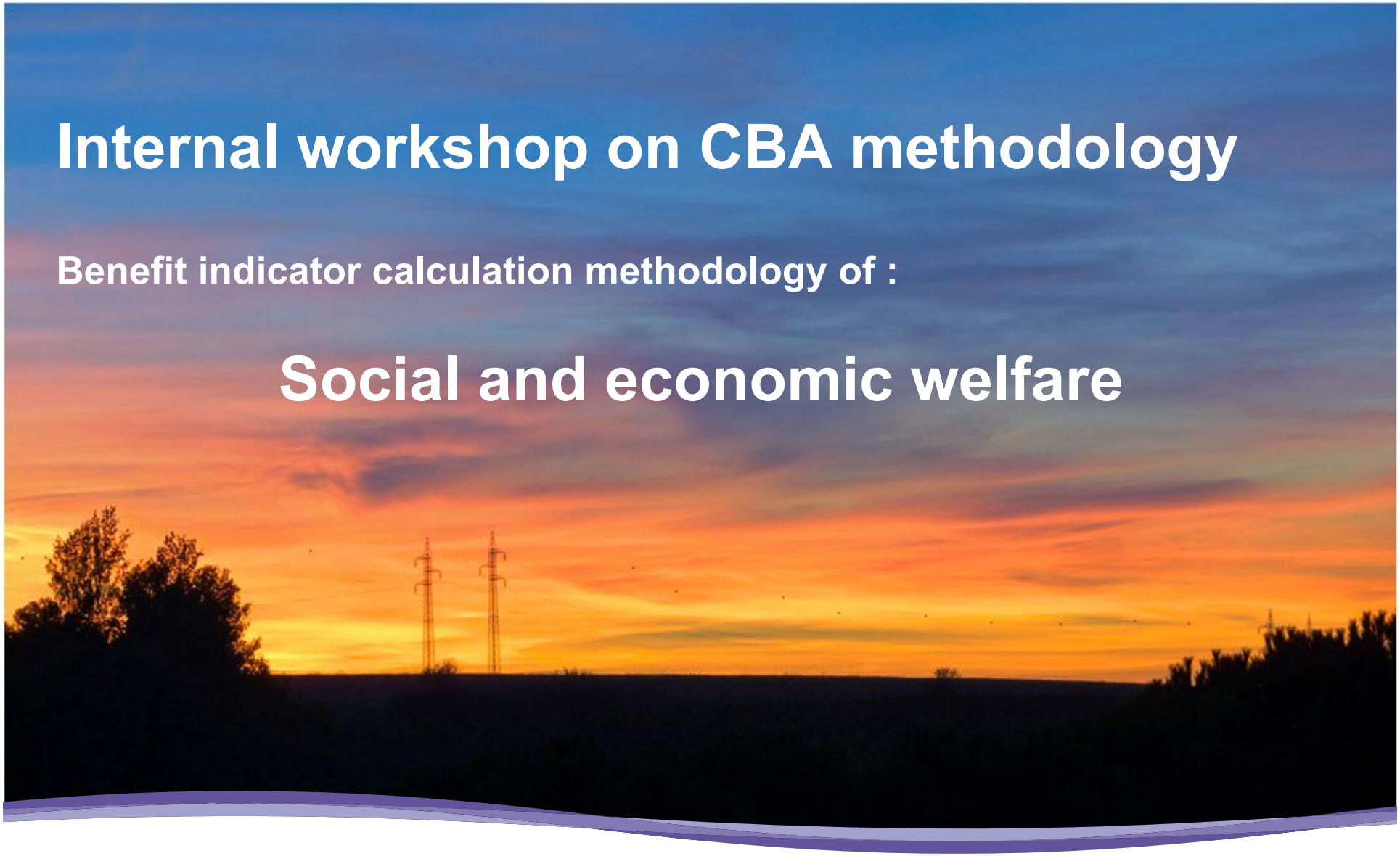


Internal workshop on CBA methodology

Benefit indicator calculation methodology of :

Social and economic welfare

entsoe

Reliable Sustainable Connected

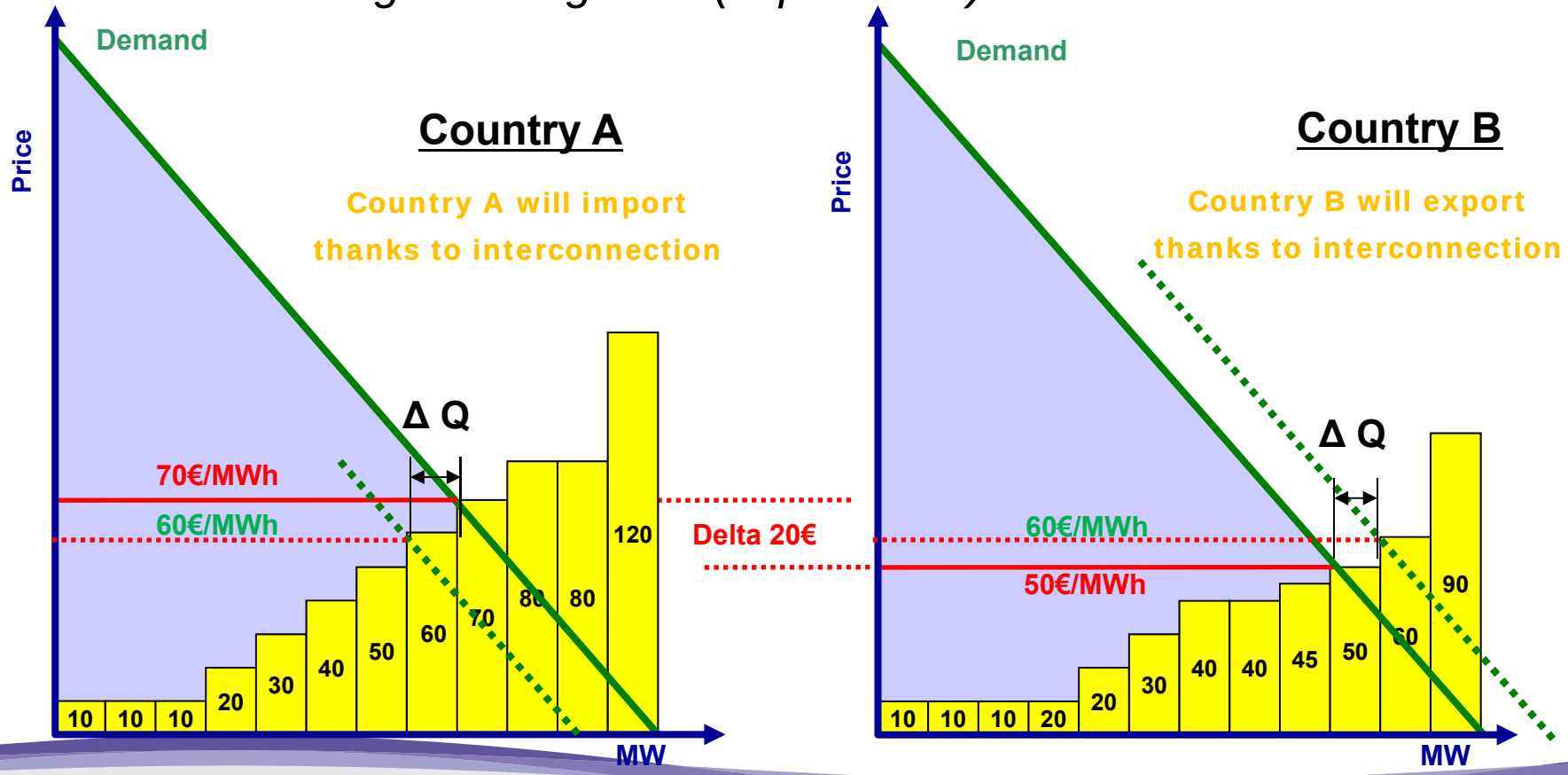
Contents

- Social and economic welfare (SEW)
  - Methodology
  - Indicator
- SEW: Practical examples
- Transmission Losses
  - Methodology
  - Indicator
- Discussion Questions

Social and economic welfare

Social and economic welfare – Methodology

"A project leading to a GTC increase between two prices areas will allow generators in the low price bidding area (export area) to supply load in the high bidding area (import area)."



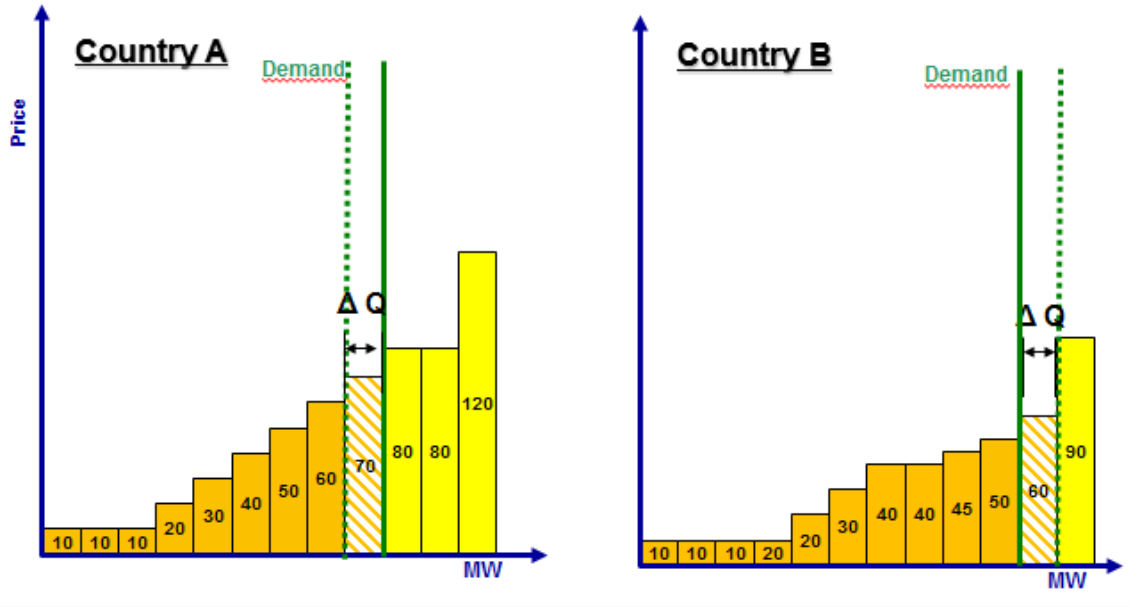
Social and economic welfare – Methodology

- A project leading to a GTC increase will increase the overall welfare if the sum of the producer surplus, consumer surplus and congestion rents are higher that the costs of the project

- There are 2 different approaches to calculate the overall increase of social and economic welfare :
  - Generation cost approach
  - Total surplus approach

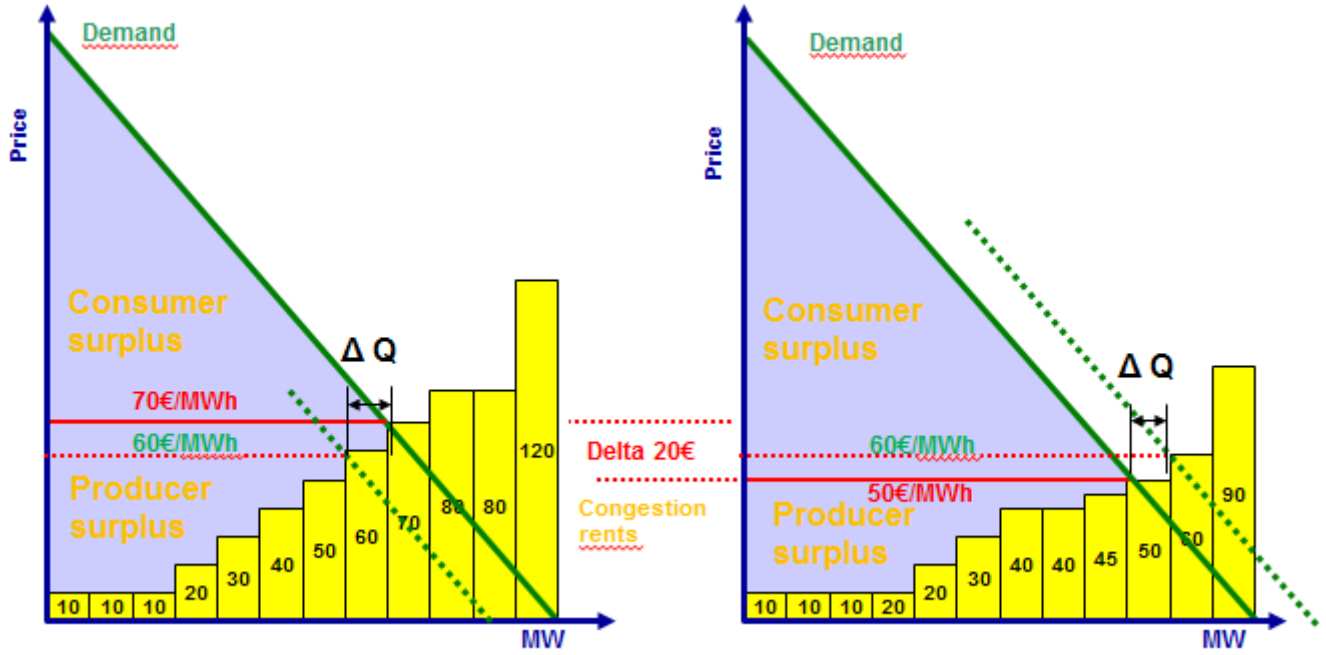
Social and economic welfare – Methodology

- **Generation costs approach**
  - Comparison of the generation costs with and without the project for the different bidding areas
  - The delta costs with and without the project corresponds to the increase of the overall welfare if the demand is considered as price inelastic
  - Benefit (for each hour) = generation costs without the project – generation costs with the project



Social and economic welfare – Methodology

- **Total surplus approach**
  - Total surplus corresponds to sum of consumer surplus, producer surplus and congestion rents (or TSO revenue)
  - In case of price elastic demand, the overall welfare has to calculated with the total surplus approach
  - Benefit (for each hour) = total surplus with the project – total without the project



Social and economic welfare – Methodology

o Internal congestions:

- The limited network model used in market studies can lead to generation and load flow patterns that cannot be technically achieved
- GTC variation : the delta GTC value (allowed by the reinforcement) should always take into account all congestions on the grid :
  - either the grid is reinforced and this is part of the cluster (project includes cost of cluster)
  - or the GTC is reduced
- Third party projects to be assessed in the same way

Social and economic welfare– Methodology (ctd)

Parameter	Source of calculation	Basic unit of measurement	Monetary measure	Level of coherence
Reduced generation costs/ additionnal overall welfare	Market studies (Optimisation of generation portfolios across boundaries)	€	€/year	European
Internal dispatch costs	Network studies (optimisation of generation dispatch within a boundary considering grid constraints)	€	€/year	National

Indicative colours are assigned as follows:

Light green : the project has an annual benefit < € 30 million

Green: the project has an annual benefit between€ 30 and € 100 million

Dark green: the project has an annual benefit > or = to € 100 million

Social and economic welfare

Practical examples

Example 1

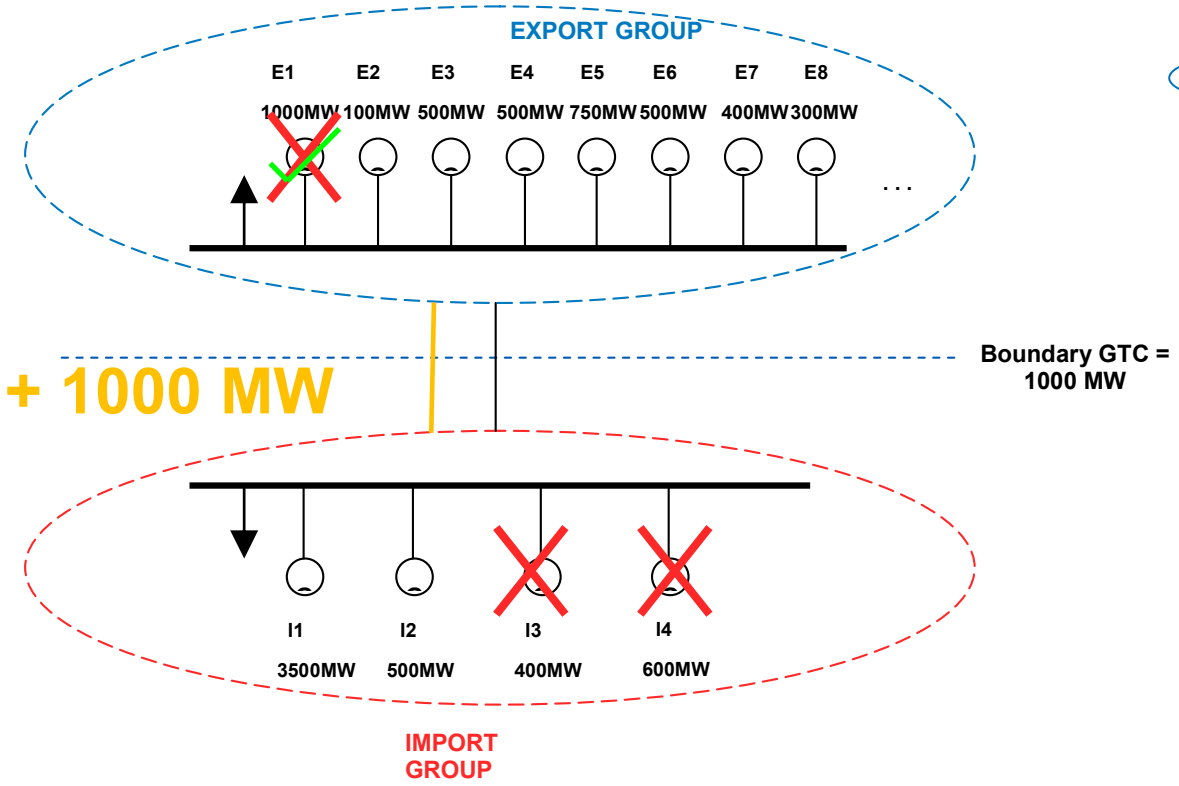
Inelastic demand

Surplus approach & generation cost approach

Social and economic welfare – Calculation example

Prod : 50 GW

Prod : 51 GW



Prod : 4 GW

Prod : 5 GW

Marginal prices

E1 =€51/MWh
E2,3,4,5,6,7= €40/MWh
E8 = €50/MWh
I1,I2 = €80/MWh
I3 = €90/MWh
I4 = €100/MWh

Without interconnection

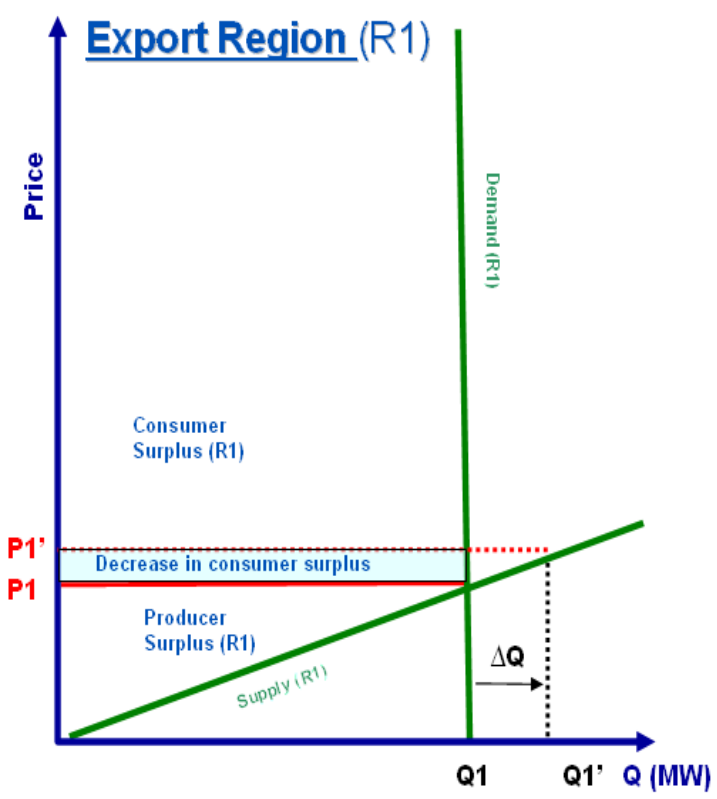
Price export market = 50€/MWh
Price import market = 100€/MWh

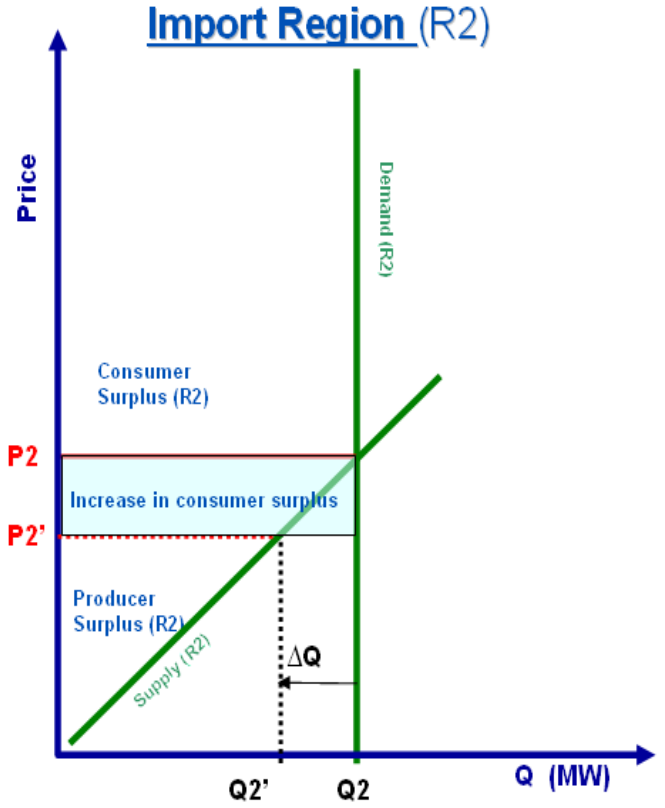
With interconnection

Price export market = 51€/MWh
Price import market = 80 €/MWh

Surplus calculation if demand is inelastic

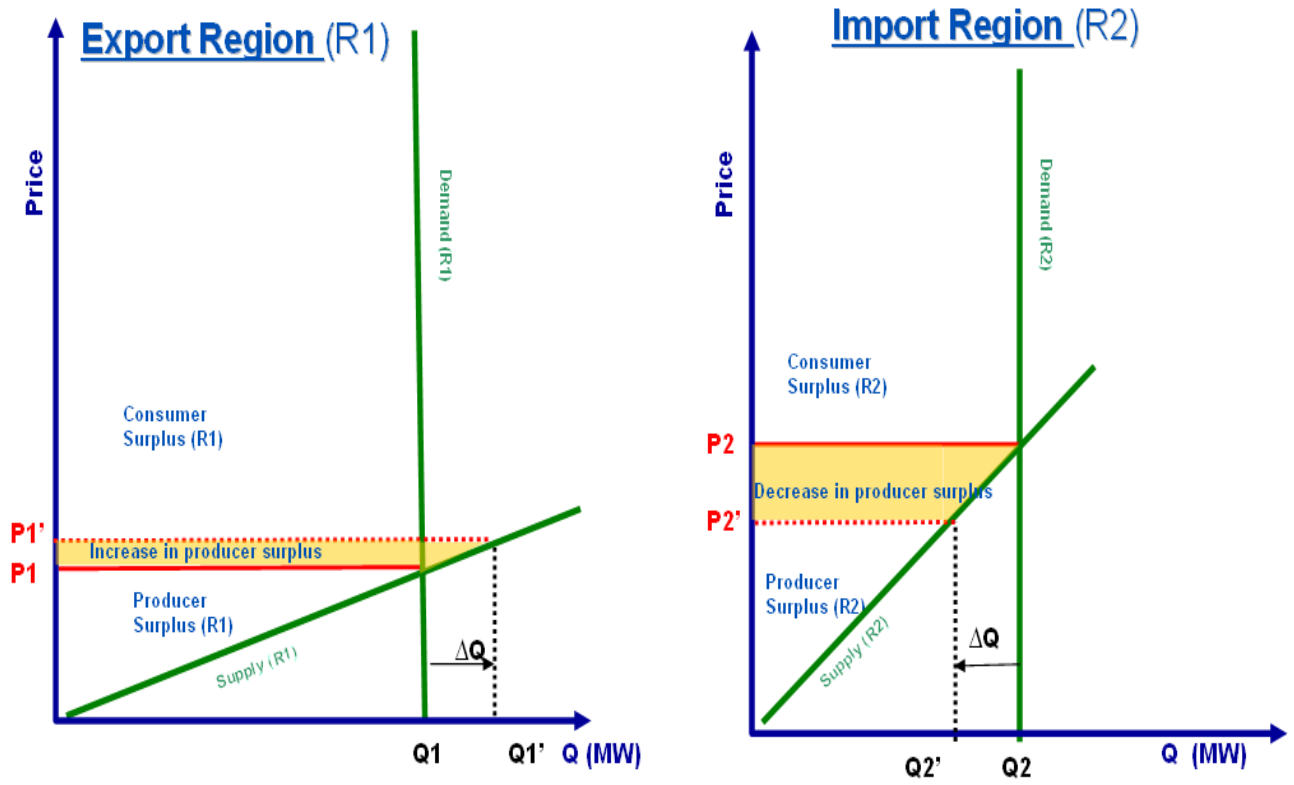
Change in consumer surplus calculation





Surplus calculation if demand is inelastic

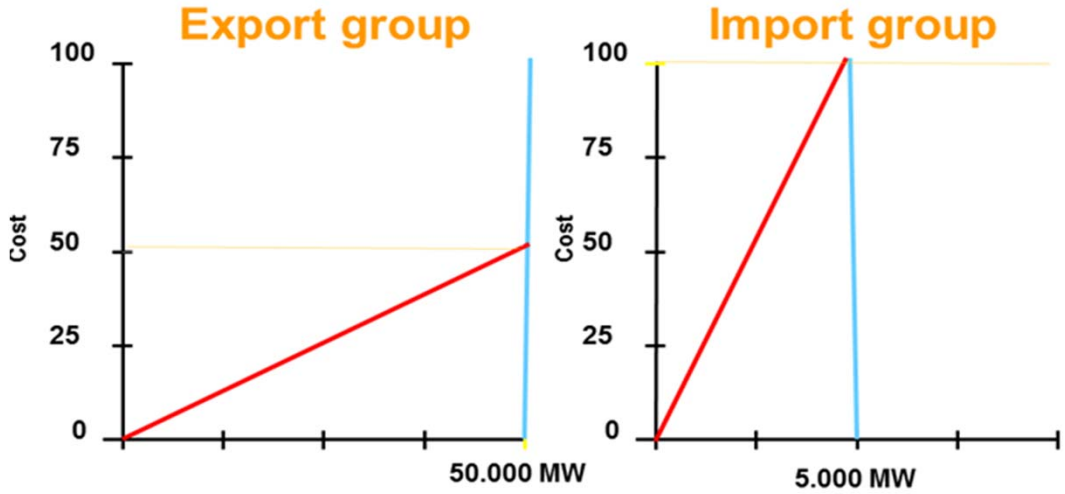
Change in producer surplus calculation



Social and economic welfare– Calculation example

Social and economic welfare : surplus approach

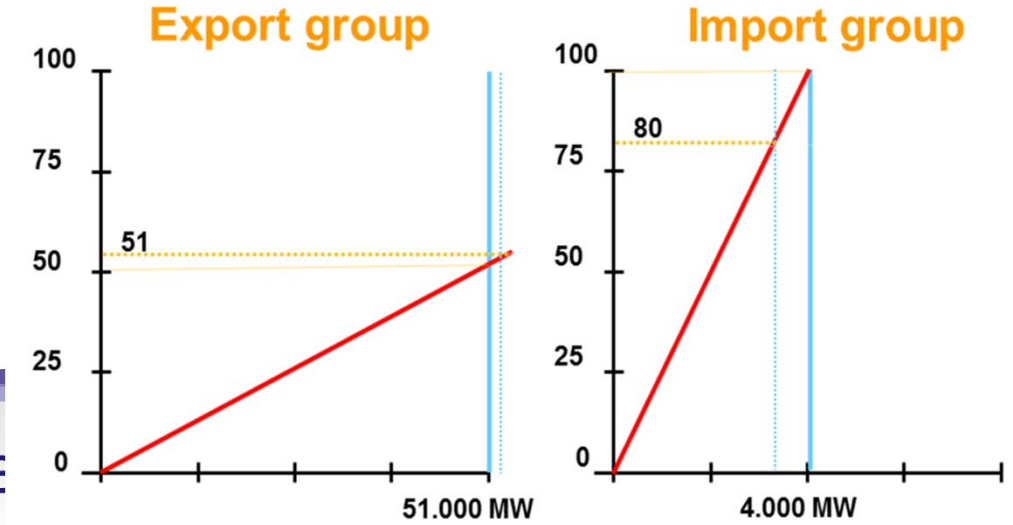
Without interco



Without interconnection

Price export market = 50€/MWh
Price import market = 100€/MWh

With 1000 MW interco

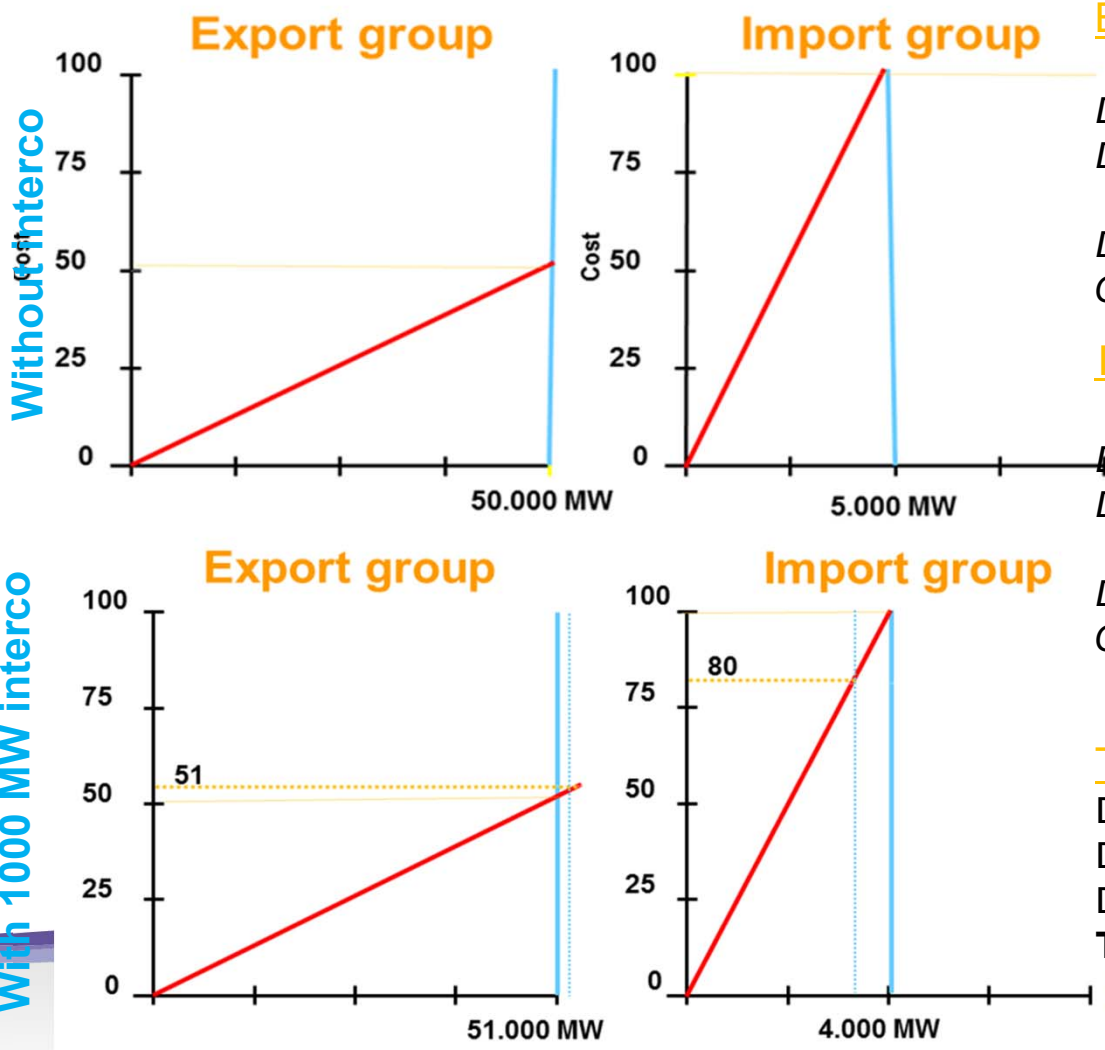


With 1000 MW interconnection

Price export market = 51€/MWh
Price import market = 80 €/MWh

Social and economic welfare – Calculation example

Social and economic welfare : surplus approach



Export group:

*Delta CS : 50 000 * -1 = -50 000€*
*Delta PS : 51 000*51/2 – 50000*50/2 = 50 500 €*
*Delta CR : (80-51)*1000/2 = 14 500€*
Change of welfare : 15 000€

Import group:

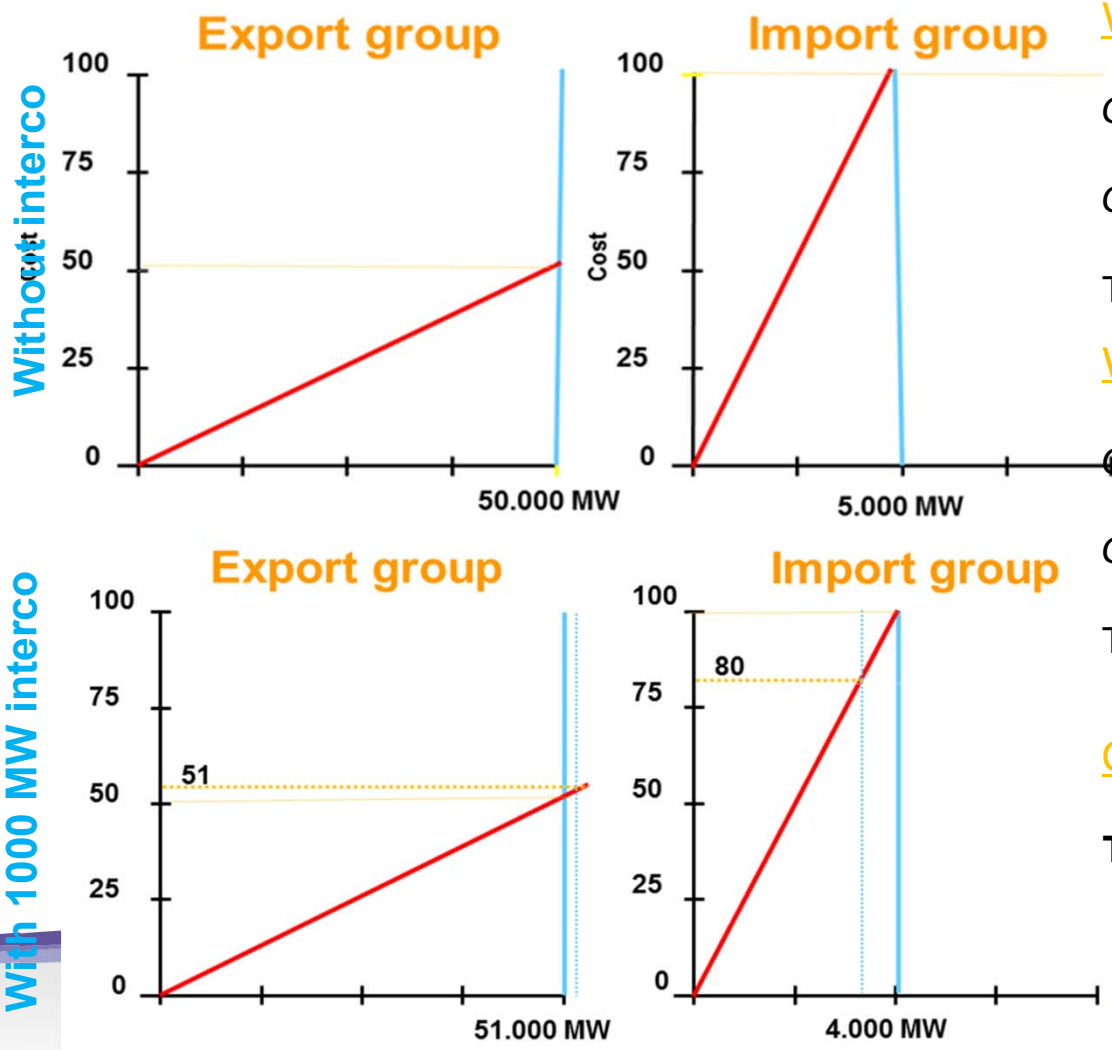
*Delta CS : 5000 * (100-80) = 100 000*
*Delta PS : 4000*80/2 – 5000*100/2 = -90 000€*
*Delta CR : (80-51)*1000/2 = 14 500€*
Change of welfare : 24 500€

Total change of welfare :

Delta CS : 50 000 €
Delta PS : -39 500 €
Delta CR : 29 000€
Total : 39 500 €

Social and economic welfare – Calculation example

Social and economic welfare : check with generation costs



Without interconnection:

Gen costs export region :
*50 000 * 50/2 = 1 250 000€*
Gen costs import region :
*5000 * 100/2 = 250 000€*
Total : 1 500 000 €

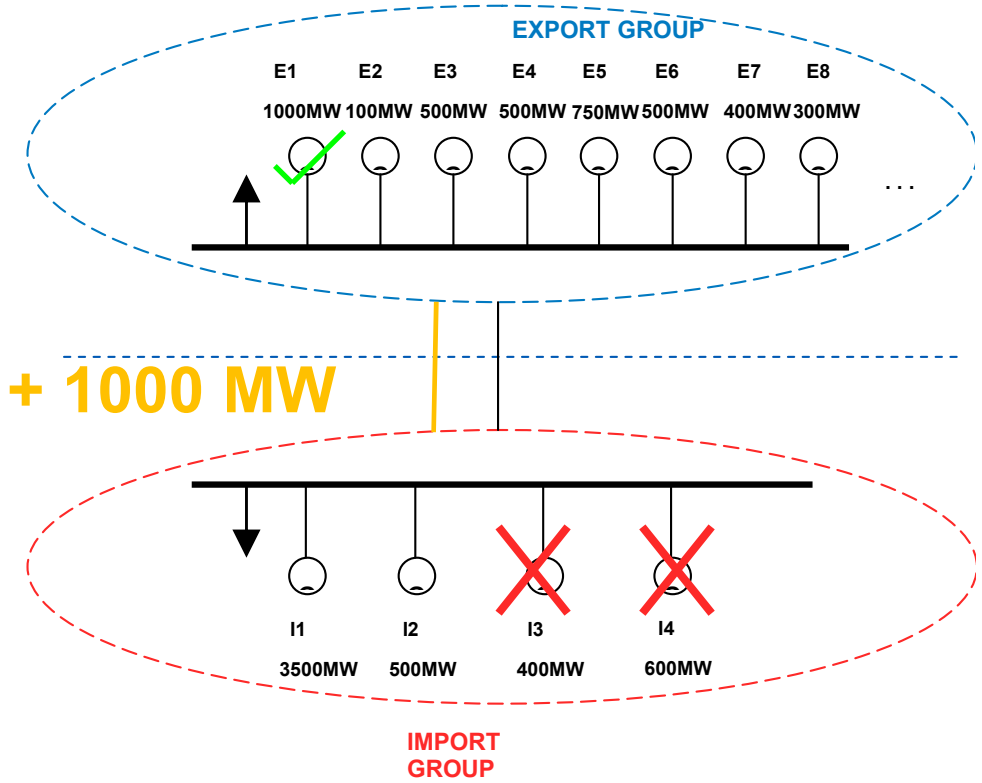
With interconnection:

Gen costs export region :
*51 000 * 51/2 = 1 300 500€*
Gen costs import region :
*4000 * 80/2 = 160 000€*
Total : 1 460 500 €

Change in generation costs:

Total : 39 500 €

Social and economic welfare– Calculation example



Hours	Social and Economic Welfare Benefit per hour (€)
1 000	39 500
2 000	25 000
1 160	30 000
2 400	50 000
2 200	60 000

→ ***Total (for one year) : 376,3 M€ / year***

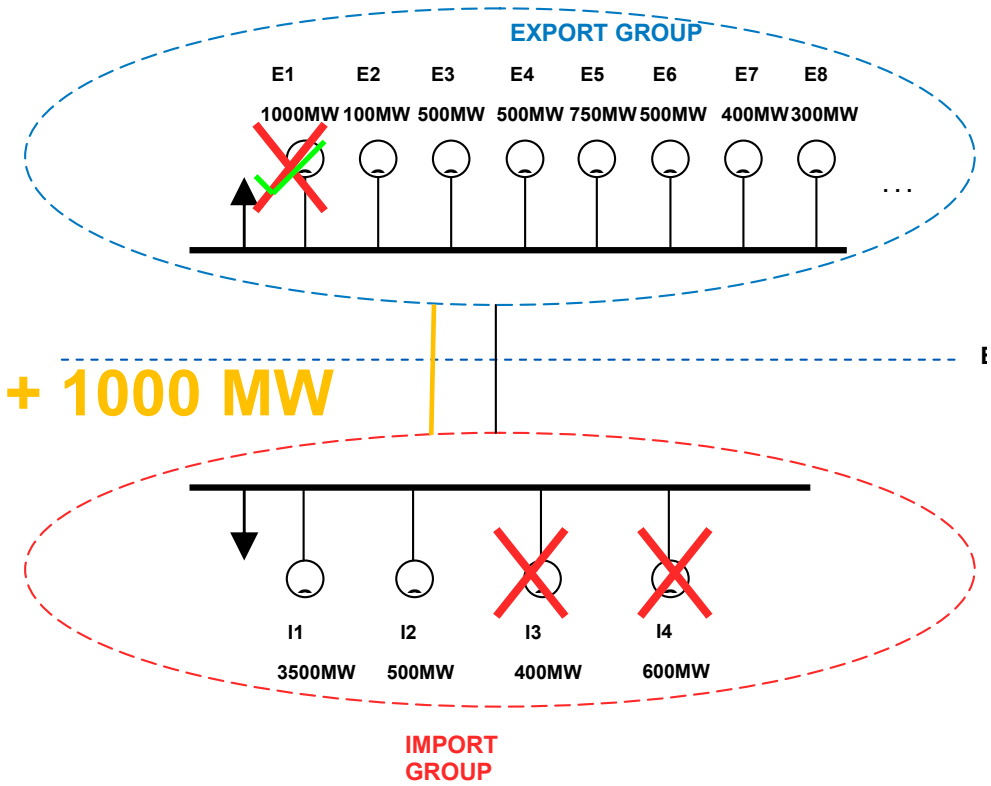
→ *colour code :*

Example 2

Elastic demand

Surplus approach
(or adapted generation cost approach)

Social and economic welfare – Calculation example



Without interconnection

Export group:

Generation= 50 GW

Demand = 50 GW

Price = 50€/MWh

Import group:

Generation= 5 GW

Demand= 5 GW

Price = 100€/MWh

With interconnection

Export group:

Generation= 50,75 GW

Demand = 49,75 GW

Price = 50,75€/MWh

Import group:

Generation= 4,5 GW

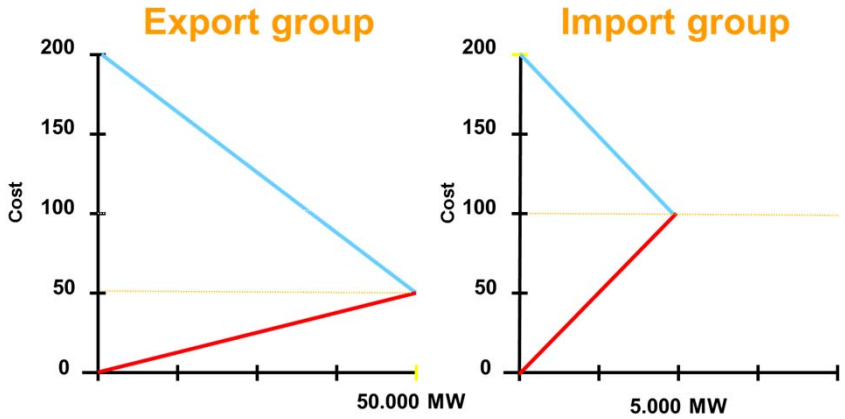
Demand= 5,5 GW

Price = 90€/MWh

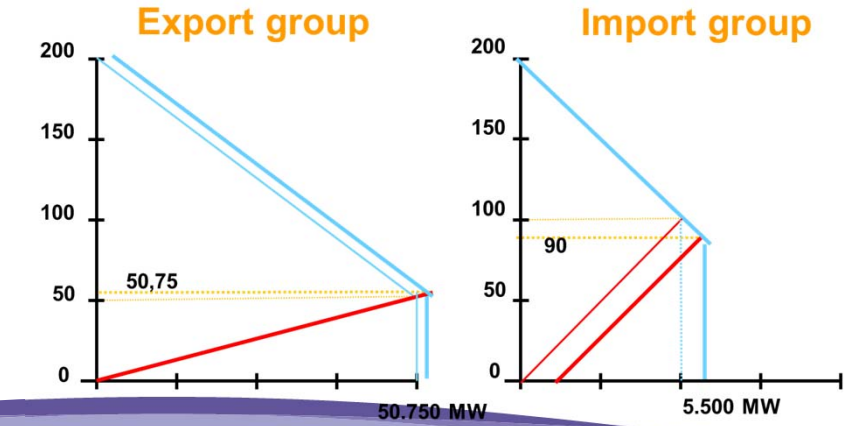
Social and economic welfare– Calculation example

Social and economic welfare : surplus approach

Without interco



With 1000 MW interco



Without interconnection

Price export market = 50€/MWh
Price import market = 100€/MWh

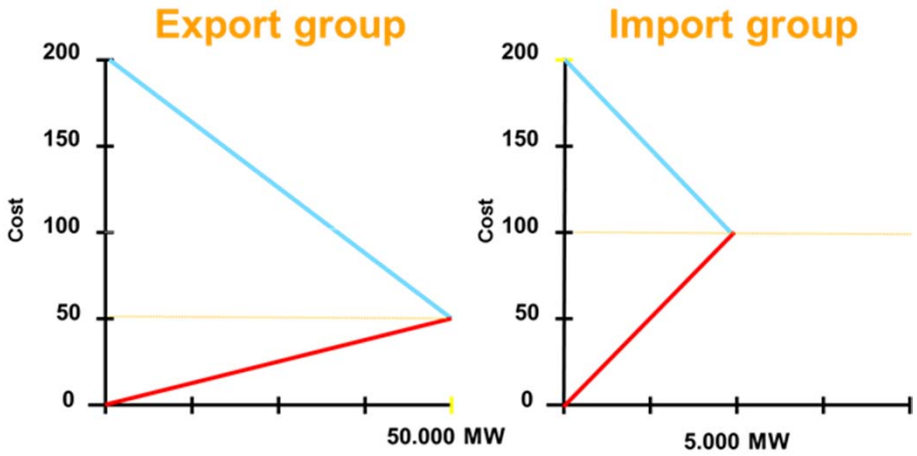
With 1000 MW interconnection

Price export market = 50,75€/MWh
Price import market = 90 €/MWh

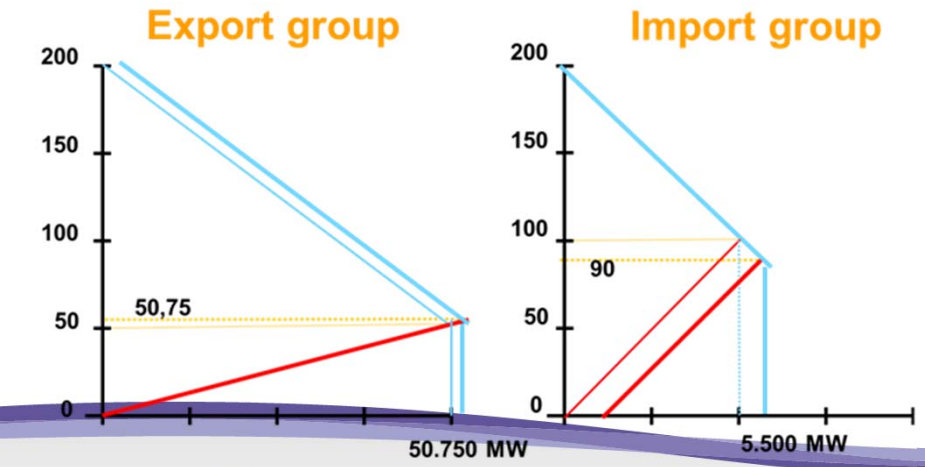
Social and economic welfare – Calculation example

Social and economic welfare : surplus approach

Without interco



With 1000 MW interco



Export group:

Delta CS : -37 406€
Delta PS : 37 781 €
*Delta CR : (90-50,75)*1000/2 = 19625€*
Change of welfare : 20 000€

Import group:

Delta CS = 52 500 €
Delta PS = -47 500 €
*Delta CR : (90-50,75)*1000/2 = 19 625€*
Change of welfare : 24 500€

Total change of welfare :

Delta CS : 15094 €
Delta PS : -9 719€
Delta CR : 39 250€
Total : 44625 €

Summary

Social and economic welfare:

- CBA only looks at overall increase of welfare

- If demand price inelastic → 2 approaches possible
  - Total surplus approach
  - Generation cost approach

- If demand price elastic → 2 approaches possible
  - Total surplus approach
  - Adapted generation cost approach (virtual generators)

→ Decision on inelasticity of demand left to regional groups

Questions

1) *Do you agree to keep both methodologies for calculating SEW ?*
2) *Do you agree that generation costs approach does not give any indication on sharing of benefits but only on overall welfare ?*
3) *Should demand elasticity be taken into account ?*
4) *If demand elasticity is assumed, how to treat it ?*

Variation in losses

Variation in losses - Methodolgy

o *Introduction*

- The energy efficiency of a project is measured through the reduction of thermal losses in the system

o *Methodology*

- Report the change in losses over the total power system, before and after adding the project, for each case; include any re-dispatch of generation to demand
- Total benefit is then calculated as the difference of the weighted sum of losses with and without the project

Variation in losses – Indicator

Parameter	Source of calculation	Basic unit of measurement	Monetary measure	Level of coherence
Losses	Network studies	MW or MWh	€/year	European

Indicative colours are assigned as follows:

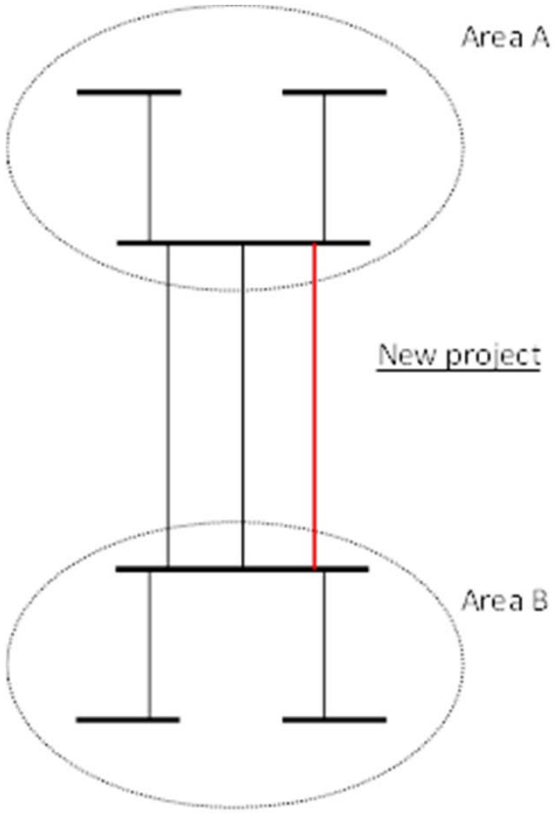
- Red: the project contributes to increase the volume of losses on the grid
- White: the project may help decreasing losses in some situations and increasing them in others
- Light green: the project the project contributes to decrease the volume of losses on the grid.

Variation in losses – Monetisation

o *Monetisation*

- Monetisation of losses is based on forecasted market prices for electricity in the studied horizon
- Price (marginal cost) is derived market studies
- Price will match with the parameters and assumptions indicated in chapter 2 (economic growth, coal cost, oil cost, gas cost, …)

Variation in losses – Example



First period of the year :

- 1032 peak hours at 70€/MWh
- 3312 off-peak hours at 50€/MWh

Second period of the year :

- 1056 peak hours at 60€/MWh
- 3360 off-peak hours at 40€/MWh

Impact of the project:

- (constant) loss variation of -2 MWh per hour in the first period of the year
- (constant) loss variation of -3 MWh per hour in the second period of the year

Results:

```
    1032 h * (- 2 MWh/h) * 70€/MWh
  + 3312 h * (- 2 MWh/h) * 50€/MWh
  + 1056 h * (- 3 MWh/h) * 60€/MWh
  + 3360 h * (- 3 MWh/h) * 40€/MWh
-------------------------------------------
```

= - 1 068 960 €

Summary

Losses:

- Report the change in losses over the total power system, before and after adding the project, for each case,
- Reflect changes in the dispatch of generation, if appropriate
- Use market studies (marginal costs) for monetisation
- Total benefit is then calculated as the difference of the weighted sum of losses with and without the project

Questions

- *Do you think Losses could be a significant benefit for any particular project?*
- *Do you agree a 'de minimis' level, for Losses indicator?*

o Losses indicator is White if | ⌂MWh Losses | < project size x 200hr