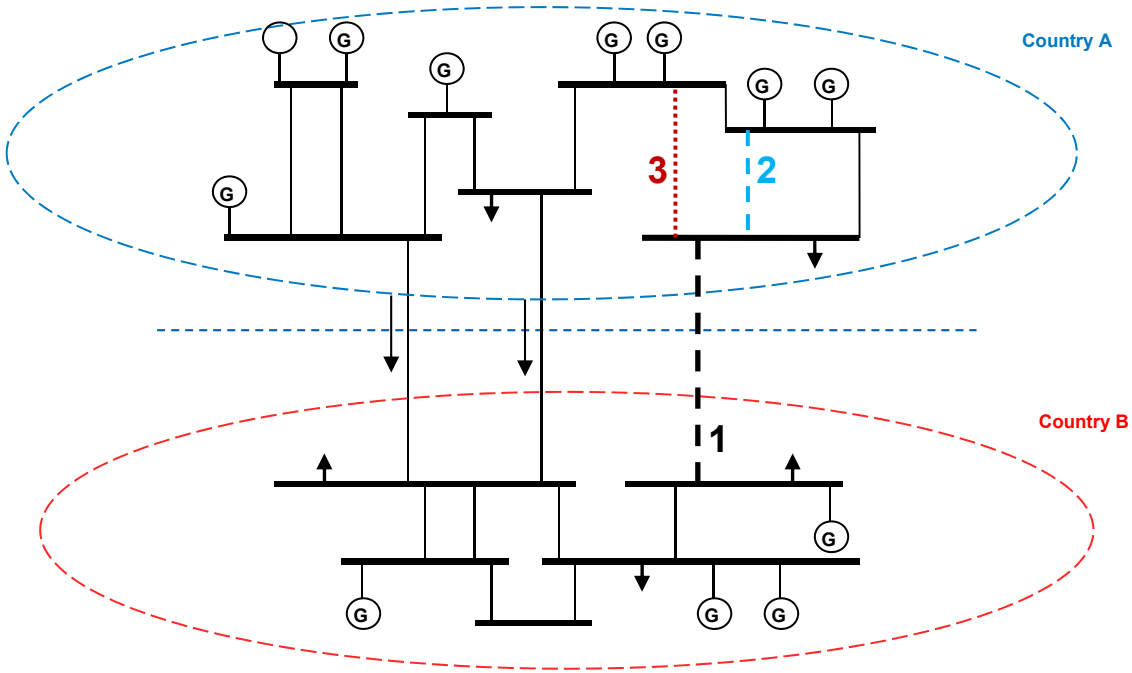
- A project is defined as a **cluster of investment items** that have to be realised in total to achieve a desired effect. Therefore, a project consists of one or a set of various investments.
- The clustering of a group of investments is recommended by European Commission when:
  - They are located in the same area or along the same transmission corridor;
  - They achieve a common measurable goal;
  - They belong to a general plan for that area or corridor;
- A group of investments belong to the same transmission project if the investments (lines, substations, …) comply with two conditions:
  - They are required to develop the grid transfer capability (GTC) increase
  - They are located in the same area of the project or along the same corridor.
- The most common example of clustering is an interconnection project that should be composed of the cross-border line, as well as internal reinforcements necessary to achieve the desired GTC.

Clustering of Investments: Evaluation - Case A (1/2)

- The calculation of the GTC increase provided by the main investment (1) is made obtaining ΔGTC_1. Then, taking into account the scenarios with the investment 1 incorporated, a new investment (2) is checked obtaining ΔGTC_2.
- If $\Delta GTC_2 > 0.20\ \Delta GTC_1$ the investment 2 can be clustered.



Clustering of Investments: Evaluation - Case A (2/2)



Investment 3

Investment 2

Investment 1

FUTURE INVESMENTS

With Investment **1** ⟶ GTC = 1500 ⟶ ΔGTC_1 **= 500 MW** **500*0.20 = 100 MW**

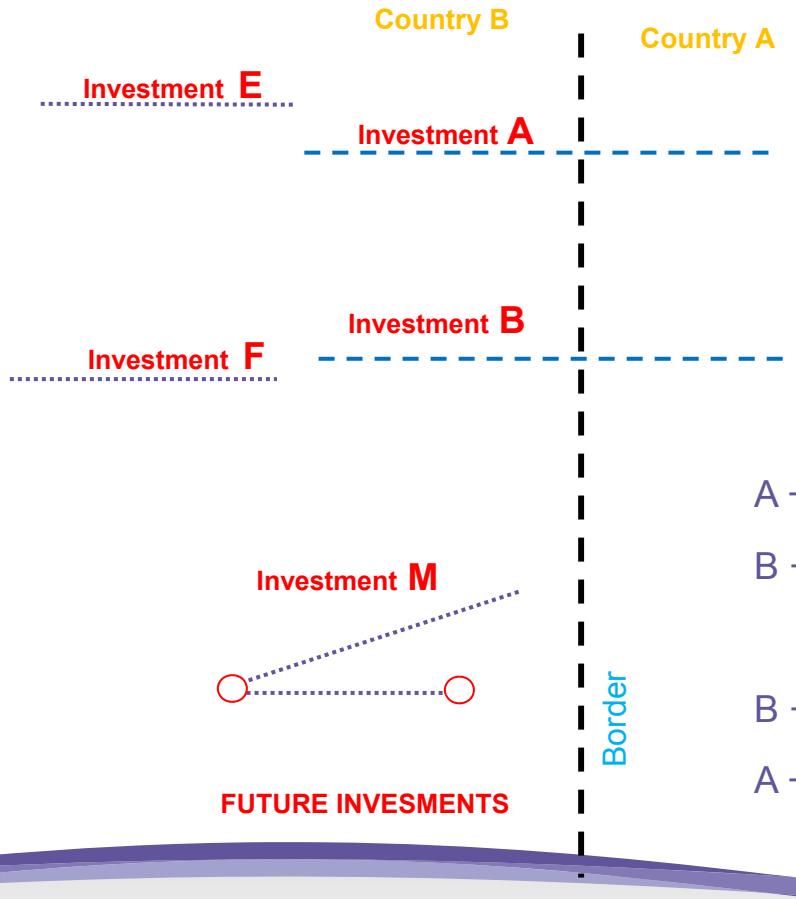
With Investment **1+2** ⟶ GTC = 1650 ⟶ ΔGTC_2 **= 150 MW** **Clustered**

With Investment **1+3** ⟶ GTC = 1550 ⟶ ΔGTC_3 **= 50 MW** **Not Clustered**

Final Project = Investment 1 + Investment 2

Clustering of Investments: Evaluation - Case B (1/2)

Two or more projects can be a clustered, if they are in series and/or almost completely dependent on each other.



A , B and M are different projects

A ➔ DGTC 800 MW and E is associated reinforcement

B ➔ DGTC 600 MW and F is associated reinforcement

M ➔ DGTC 20 MW

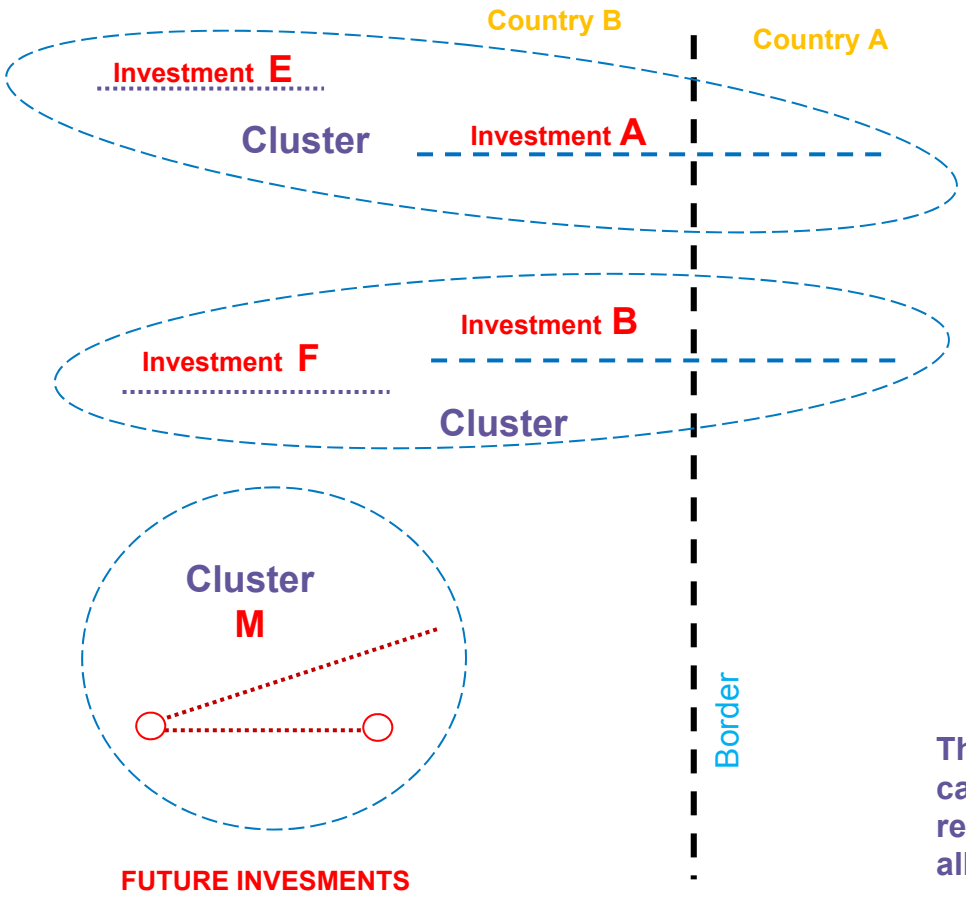
A +E=D960 MW ➔ clustered

B +F=D720 MW ➔ clustered

B +F+M <D840 MW ➔ not clustered

A +E+B+F< DGTC(A+E) + DGTC(B+F) ➔ not clustered

Clustering of Investments: Evaluation - Case B (2/2)



Examples can be reactive shunt devices needed to avoid voltage upper limit violations due to the addition of the new investment or restructuring of HV existing urban networks.

Normal Clusters A+E and B+F

M could be clustered with A or B only if

No cluster A+F neither B+E

A and B are two different projects.

This slide is not definitive; but it illustrates some of the cases that face the Transmission Planner for real. Clustering rules need to be applied sensibly, across all the cross-combination in such cases