

ENTSO-E workshop on CBA methodology

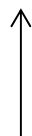
Benefit indicator calculation methodology of :

- CO₂ calculation
- Renewable Energy Supply Integration

19 November 2012

Cost benefit analysis: CO₂ and RES integration

EU CO₂ target
(ETS carbon price)



NREAPs

Current approach

- **CO₂ internalised** in socio-economic welfare with CO₂ price assumption given by the scenario
- Higher/lower CO₂ prices: sensitivity analysis
- **Multicriteria approach:**
- CO₂ (tons) and RES (MW & MWh) values displayed

Criteria	Project assessment								
	Grid Transfer Capability Increase	Socio-economic Welfare		Improved Security of Supply	Losses variation	CO ₂ mitigation	Technical resilience	Flexibility	Social and environmental Impact
	MW	MC/year	MWh/year	MWh/year	MC	Mt			ME
Project A	1000	150	500			5	+++	++	650
Project B	500	30		3000	20		++		25
Project C	800	225	5000		10		++	+++	150

Variation in CO₂ emission

Methodology

Indicator

Examples

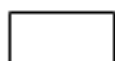
Variation in CO₂ emissions – Methodology

- By relieving congestion, reinforcements may enable low-carbon power plants to generate more electricity than without the reinforcement (substitution effect);
- Benefit linked to substitution effect. Generation dispatch and unit commitment with and without the project is used to calculate the carbon impact using standard emission rates;
- The monetisation is based on forecast CO₂ prices for electricity (official sources) and the cost of CO₂ is already internalised in generation costs;
- Sensibility analysis (CO₂ prices under-state the full long-term societal value). To perform this analysis without double counting:
 - a) Determine the delta volume of CO₂;
 - b) Considerer de CO₂ price internalised in generation costs;
 - c) Adopt a long-term societal price of CO₂;
 - d) Multiply the volume of a) by a difference in price (c) - b)).

Variation in CO₂ emissions – Indicator

Parameter	Source of calculation	Basic unit of measurement	Monetary measure	Level of coherence
CO ₂	Market and network studies (substitution effect)	tons	CO ₂ price derived from generation costs (B2)	European

Indicative colours are assigned as follows:



White: the project has no positive effect on CO₂ emissions



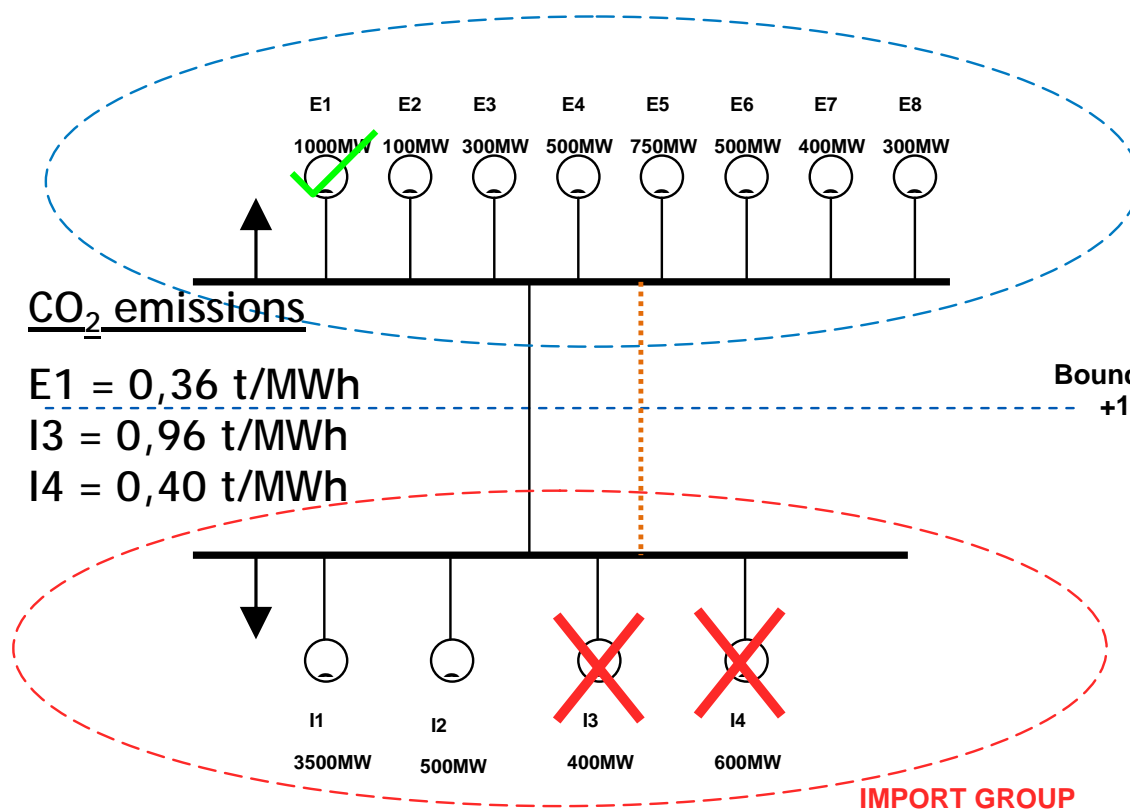
Green: the total of projects reduces CO₂ emissions by < 500 kt/year



Dark green: the total of projects reduces CO₂ emissions by > 500 kt/year

Variation in CO₂ emissions – Calculation Example

Reduction of CO₂ emissions:



Delta CO₂ emissions in export group (hour):

$$1000 * 0,36 = 360 \text{ t CO}_2$$

Delta CO₂ emissions in import group (hour):

$$400 * 0,96 + 600 * 0,4 = - 624 \text{ t CO}_2$$

Total (1 hour): -264 tCO₂ / hour

Hours	CO ₂ benefit / hour (t)
1600	264
1400	60
1160	90
2400	60
2200	20

→ *Total (1 year) - 799 000 tCO₂ / year*

Variation in CO₂ emissions – Calculation Example

CO₂ Emissions Indicator:

Parameter	Source of calculation	Basic unit of measure	Result	Colour code
Variation of CO ₂	Market or network studies	tons	799 k tons	

Renewable Energy Supply Integration



Methodology

Indicator

Examples

RES integration - Methodology

“Support to RES integration is (...) the ability of the system to allow the connection of new RES plants and unlock existing “green” generation, while minimising curtailments.”

The integration of both existing and planned RES is facilitated by:

1. Connection the RES generation to the main system;
2. Increasing GTC between areas with excess RES generation to others areas, in order to facilitate higher RES penetration.

The indicators are calculated on the basis of different measurements:




1. Additional amount of RES connected [MW], without regarding to actual avoided spillage;
2. Reduction of curtailment (avoided spillage) [MWh], due to a reduction of congestion in the main system.

Any monetisation of this indicator will be reported in the generation costs.

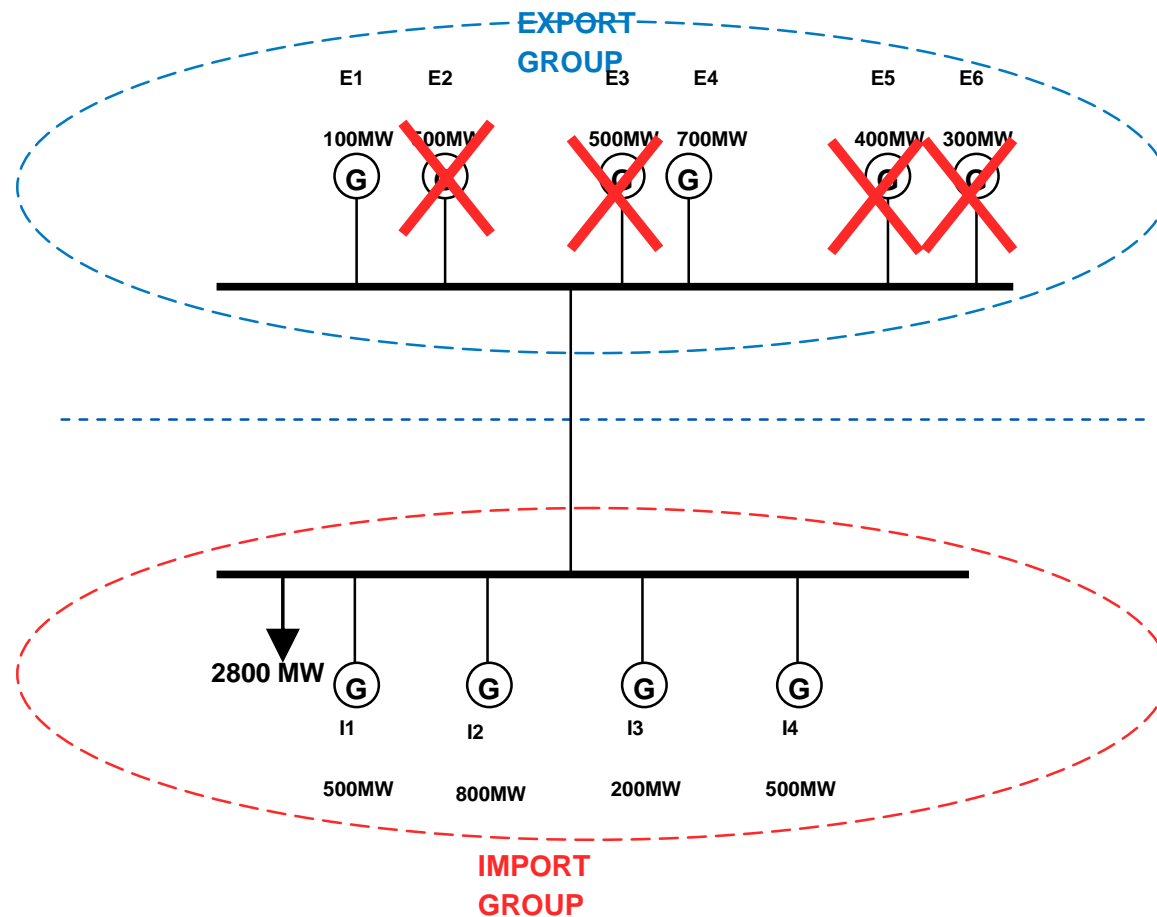
RES integration – Indicator

Parameter	Source of calculation	Basic unit of measurement	Monetary measure	Level of coherence
Avoided RES spillage	Market or network studies	MWh	Incl. in generation cost savings (B2)	European
Connected RES	Market or network studies	MW	None	European

Indicative colours are assigned as follows:

-  White: the project has a neutral effect on the capability of integrating RES (i.e. allows less than 100 MW of direct connection of RES production and an increase in RES generation of less than 50 GWh)
-  Light green: the project increases GTC by, or allows direct connection of RES production, between 100 MW and 500 MW or permits an increase in RES generation (decrease in RES curtailment) between 50 GWh and 300 GWh
-  Dark green: This project increases GTC by, or allows a direct connection of RES production, of more than 500 MW and increase of RES generation (decrease in RES curtailment) of more than 300 GWh

RES integration – Calculation Example



Base Case:

- Export area with excess RES (2500 MW)
- Import area with 2800 MW of Demand and 4 conventional generators (2000 MW)

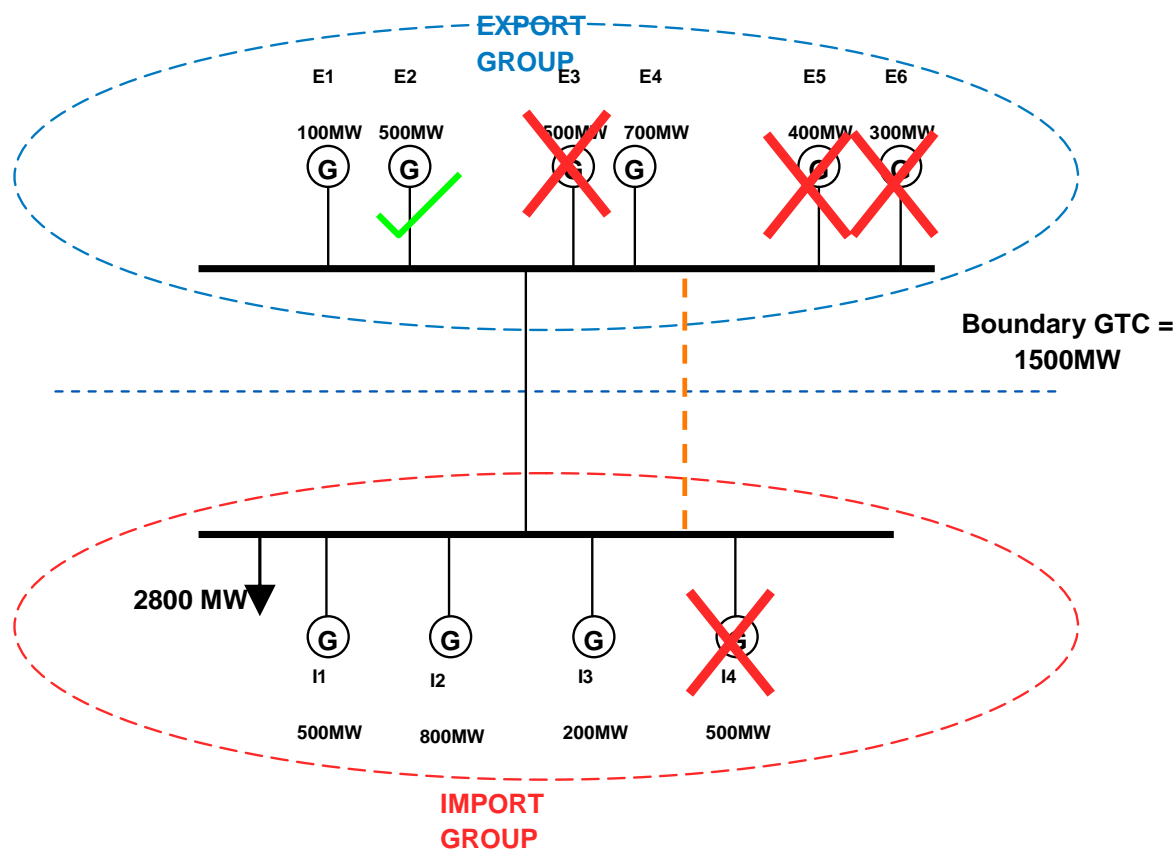
Boundary GTC = 1000 MW (thermal capacity 800 MW)

Boundary GTC =
1000MW

Conclusion:

In this particularly situation, only 800 MW of the RES production can be transported, whereas 1700 MW must be curtailed due to the GTC limitation.

RES integration – Calculation Example



With GTC increases 1500 MW:

- Export area with excess RES (2500 MW)
- Import area with 2800 MW of Demand and 4 conventional generators (2000 MW)

Boundary GTC = 1500 MW (thermal capacity 1300 MW)

- Conclusion:

This additional transfer capacity permits generator E2 to produce (and displace generator I4, which is not RES).

RES integration – Calculation Example (Conclusion)

RES integration benefit for the case:

- The benefit for the project is calculated from the maximum change in RES production. In this specific case the benefit is 500 MW.

RES integration - Annual benefits:

- The table below presents the three cases that can be considered to represent the whole year:

Hours	Additional RES integration (MW)
260	500
3800	100
4700	50

The annual RES integration benefit is calculated as:

$$260 * 500 + 3800 * 100 + 4700 * 50 = 745 \text{ GWh}$$

RES integration – Calculation Example (Conclusion)

RES integration Indicator:

Parameter	Source of calculation	Basic unit of measure	Result	Colour code
Connected RES	Network studies	MW	500 MW	
RES integration	Network/Market studies	MWh	745 GWh	