

ENTSO-E ITC Transit Losses Data report 2021

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European Network of
Transmission System Operators
for Electricity



ENTSO-E Mission Statement

Who we are

ENTSO-E, the European Network of Transmission System Operators for Electricity, is the **association for the cooperation of the European transmission system operators (TSOs)**. The 42 member TSOs, representing 35 countries, are responsible for the **secure and coordinated operation** of Europe's electricity system, the largest interconnected electrical grid in the world. In addition to its core, historical role in technical cooperation, ENTSO-E is also the common voice of TSOs.

ENTSO-E **brings together the unique expertise of TSOs for the benefit of European citizens** by keeping the lights on, enabling the energy transition, and promoting the completion and optimal functioning of the internal electricity market, including via the fulfilment of the mandates given to ENTSO-E based on EU legislation.

Our mission

ENTSO-E and its members, as the European TSO community, fulfil a common mission: Ensuring the **security of the interconnected power system in all time frames at pan-European level** and the **optimal functioning and development of the European interconnected electricity markets**, while enabling the integration of electricity generated from renewable energy sources and of emerging technologies.

Our vision

ENTSO-E plays a central role in enabling Europe to become the first **climate-neutral continent by 2050** by creating a system that is secure, sustainable and affordable, and that integrates the expected amount of renewable energy, thereby offering an essential contribution to the European Green Deal. This endeavour requires **sector integration** and close cooperation among all actors.

Europe is moving towards a sustainable, digitalised, integrated and electrified energy system with a combination of centralised and distributed resources.

ENTSO-E acts to ensure that this energy system **keeps consumers at its centre** and is operated and developed with **climate objectives** and **social welfare** in mind.

ENTSO-E is committed to use its unique expertise and system-wide view – supported by a responsibility to maintain the system's security – to deliver a comprehensive roadmap of how a climate-neutral Europe looks.

Our values

ENTSO-E acts in **solidarity** as a community of TSOs united by a shared **responsibility**.

As the professional association of independent and neutral regulated entities acting under a clear legal mandate, ENTSO-E serves the interests of society by **optimising social welfare** in its dimensions of safety, economy, environment, and performance.

ENTSO-E is committed to working with the highest technical rigour as well as developing sustainable and **innovative responses to prepare for the future** and overcoming the challenges of keeping the power system secure in a climate-neutral Europe. In all its activities, ENTSO-E acts with **transparency** and in a trustworthy dialogue with legislative and regulatory decision makers and stakeholders.

Our contributions

ENTSO-E supports the cooperation among its members at European and regional levels. Over the past decades, TSOs have undertaken initiatives to increase their cooperation in network planning, operation and market integration, thereby successfully contributing to meeting EU climate and energy targets.

To carry out its **legally mandated tasks**, ENTSO-E's key responsibilities include the following:

- › Development and implementation of standards, network codes, platforms and tools to ensure secure system and market operation as well as integration of renewable energy;
- › Assessment of the adequacy of the system in different timeframes;
- › Coordination of the planning and development of infrastructures at the European level (Ten-Year Network Development Plans, TYNDPs);
- › Coordination of research, development and innovation activities of TSOs;
- › Development of platforms to enable the transparent sharing of data with market participants.

ENTSO-E supports its members in the **implementation and monitoring** of the agreed common rules.

ENTSO-E is the common voice of European TSOs and provides expert contributions and a constructive view to energy debates to support policymakers in making informed decisions.

Background and purpose of this document

The Inter Transmission System Operator Compensation (ITC) Agreement is a multiparty agreement concluded between ENTSO-E and ENTSO-E member countries. It offers a single frame to compensate parties for costs associated with losses resulting with hosting transits flows on networks and for the costs of hosting those flows. All parties removed previously applied transit charges. This report offers a transparent overview of the method to compute losses resulting from transits flows and the amount incurred by all parties.

The ITC Compensation mechanism is governed by Article 49 of Regulation (EU) 2019/943. The ITC mechanism is further specified by Commission Regulation (EU) No 838/2010 of 23 September 2010 on laying down guidelines relating to the inter-transmission system operator compensation mechanism and a common regulatory approach to trans-

mission charging. According to Articles 4.2 and 4.3 of the Annex, Part A, of Commission Regulation (EU) No 838/2010, ENTSO-E is mandated to determine the amount of losses incurred on national transmission systems by calculating the difference between:

- (1) the amount of losses actually incurred on the transmission system during the relevant period; and
- (2) the estimated amount of losses on the transmission system which would have been incurred on the system during the relevant period if no transits of electricity had occurred. ENTSO-E is also responsible for publishing this calculation and its method in an appropriate format. This document contains these publications.

Method

The losses caused by transits in each transmission system are determined by:

- recording the load flow situation for each party to the ITC mechanism (ITC Party) for 6 monthly snapshots τ (3rd Wednesdays of a month and preceding Sundays at 03:30h, 11:30h and 19:30 CET/CEST):
 - › with transit represented on the interconnected system;
 - › with transit represented on the disconnected system;
- the losses caused by transit for the particular hour $\Delta P_{loss\ k\ (T)}$ is then determined as the difference of the losses observed in the two situations;
- based on a mapping that attributes every hour of the month to one of the six snapshot timestamps τ , each snapshot timestamp is given a weight w_{τ} ;
- the overall monthly amount of transit losses for each ITC party is derived by aggregating the weighted transits for the particular hours.

Annex 1 contains further illustrations of this method.

Calculation

Annex 2 contains the calculation results for the year 2021.

Annex 1: Illustration of the methodology

WWT = “With and Without Transit”. To assess the losses caused by transits, TSOs compute what would have been the losses without transit and compare the outcome with the metered values (with transits).

Monthly WWT Calculation: Introduction

- The losses caused by transit $\Delta P_{loss}(\tau, k)$ are determined for each ITC Party k for 6 monthly snapshots τ (3rd Wednesday of a month and preceding Sunday at 03:30 h, 11:30 h and 19:30 h CET/CEST).
- Based on a mapping that attributes every hour of the month to one of the six snapshots timestamps τ , each snapshot timestamp is given a weight w_τ .
- The monthly WWT compensation is yielded by ITC Party k 's losses cost $C_{losses}(k)$ multiplied by the losses energy caused by transit.

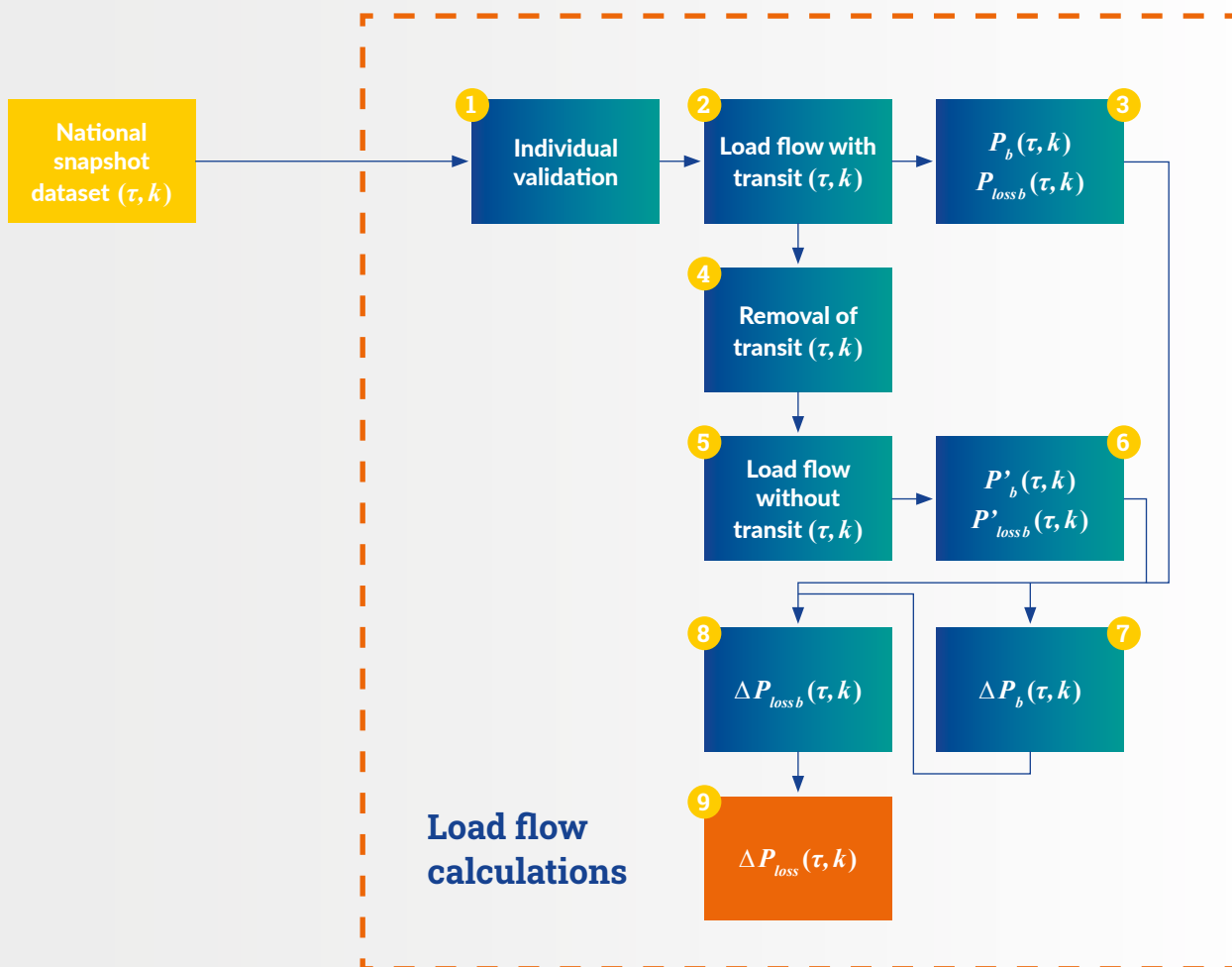
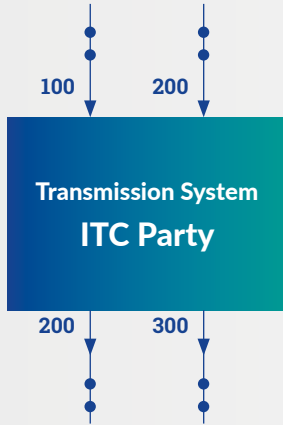


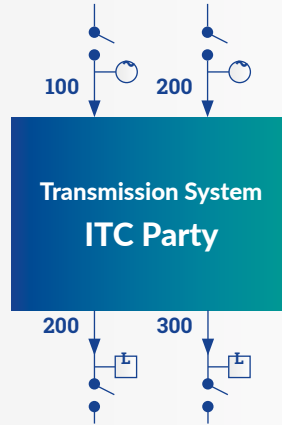
Figure 1: Monthly WWT Calculation

$\Delta P_{loss}(\tau, k)$ – 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)

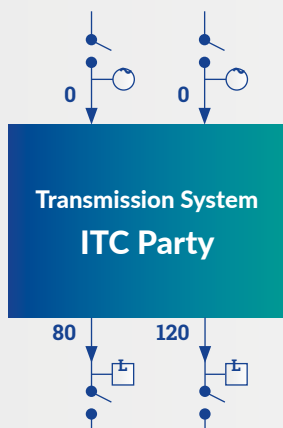


$$\text{Transit} = \text{Minimum} \{ \sum \text{Export}_i, \sum \text{Import}_j \}$$

Example: $\sum \text{Export} = 500 \text{ MW}, \sum \text{Import} = 300 \text{ MW}$
 $\text{Transit} = \text{Minimum} \{ 500 \text{ MW}, 300 \text{ MW} \} = 300 \text{ MW}$

$\Delta P_{loss}(\tau, k)$ – Load flow without transits (Module 4, 5, 6, 7)

Simulated Situation **without transit**
represented on **disconnected**
system (measured load flow, result
from State Estimation)



Removal of transit by modifying
the flows on tie-lines

$$\text{If } \left(\sum_i P_{ex_i} \geq \sum_j P_{im_j} \right) \text{ then } \begin{aligned} P_{ex'_k} &= P_{ex_k} \times \left(1 - \frac{\sum_i P_{im_i}}{\sum_j P_{ex_j}} \right) \\ P_{im'_m} &= 0 \end{aligned}$$

$$\text{If } \left(\sum_i P_{ex_i} < \sum_j P_{im_j} \right) \text{ then } \begin{aligned} P_{im'_k} &= P_{im_k} \times \left(1 - \frac{\sum_j P_{ex_j}}{\sum_i P_{im_i}} \right) \\ P_{ex'_m} &= 0 \end{aligned}$$

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

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

$\Delta P_{loss}(\tau, k)$ – 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)

$$\Delta P_{loss\ b}(\tau, k) = P_{loss\ b}(\tau, k) - P'_{loss\ b}(\tau, k)$$

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

$$\Delta p_b(\tau, k) = \Delta P_b(\tau, k) / P_b(\tau, k)$$

If $\{ \text{sign}(\Delta p_{loss\ b}(\tau, k)) = \text{sign}(\Delta p_b(\tau, k)) \text{ and } |\Delta p_{loss\ b}(\tau, k)| > |\Delta p_b(\tau, k)| \}$

then

$$\Delta P_{loss\ b}(\tau, k) = \Delta p_b(\tau, k) \times P_{loss\ b}(\tau, k)$$

else

$$\Delta P_{loss\ b}(\tau, k) = P_{loss\ b}(\tau, k) - P'_{loss\ b}(\tau, k)$$

k = country

b = branch

τ = snapshot timestamp

ΔP_{loss} = relative increase in losses

ΔP = relative increase in flows

$\Delta P_{loss}(\tau, k)$ – sum for ITC Party k (Module 9)

Sum of all branches within a country

$$\Delta P_{loss}(\tau, k) = \sum_b \Delta P_{loss\ b}(\tau, k)$$



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

$$Compensation_WWT(k, m) = C_{losses}(k) \sum_{t=1-6}^b \left[\Delta P_{loss}(\tau, k) \ w_\tau \right]$$

Annex 2: Calculation Results 2021

2021												
WWT												
weighted												
MWh												
Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Albania / AL	-145,527	-14,636	113,346	68,910	72,227	1.514,118	204,000	557,220	999,034	328,143	208,190	3.559,995
Austria / AT	14.945,486	16.864,836	6.973,103	23.000,926	4.880,506	-1.584,890	13.474,320	16.431,717	16.019,338	31.519,267	17.284,548	10.300,864
Bosnia / BA	708,101	543,184	2.138,703	2.797,188	2.779,788	5.275,220	1.460,471	5.353,839	4.849,574	3.226,623	1.512,852	2.296,911
Belgium / BE	11.789,638	8.616,164	2.494,944	8.051,282	8.572,272	9.973,858	6.289,931	7.189,243	6.226,140	6.659,972	16.968,728	29.038,432
Bulgaria / BG	553,317	627,540	2.958,558	677,600	3.723,857	3.866,956	2.914,983	327,105	369,650	2.263,933	278,454	4.623,534
Switzerland / CH	44.616,648	49.260,056	32.258,376	21.238,788	15.094,184	19.233,982	29.627,577	13.378,720	24.437,630	48.687,060	31.119,592	10.968,696
Czech Rep. / CZ	64.862,072	31.596,956	10.208,533	37.224,788	1.478,429	763,912	9.045,415	23.383,591	23.351,148	34.868,093	21.362,776	33.989,092
Germany / DE	123.437,970	31.868,320	86.104,323	229.993,808	34.880,641	32.853,022	43.040,801	18.704,550	91.952,206	85.942,187	210.130,202	156.011,343
Denmark / DK	54.918,581	30.527,544	47.103,426	52.017,592	51.915,486	14.377,348	20.604,659	19.650,564	31.080,258	38.041,710	43.366,594	28.794,530
Estonia / EE	11.559,923	5.463,627	5.613,779	15.910,068	16.330,137	12.125,260	14.479,255	29.760,363	13.833,220	14.893,384	17.978,450	16.255,665
Spain / ES	7.091,016	44.006,128	26.593,251	17.749,318	2.309,260	4.616,124	11.778,919	50.092,710	15.518,758	-7.595,339	12.874,524	17.903,427
Finland / FI	36.398,548	15.901,592	38.560,095	43.921,050	34.879,605	18.028,446	38.062,482	49.986,901	32.724,454	52.796,850	57.079,344	45.462,914
France / FR	62.587,830	81.134,572	113.874,959	86.456,332	46.008,777	48.000,172	16.328,035	10.707,857	31.563,630	37.708,106	52.908,632	37.094,133
Great Britain / GB	27.622,927	4.468,352	9.481,454	15.574,096		1.677,810	40.784,612	10.264,903	11.855,950	8.928,629	5.759,640	39.082,237
Greece / GR	858,963	2.458,940	5.993,148	2.898,594	287,196	1.435,258	270,108	3.478,359	13.218,614	5.402,797	2.489,258	1.061,425
Croatia / HR	8.632,087	8.620,272	8.062,317	5.909,418	5.228,251	6.873,740	5.421,036	1.845,359	7.297,722	3.281,630	1.949,186	8.449,284
Hungary / HU	3.326,082	1.854,024	1.696,653	4.381,730	786,350	7.163,600	2.749,302	8.465,691	3.451,088	13.863,746	10.224,508	2.748,208
Ireland / IE	0,189	741,708	-0,144	-0,170	-0,067	-0,020	0,684	18,499	0,830	0,315	0,000	902,476
Italy / IT	-287,633	5.669,072	-1.587,419	2.444,202	-401,591	-944,428	-947,343	-1.571,715	5.730,782	6.921,197	7.725,214	12.011,580
Kosovo* / KS*	1.636,607	2.033,040	992,446	1.266,550	1.687,360	1.137,592	1.339,926	2.448,929	3.794,842	1.600,014	1.217,364	2.305,888
Lithuania / LT	5.348,330	869,624	3.425,429	11.701,544	208,575	3.513,938	7.773,943	7.277,734	764,286	7.921,680	13.730,268	14.739,414
Luxembourg / LU	0,000	82,768	15,982	0,000	0,000	0,000	0,000	0,000	0,000	100,989	1,064	52,211
Latvia / LV	3.908,819	1.386,484	2.323,942	3.265,278	1.908,556	1.954,416	5.616,388	3.898,317	3.082,328	2.486,095	1.686,746	1.118,254
Montenegro / ME	1.236,447	1.988,320	953,943	1.722,570	2.338,682	2.356,404	730,431	1.578,609	2.325,254	1.581,529	2.706,746	651,977
FYROM / MK	317,801	569,736	376,549	12,472	515,742	1.764,620	2.077,206	1.657,689	2.648,354	451,465	383,400	3.710,666
Northern Ireland / I	734,727	519,456	1.624,509	1.098,406	2.077,941	685,218	2.237,289	1.072,970	1.127,686	1.478,919	1.267,774	577,479
Netherlands / NL	38.721,008	16.690,588	14.189,277	23.551,330	11.090,126	10.224,016	11.586,150	18.930,461	22.281,120	30.301,109	70.674,768	55.881,134
Norway / NO	-2.788,140	921,400	1.599,781	5.513,508	804,000	9.538,794	2.023,756	4.453,743	1.003,640	15.947,971	3.616,010	-7.497,495
Poland / PL	46.506,409	13.072,156	17.404,393	35.271,956	5.609,576	5.298,010	18.215,671	40.690,561	13.576,558	62.724,135	24.045,544	48.176,534
Portugal / PT	4.727,531	-915,500	-1.731,408	-477,652	318,585	-133,542	18,497	168,539	-611,048	1.782,648	851,950	-583,195
Romania / RO	-1.110,135	-669,720	-2.174,863	-4.310,256	3.388,585	8.236,224	-3.886,521	-1.489,712	-1.157,470	-4.123,508	-1.329,000	1.915,598
Serbia / RS	1.903,875	2.506,096	4.292,917	3.843,970	7.802,895	13.446,274	6.604,568	2.103,608	8.447,102	3.918,507	2.126,872	6.840,978
Sweden / SE	56.647,755	43.822,856	33.019,822	8.275,670	62.424,525	19.628,268	31.768,629	14.049,290	42.246,022	7.078,272	43.557,216	48.422,013
Slovenia / SI	5.672,485	7.558,240	5.232,713	4.448,196	1.949,980	5.135,948	7.317,645	4.222,927	8.371,770	7.108,519	2.319,320	5.096,159
Slovakia / SK	17.586,119	8.459,736	2.686,421	12.029,502	1.089,724	1.184,092	3.593,611	15.032,265	9.137,012	16.627,381	20.313,890	8.137,770
TOTAL	654.525,856	439.103,531	482.873,258	677.528,564	375.974,518	269.219,760	352.606,436	384.121,406	451.517,482	544.724,028	698.390,624	650.100,131

Any question? Contact us:

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