

Overview of ITC principles

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What is ITC?

ITC = Inter-TSO Compensation mechanism

- **Goal= Compensate parties (TSOs) for costs**
 - Cost of losses resulting from hosting transits
 - Cost of infrastructure to enable cross-border flows
- **Why a mechanism?**
 - Setting the transit in the wheeling model
 - In the late nineties there used to be a “pancaking” of cross-border tariffs (like toll)
 - By entering into an ITC mechanism, these “tolls” are abolished and a more level playing field for cross-border trade is achieved
 - ➔ Today, some international transactions are not directly charged for transits (tariffs are only paid in the country where actual injection and offtake takes place outside of the mechanism)
 - ➔ Today, TSOs compensate each other for the related costs and the compensation (either positive or negative) is directly incorporated in the transmission tariffs

Organisation of ITC

- **Multi-party agreement**
 - Between ENTSO-E, ENTSO-E members and non-ENTSO-E members (but countries who have signed agreement with EU)
 - Two data administrators (Swissgrid and Amprion)
 - Long-lasting agreement signed in March 2011 (used to be temporary agreements!)
 - Agreement determines all aspects (algorithm, data collection, deadlines, invoicing,...)
- **Governed by European Regulations 714/2009 & 838/2010**

ITC process

The overall ITC process:

For each step a flow-chart is described in the contract

- Step 1** Yearly data collection (Entsoe ⇔ TSOs)
- Step 2** Monthly data collection (Data admins ⇔ TSOs)
 - step 2a:** Metered flows, scheduled import flows, scheduled export flows
 - step 2b:** Snapshots
- Step 3** Calculation of transit, net import flows, net export flows and transit losses (data admins)
- Step 4** Collection of data concerning capacity allocated in a manner non-compatible with congestion management guidelines
- Step 5** Calculation of final net positions, i.e. € to be paid/received (data admins)
- Step 6** Preliminary settlement (Data admins → Entsoe → TSOs → data admins)
Notification, signing, invoicing
- Step 7** Final settlement (Data admins → Entsoe → TSOs → data admins)
Notification, signing
- Step 8** Calculate Netted Final Settlement (Jan-Jul / Jul-Dec) (Data admins → Entsoe → TSOs → data admins)
Notification, signing, invoicing

ITC process

- **A dedicated e-mail address for ITC of the ENTSO-E secretariat**
 - Settlement notifications
 - Confirmation of signed notifications
 - Any other relevant (official) info
- **ENTSO-E Extranet: history of notifications, results, quality reports...**
- **The updated SPOC-list: to facilitate direct solutions**

How ITC works

ITC consists of two separate mechanisms (art. 1.2 of the ITC Guidelines)

- **Cost of losses:** means the value of losses incurred by a national transmission system as a result of the cross-border flow of electricity
- **Cost of infrastructure:** “Framework Fund” i.e. the fund for compensating the costs of making infrastructure available to host cross-border flows of electricity.

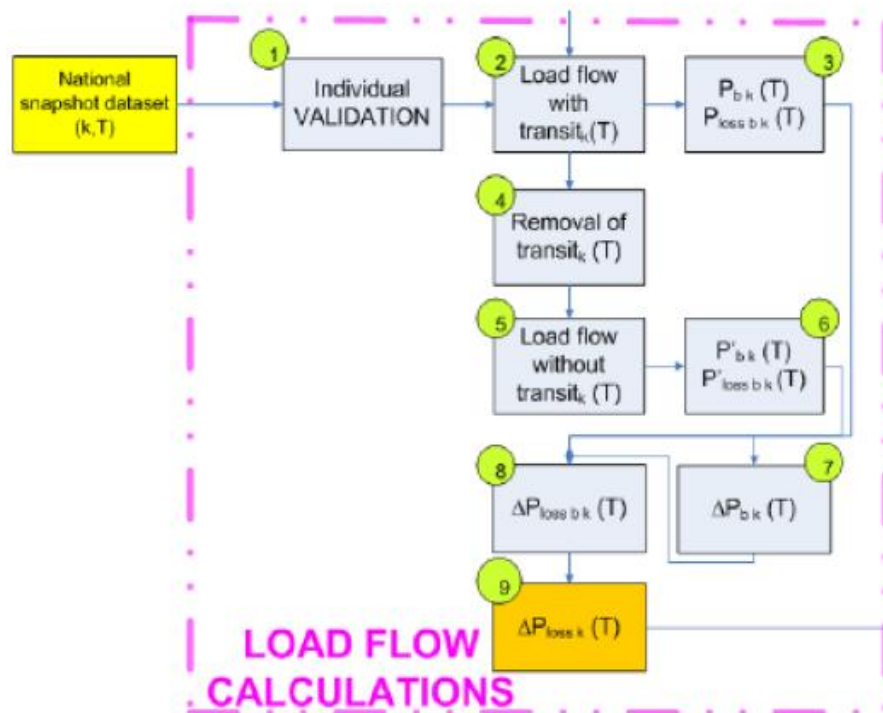
How ITC works: cost of losses

Bottom-line:

- Transit flows cause losses on the network
- Losses are calculated according to a 'with and without transit' (WWT) method
- Those costs are compensated at a price equal to the cost of losses (as approved by national regulators)
 - ➔ Transited countries receive money
 - ➔ Net sinks/sources pay money
- Zero sum game (what is paid = what is compensated)

Monthly WWT Calculation: Introduction

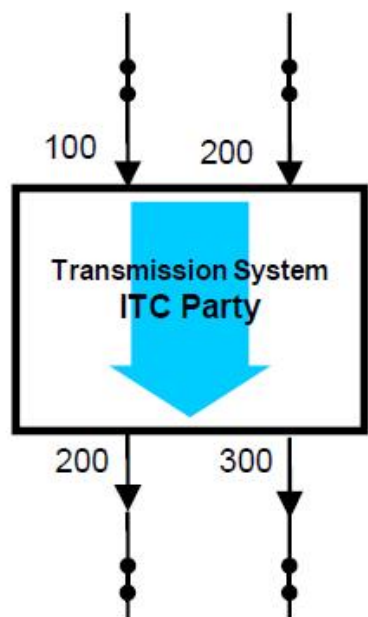
STEP 1: Compensation – How much does a *country* receive?



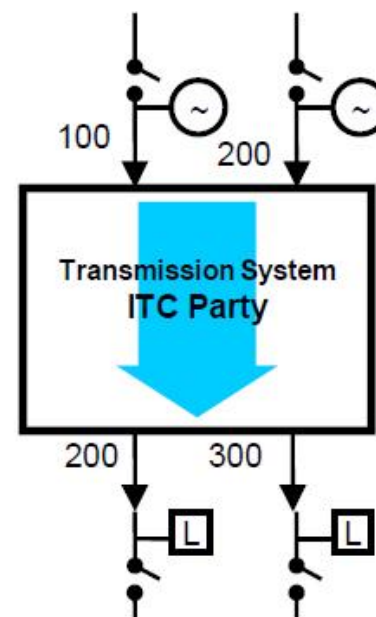
- The losses caused by transit $\Delta P_{loss k}(T)$ are determined for each ITC Party k for 6 monthly snapshots T (3rd Wednesdays and preceding Sundays at 03:30h, 11:30h and 19:30h CET/CEST)
- Based on a mapping that attributes every hour of the month to one of the six snapshots timestamps T , each snapshot timestamp is given a weight w_T
- The monthly WWT compensation is yielded by ITC Party k 's losses costs $C_{losses}(k)$ multiplied by the losses energy caused by transit.

$\Delta P_{loss\ k\ (T)}$ – load flow calculation (Module 2-3)

Recorded Situation **with transit** represented on **interconnected system** (snapshots)
(measured load flow, result from State Estimation)



Recorded Situation **with transit** represented on **disconnected system**
(measured load flow, result from State Estimation)



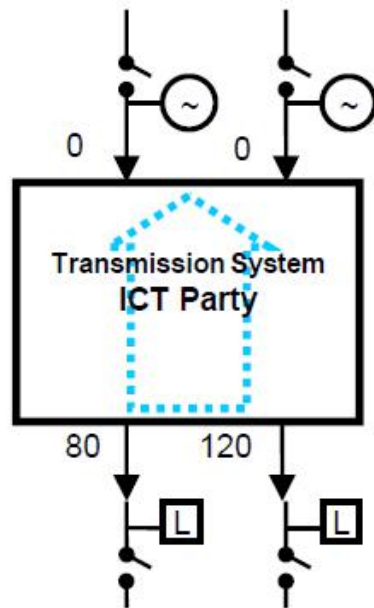
Transit = Minimum { Σ Export, Σ Import }

Example: Σ Export = 500 MW, Σ Import = 300 MW

Transit = Minimum { 500 , 300 } = 300 MW

$\Delta P_{loss\ k\ (T)}$ – load flow without transits (Module 4-5-6-7)

Recorded Situation **without transit** represented on **dis**connected system
(measured load flow, result from State Estimation)



Removal of transit by modifying the flows on tie-lines

$$\text{If } \left(\sum_i P_{ex_i} \geq \sum_j P_{im_j} \right) \text{ then } P_{ex'_k} = P_{ex_k} \cdot \left(1 - \frac{\sum_i P_{im_i}}{\sum_j P_{ex_j}} \right)$$

$$P_{im'_m} = 0$$

$$\text{If } \left(\sum_i P_{ex_i} < \sum_j P_{im_j} \right) \text{ then } P_{im'_k} = P_{im_k} \cdot \left(1 - \frac{\sum_j P_{ex_j}}{\sum_i P_{im_i}} \right)$$

Distribution of the overall modification in losses observed on the slack node to all generators nodes

$$P'_i = P_i \cdot \left(1 + \frac{\Delta P_{Loss}}{\sum_n P_n} \right)$$

$\Delta P_{loss\ b\ k\ (T)}$ – for each branch (Module 8)

In case the relative share of losses caused by transits exceeds the relative share of power flow caused by transits, it shall be delimited to this proportion. (Interpretation of ERGEG Guideline)

$$\Delta P_{loss\ b\ k\ (T)} = P_{loss\ b\ k\ (T)} - P'_{loss\ b\ k\ (T)}$$

$$\Delta p_{loss\ b\ k\ (T)} = \Delta P_{loss\ b\ k\ (T)} / P_{loss\ b\ k\ (T)}$$

$$\Delta p_{b\ k\ (T)} = \Delta P_{b\ k\ (T)} / P_{b\ k\ (T)}$$

If $\{ \text{sign}(\Delta p_{loss\ b\ k\ (T)}) = \text{sign}(\Delta p_{b\ k\ (T)}) \text{ and } |\Delta p_{loss\ b\ k\ (T)}| > |\Delta p_{b\ k\ (T)}| \}$
then

$$\Delta P_{loss\ b\ k\ (T)} = \Delta p_{b\ k\ (T)} * P_{loss\ b\ k\ (T)}$$

else

$$\Delta P_{loss\ b\ k\ (T)} = P_{loss\ b\ k\ (T)} - P'_{loss\ b\ k\ (T)}$$

K	country
B	branch
T	snapshot timestamp
P_{loss}	relative increase in losses
Δp	relative increase in flows

$\Delta P_{loss\ b\ k}(T)$ – sum for ITC party (Module 9-10)

Sum of all branches within a country

$$\Delta P_{Loss_k}(T) = \sum_b \Delta P_{Loss_b_k}(T)$$



The losses energy caused by transit is the scalar product of the $\Delta P_{loss\ k}(T)$ vector times the w_T vector that attributes each hour of the month to a snapshot

$$Compensation_WWT(k, m) = Closses(k) \sum_{T=1}^6 [\Delta P_{loss_k}(T) w_T]$$

How ITC works: cost of losses

STEP 2: Total fund = sum of all compensations

STEP 3: Contribution – How much does a country pay?

NetFlowPrice_WWT(m)

“How much should be paid per MWh of net export or import”

$$\frac{\sum_{\mu=1}^m WWT_Fund(\mu) - \sum_{j \in ITC} \sum_{\mu=1}^m Perimeter_Contribution_WWT(j, \mu)}{\sum_{j \in ITC} \sum_{\mu=1}^m [NIF(j, \mu) + NEF(j, \mu)]}$$

1/12 of total fund corrected for payments paid by countries adjacent to the ITC zone (i.e. perimeter countries)

$$\sum_{\mu=1}^m Contribution_WWT(k, \mu) =$$

$$NetFlowPrice_WWT(m) \sum_{\mu=1}^m [NIF(k, \mu) + NEF(k, \mu)]$$

Sum of total net import/export
National contribution to the fund of the m first months
= price for net import/export x volume net import/export

$$Contribution_WWT(k, m)$$

$$\sum_{\mu=1}^m Contribution_WWT(k, \mu) - \sum_{\mu=1}^{m-1} Contribution_WWT(k, \mu)$$

Monthly contribution is delta compared to total since previous month (contribution of the first m months minus contribution of the first m – 1 months)

How ITC works: framework fund

Bottom-line:

- Transited countries receive money (i.e. they are 'compensated' from the fund)

Sources and sinks pay money (i.e. they 'contribute' to the fund)

- Zero-sum game (Sum of contributions = Sum of compensations)
- Fund of 100.000.000 euro (to be evaluated by ACER)

How ITC works: framework fund

STEP 1: Compensation – How much does a country receives?

$$\sum_{\mu=1}^m \text{Compensation_FF}(k, \mu) =$$

$$\frac{m}{12} \text{FrameworkFund} \left[0.75 \frac{\sum_{\mu=1}^m T(k, \mu)}{\sum_{j \in \text{ITC}} \sum_{\mu=1}^m T(j, \mu)} + 0.25 \frac{\frac{\left[\sum_{\mu=1}^m T(k, \mu) \right]^2}{\sum_{\mu=1}^m T(k, \mu) + \frac{m}{12} L(k)}}{\sum_{j \in \text{ITC}} \frac{\left[\sum_{\mu=1}^m T(j, \mu) \right]^2}{\sum_{\mu=1}^m T(j, \mu) + \frac{m}{12} L(j)}} \right]$$

National transit / Sum of national transits

(national transit)² / (national transit + national vertical load)

sum of [(national transit)² / (national transit + national vertical load)]

$$\text{Compensation_FF}(k, m) =$$

$$\sum_{\mu=1}^m \text{Compensation_FF}(k, \mu) - \sum_{\mu=1}^{m-1} \text{Compensation_FF}(k, \mu)$$

Monthly compensation is delta compared to total since previous month (compensation of the first m months minus compensation of the first m-1 months)

How ITC works: framework fund

STEP 2: Contribution – How much does a country pay?

NetFlow Price _FF(m)

“How much should be paid per MWh of net export or import”

$$\frac{\frac{m}{12} \text{FrameworkFund} - \sum_{j \in \text{ITC}} \sum_{\mu=1}^m \text{Perimeter_Contribution_FF}(j, \mu)}{\sum_{j \in \text{ITC}} \sum_{\mu=1}^m [NIF(j, \mu) + NEF(j, \mu)]}$$

1/12 of 100 M€ corrected for payments paid by countries adjacent to the ITC zone (i.e. perimeter countries)

Sum of total net import/export

$$\sum_{\mu=1}^m \text{Contribution_FF}(k, \mu) =$$

$$\text{NetFlowPrice_FF}(m) * \sum_{\mu=1}^m [NIF(k, \mu) + NEF(k, \mu)]$$

National contribution to the fund

= price for net import/export x volume net import/export

$$\text{Contribution_FF}(k, m) =$$

$$\sum_{\mu=1}^m \text{Contribution_FF}(k, \mu) - \sum_{\mu=1}^{m-1} \text{Contribution_FF}(k, \mu)$$

Monthly contribution is delta compared to total since previous month (contribution of the first m months minus contribution of the first m – 1 months)

STEP 3: Actual amount received (or paid if <0) = Compensation – contribution

Thank you for your attention.

15 October 2014 | Page 17