TYNDP 2024

The Hydrogen and Natural Gas TYNDP

Hydrogen Infrastructure Gaps Identification Report

Draft including stakeholder feedback

entsog

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1 INTRODUCTION

The TYNDP 2024 Hydrogen Infrastructure Gaps Identification report (IGI report) aims at identifying regional infrastructure gaps within the assessed sets of hydrogen infrastructure assumed to be in place in a given year (i.e., hydrogen infrastructure level). IGI indicators are used for this identification.

This document is established in line with Article 13 of the TEN-E Regulation. Further details about its legal background, assumptions, modelling tools, and methodologies are provided in the TYNDP 2024 IGI methodology (Annex D2) that is cross-referencing to the TYNDP 2024 Implementation Guidelines (Annex D1) as well as to the TYNDP 2024 scenarios.

Infrastructure gaps identified in ENTSOG's hydrogen-related TYNDP 2024 IGI report may in some cases also be addressable by energy infrastructure solutions in other sectors like the electricity sector or the natural gas sector. This is the case for any infrastructure gaps identification that is focused on a specific energy vector. For electricity, ENTSO-E prepares the Identification of System Needs (IoSN) report, which is the equivalent to ENTSOG's IGI report.

This document is the draft version after integration of stakeholder feedback received during a public consultation, which ran between 18 December 2024 and 22 January 2025. The results of the IGI indicators 2.1 and 2.2 may be updated in the final version once the results of the Dual Hydrogen/Natural Gas Model (Dual Gas Model, DGM) are available.

There are two hydrogen infrastructure levels analysed as part of the IGI report (see section 1.1):

- A **PCI/PMI hydrogen infrastructure level** containing existing hydrogen infrastructure, FID hydrogen projects, and hydrogen projects on the Union list[1], modified by requests of the European Commission concerning import corridors.
- An **Advanced hydrogen infrastructure level** containing the PCI/PMI hydrogen infrastructure level as well as advanced hydrogen projects, modified by requests of the European Commission concerning import corridors.

The electricity infrastructure level considered in the IGI reflects the reference grid including generation and storage assets used in the NT+ scenario. Depending on time horizon (i.e., 2030 or 2040) different electricity projects will be considered to be part of the reference grid (as described in the Annex D1 section 2.3.2).

The analysis is performed for 2030 and 2040 for the TYNDP 2024 National Trends+ (NT+) scenario. Thereby, three indicators are used to identify regional hydrogen infrastructure gaps (see section 1.2).

1 6th Union list of Projects of Common Interest (PCI) and Projects of Mutual Interest (PMI) (i.e., 1st Union list under the revised TEN-E Regulation) as detailed in section B of Annex VII to the TEN-E Regulation.

1.1 HYDROGEN INFRASTRUCTURE LEVELS

1.1.1 PCI/PMI HYDROGEN INFRASTRUCTURE LEVEL

Projects conforming the PCI/PMI hydrogen infrastructure level are shown in the Figure 1 and are listed in Annex I of the TYNDP 2024 Annex D1. The hydrogen production assets available in both hydrogen infrastructure levels are identical and stated in Annex I of this report.

This IGI report focusses the analysis on two assessed simulation years (i.e., 2030 and 2040). Not all projects included in the PCI/PMI hydrogen infrastructure level will be fully implemented in the 2030 timeframe. It might be the case that projects are composed by several phases with different commissioning years and that the commissioning year of some projects and/or phases is 2030 or later and therefore not considered in the 2030 assessment[2]. Whereas, in the 2040 assessment, full deployment of PCIs and PMIs is assumed.

Regarding intra-EU transmission infrastructure, in the PCI/PMI hydrogen infrastructure level, some Southern European countries are not connected to the European network, as visible in Figure 1. More specifically, the Greek and Bulgarian hydrogen systems are interconnected by PCIs, but remain isolated from other neighbouring countries. Countries and regions that are isolated without any cross-border hydrogen infrastructure in this hydrogen infrastructure level are Hungary, Romania, Slovenia, Switzerland, Croatia, Ireland, the United Kingdom, Cyprus, Malta, Luxembourg, the France-Southwest region, the Poland-North-region and the Poland-South region. Slovakia is isolated in 2030 and connected with Czechia and Austria only in 2040.

Regarding storage infrastructure in the PCI/PMI hydrogen infrastructure level, only Denmark, Germany, the Netherlands, France, and Spain have hydrogen storage capacities (see Table 1).

Storage capacities	Direction	2030	2040
Denmark	Injection	3.16	3.16
Denmark	Withdraw	9.5	9.5
Denmark	Working Gas Volume	100	100
France	Injection & Withdraw	10.0	10.0
France	Working Gas Volume	250	250
Germany	Injection & Withdraw	4.25	21.25
Germany	Working Gas Volume	154	359
Netherlands	Injection & Withdraw	3.3	13.2
Netherlands	Working Gas Volume	206	850
Spain	Injection & Withdraw	62.0	62.0
Spain	Working Gas Volume	708	2728
Sum	**Injection**	**82.71**	**109.61**
Sum	**Withdraw**	**89.05**	**115.95**
Sum	**Working Gas Volume**	**1418**	**4287**

Table 1: Hydrogen storage capacities considered in the PCI/PMI hydrogen infrastructure level for the assessed years (unit: GWh/d for injection and withdrawal and GWh for working gas volume).

2 Hydrogen infrastructure capacities of the PCI/PMI hydrogen infrastructure level as well as the Advanced hydrogen infrastructure level for 2030 and 2040 are published as part of the TYNDP 2024 Annex C2

Regarding extra-EU supplies, the PCI/PMI hydrogen infrastructure level has limited access to extra-EU supply potential. This is particularly relevant when considering the 2030 assessment:

- Regarding pipeline imports from extra-EU sources (see Table 2): PCIs and PMIs are considered to unlock North African, Norwegian and Ukrainian supply potential only from 2040.
- Regarding hydrogen import terminals (see Table 3): In 2030, extra-EU imports will be limited to the PCI import terminals in Belgium, Germany, and the Netherlands. In 2040, higher capacity of PCI import terminals will be considered in these countries due to the planned full implementation of the multiple phases of the PCIs. In 2040, also an additional PCI import terminal located in France will be considered to be connected to the Belgian hydrogen network.

From Country	To Country	Hydrogen import capacity		Extra-EU hydrogen supply potential		Effective hydrogen import potential	
		2030	2040	2030	2040	2030	2040
Algeria	**Italy**	0.0	448.0	116.8	1,124.5	0.0	448.0
Morocco	**Spain**	0.0	106.0	0.0	106.2	0.0	106.0
Norway	**Germany**	0.0	432.0	146.3	724.52	0.0	432.0
Ukraine	**Slovakia**	0.0	218.4	85.0	878.9	0.0	218.4

Table 2: Extra-EU import capacities via pipelines considered in the PCI/PMI hydrogen infrastructure level and extra-EU supply potential for the assessed years (unit: GWh/d).

Import capacities by ship To Country	2030	2040
Belgium	59.3	193.6
France	0.0	48.0
Germany	44.2	67.7
The Netherlands	90.8	177.1
Sum	194.3	486.4
Shipped supply potential	2030	2040
Extra-EU to EU	193.3	1,327.4
Effective hydrogen import potential	2030	2040
Minimum of import capacities by ship and shipped supply potential	194.3	486.4

Table 3: Extra-EU import capacities via terminals considered in the PCI/PMI hydrogen infrastructure level and extra-EU supply potential by ship for the assessed years (unit: GWh/d).


Picture courtesy of ENAGAS

TYNDP 2024 HYDROGEN PROJECTS – PCI STATUS (EXCLUDING ELECTROLYSERS)

HYDROGEN TRANSMISSION PIPELINES (H2T)

	H2T-F-468	National H2 Backbone	Gasunie	FID	PCI
★	H2T-F-899	mosaHYc - Mosel Saar Hydrogen Conversion	GRTgaz	FID	PCI
	H2T-A-443	Nordic-Baltic Hydrogen Corridor - FI section	Gasgrid	Advanced	PCI
	H2T-A-642	HyPipe Bavaria - The Hydrogen Hub	bayernets	Advanced	PCI
	H2T-A-757	H2 Backbone WAG + Penta West	Gas Connect Austria	Advanced	PCI
	H2T-A-788	H2 transmission system in Bulgaria	Bulgartransgaz	Advanced	PCI
★	H2T-A-906	Vlieghuis - Ochtrup	Gasunie, Thyssengas	Advanced	PCI
	H2T-A-909	Connection HY-FEN-GeoH2	GRTgaz	Advanced	PCI
★	H2T-A-926	Baltic Sea Hydrogen Collector – Offshore Pipeline [BHC] – Sweden	Nordion Energi	Advanced	PCI
	H2T-A-969	RHYn	GRTgaz	Advanced	PCI
	H2T-A-978	Portuguese Hydrogen Backbone	REN Gasodutos	Advanced	PCI
	H2T-A-986	H2 Readiness of the TAG pipeline system	TAG	Advanced	PCI
	H2T-A-987	MosaHYc (Mosel Saar Hydrogen Conversion) - Germany	GRTgaz	Advanced	PCI
	H2T-A-990	Czech H2 Backbone SOUTH (formerly CEHC, Czech part)		Advanced	PCI
	H2T-A-1001	Hyperlink 3 Danish-German Hydrogen Network - German part	Gasunie	Advanced	PCI
	H2T-A-1034	Czech H2 Backbone WEST (formerly CGHI, Czech part)		Advanced	PCI
	H2T-A-1035	Franco-Belgian H2 corridor (incl. WHHYN)	GRTgaz	Advanced	PCI
	H2T-A-1037	H2ercules Network North	OGE	Advanced	PCI
	H2T-A-1038	H2ercules Network West	OGE	Advanced	PCI
★	H2T-A-1052	H2ercules Network South-West	GRTgaz, OGE	Advanced	PCI
	H2T-A-1055	H2ercules Network South-East	GRTgaz, OGE	Advanced	PCI
	H2T-A-1075	H2ercules Network North-West	OGE	Advanced	PCI
	H2T-A-1096	RHYn Interco (Section 1-3)	badenova Netze, terranets bw, GRTgaz	Advanced	PCI
★	H2T-A-1136	Nordic Hydrogen Route – Bothnian Bay – Finnish section - Pipeline	Gasgrid	Advanced	PCI
	H2T-A-1137	Central European Hydrogen Corridor (CEHC) (UKR part)	Operator	Advanced	PCI
	H2T-A-1144	Nordic-Baltic Hydrogen Corridor - PL section	Gaz-System	Advanced	PCI
	H2T-A-1049	Spanish hydrogen backbone 2030	Enagás	Advanced	PCI
★	H2T-A-1056	H2Med/CelZa	REN Gasodutos	Advanced	PCI
	H2T-A-1171	Nordic Hydrogen Route- Bothnian Bay- Swedish part	Nordion Energi	Advanced	PCI
	H2T-A-1236	Danish Backbone West	Energinet	Advanced	PCI
	H2T-A-1264	Slovak Hydrogen Backbone	eustream	Advanced	PCI
	H2T-A-1280	Nordic-Baltic Hydrogen Corridor - LV section	Conexus	Advanced	PCI
	H2T-A-1310	Nordic-Baltic Hydrogen Corridor - DE section	ONTRAS	Advanced	PCI
	H2T-A-1311	Belgian Hydrogen Backbone	fluxys	Advanced	PCI
	H2T-A-1355	Baltic Sea Hydrogen Collector - Offshore Pipeline [BHC]	Nordion Energi, Gasgrid	Advanced	PCI
	H2T-N-569	HY-FEN H2 Corridor Spain France Germany connection	GRTgaz	Less-Adv.	PCI
	H2T-N-738	Delta Rhine Corridor H2	OGE	Less-Adv.	PCI
	H2T-N-796	FLOW – making hydrogen happen (East)	Gascade	Less-Adv.	PCI
	H2T-N-884	CHE Pipeline	equinor	Less-Adv.	PCI
	H2T-N-970	Dedicated H2 Pipeline		Less-Adv.	PCI
	H2T-N-991	AquaDuctus	fluxys, Gascade	Less-Adv.	PCI
	H2T-N-1122	Nordic-Baltic Hydrogen Corridor - EE section	elering	Less-Adv.	PCI
	H2T-N-1151	H2Med-BarMar	Enagás, Teréga, GRTgaz	Less-Adv.	PCI
	H2T-N-1239	Nordic-Baltic Hydrogen Corridor - LT section	Amber Grid	Less-Adv.	PCI
	H2T-N-1324	H2Med-CelZa (Enagas)	Enagás	Less-Adv.	PCI

HYDROGEN STORAGE FACILITIES (H2S)

H2S-A-508	H2 storage North-1	Enagás	Advanced	PCI
H2S-A-565	GeoH2	Géométhane	Advanced	PCI
H2S-A-767	RWE H2 Storage expansion 2 Gronau-Epe	RWE	Advanced	PCI
H2S-A-1152	H2 storage North-2	Enagás	Advanced	PCI
H2S-A-1238	DK Hydrogen Storage	Gas Storage Denmark	Advanced	PCI
H2S-A-1279	Hystock	Gasunie	Advanced	PCI
H2S-A-1284	RWE H2 Storage Gronau-Epe - 2nd expansion	RWE	Advanced	PCI
H2S-N-934	SaltHy Harsefeld	storengy	Less-Adv.	PCI

HYDROGEN RECEPTION FACILITIES (H2L)

	H2L-A-754	ACE Terminal	Gasunie	Ammonia	Advanced	PCI
★	H2L-N-543	LH2.Rotterdam	Vopak	Ammonia	Less-Adv.	PCI
	H2L-N-664	Antwerp NH3 Import Terminal	fluxys	Ammonia	Less-Adv.	PCI
	H2L-N-820	Dunkerque New Molecules development	fluxys	Ammonia	Less-Adv.	PCI
	H2L-N-968	Green Wilhelmshaven Terminal/Storage/Cracker	Uniper	Ammonia	Less-Adv.	PCI
	H2L-N-1099	Ammonia Import Terminal Brunsbuttel	RWE	Ammonia	Less-Adv.	PCI
	H2L-N-1100	Amplifhy Antwerp	vtti	Ammonia	Less-Adv.	PCI
	H2L-N-1127	Amplifhy Rotterdam	vtti	Ammonia	Less-Adv.	PCI
	H2L-N-1159	bp Wilhelmshaven Green Hydrogen Hub	bp	Ammonia	Less-Adv.	PCI
	H2L-N-1325	Zeebrugge New Molecules development	fluxys	Ammonia	Less-Adv.	PCI

Figure 1: Representation of the PCI/PMI hydrogen infrastructure level.

DOWNLOAD THE MAP

KEYS
ENTSOG currently comprises 43 TSO members, 1 Associated Partner and 9 Observers from 32 European Countries
When the same point is affected by several projects, the point is shown with the highest project status (operational, FID, advanced, non-FID), the status from single projects can vary from that. The projects are shown with the planning status reported in their TYNDP 2024 submission.
Project information, initially based on TYNDP project collection conducted in Nov 2023 - Feb 2024.
All data provided on this map is for information purposes and shall be treated as indicative and non-contractual in nature, without pre-empting different outcomes of any possible discussion held at regional level. Under no circumstances shall it be regarded as information intended for commercial use.
Project status :
TRA-F-123
Infrastructure Project Name
BULGARTRANSGAZ
FID
PCI
Project ENTSOG code
Project Name
Project Promoter
Project status codes
Project not marked on map
Exact project location is not available or is marked as confidential
Exact project locations not marked on map
Project has several locations/points.
The indicated location is for representation purposes only and does not indicate the exact location of the project
Newly added project in TYNDP 2024
(additional to www.h2inframap.eu)
Project ENTSOG codes / color :
TRA-N-000 — Project is part of 1st PCI/PMI list
TRA-N-000
TRA-N-000
TRA-N-000
Project is not part of 1st PCI/PMI list
Project status codes :
The project advancement status is based on the TYNDP project collection conducted in Nov. 2023 - Feb. 2024.
PCI
Non-PCI
PCI status (Project of Common Interest)
FID
Advanced
Less-Adv.
FID status (Final Investment Decision)
Advanced status is applied to all projects that, based on the information submitted, have:
Commissioning expected at the latest by 31 December 2029
AND the project fulfils at least one of the following criteria:
- Project has taken the final investment decision (FID) ahead of the TYNDP 2024 project collection
- Project is included in the NDP(s) of the respective country(ies) or in the national law
- Project has successfully consulted the market through a market test (including non-binding processes), which delivered positive results
Cross-border points / intra-country or intra balancing zone points
Cross-border interconnection point within Europe or export point to non-EU country
Cross-border interconnection point with third country (import)
Cross-border interconnection point within Europe or export point to non-EU country
Under construction or Planned
LNG Import terminal (operational)
LNG Export terminal (operational)
Intra-country or intra balancing zone points
Third country cross-border interconnection point
Cross-border interconnection point (Virtual Point)
Third country cross-border (Virtual Point / import)
Gas Reserve areas
Gas field
Drilling platform
Countries
EU Countries
Other Countries
Transport by pipeline
Existing infrastructure for natural gas :
Diameter < 600 mm
Diameter 600 - 900 mm
Diameter > 900mm
Not operational
Planned infrastructure for natural gas :
Project
Storage facilities
Acquifer
Salt cavity - cavern
Depleted (Gas) field on shore / offshore
Other type
Gas storage projects
Hydrogen Transmission Pipelines (H2T)
Project is part of 1st PCI/PMI list :
FID projects
Non-FID, advanced projects
Non-FID, less-advanced projects
Project identification :
H2T-N-123 — ENTSOG project code
Hydrogen Storage Facilities (H2S)
Project is part of 1st PCI/PMI list :
FID projects
Non-FID, advanced projects
Non-FID, less-advanced projects
Project identification :
H2S-N-123 — ENTSOG project code
Hydrogen Reception Facilities (H2L)
Project is part of 1st PCI/PMI list :
FID projects
Non-FID, advanced projects
Non-FID, less-advanced projects
Project identification :
H2L-N-123 — ENTSOG project code
North Sea
Atlantic Ocean
Irish Sea
Bay of Biscay
Baltic Sea
Mediterranean Sea
Black Sea
Skagerrak
Kattegat
Gulf of Riga
Ligurian Sea
Adriatic Sea
Tyrrhenian Sea
Ionian Sea
Aegean Sea
Balearic Sea
Sea of Azov
English Channel
Bristol Channel
Gulf of Lion
UNITED KINGDOM
DENMARK
THE NETHERLANDS
BELGIUM
LUX.
FRANCE
GERMANY
POLAND
CZECH REPUBLIC
SLOVAKIA
AUSTRIA
SWITZERLAND
HUNGARY
SLOVENIA
CROATIA
BOSNIA AND HERZEGOVINA
SERBIA
ROMANIA
MOLDOVA
BULGARIA
GREECE
ITALY
SPAIN
PORTUGAL
CORSICA
SARDINIA
MALTA
ESTONIA
LATVIA
LITHUANIA
RUSSIA
TÜRKYE
MONTENEGRO
KOSOVO
NORTH MACEDONIA
ALBANIA
LONDON
PARIS
BRUSSELS
AMSTERDAM
BERLIN
COPENHAGEN
STOCKHOLM
TALLINN
RIGA
VILNIUS
WARSAW
PRAGUE
VIENNA
BRATISLAVA
BUDAPEST
BERN
LJUBLJANA
ZAGREB
SARAJEVO
BELGRADE
BUCHAREST
CHISINAU
SOFIA
ATHENS
ROME
MADRID
LISBON
ALGIERS
TUNIS
LA VALETTA
ANKARA

1.1.2 ADVANCED HYDROGEN INFRASTRUCTURE LEVEL

The Advanced hydrogen infrastructure level is by definition more ambitious than the PCI/PMI hydrogen infrastructure level, as it contains not only the PCIs and PMIs, but also advanced hydrogen projects, which can involve countries without PCIs and PMIs.

Projects conforming the Advanced hydrogen infrastructure level are shown in the map in Figure 2 and are listed in Annex I of the TYNDP 2024 Annex D1. The hydrogen production assets available in both hydrogen infrastructure levels are identical and stated in Annex I of this report.

Regarding intra-EU transmission infrastructure, the Advanced hydrogen infrastructure level has a higher level of interconnections in Southern Europe, as visible in Figure 2. More specifically, Slovakia, Hungary, Romania, Croatia and Bosnia are interconnected in the Advanced hydrogen infrastructure level. Countries and regions that are isolated without any cross-border hydrogen infrastructure in this hydrogen infrastructure level are Luxembourg, Slovenia, Switzerland, Ireland, the United Kingdom, Cyprus, Malta, the France-Southwest region[3], the Poland-North and the Poland-South region.

Regarding storage infrastructure, the Advanced hydrogen infrastructure level has higher storage capacities in Germany and in the France-Southwest region (see Table 4).

Storage capacities	Direction	2030	2040
Denmark	Injection	3.16	3.16
Denmark	Withdraw	9.5	9.5
Denmark	Working Gas Volume	100	100
France[4]	Injection & Withdraw	19.3	19.3
France	Working Gas Volume	750	750
Germany	Injection & Withdraw	63.25	80.25
Germany	Working Gas Volume	1,532	1,737
Netherlands	Injection & Withdraw	3.3	13.2
Netherlands	Working Gas Volume	206	850
Spain	Injection & Withdraw	62.0	62.0
Spain	Working Gas Volume	708	2728
Sum	**Injection**	**151.01**	**173.91**
Sum	**Withdraw**	**157.35**	**184.25**
Sum	**Working Gas Volume**	**3,296**	**6,165**

Table 4: Hydrogen storage capacities considered in the Advanced hydrogen infrastructure level for the assessed years (units: GWh/d for injection and withdrawal and GWh for working gas volume).

3 The hydrogen southwest region would not be isolated if MidHY was considered at the same maturity status as the rest of the projects in this geographical area. The results should show that, from 2030, the MidHY project would ensure, with the HySoW project, the export of significant excess volumes of Renewable and Low Carbon hydrogen from the south west zone of France to the HI west corridor.

4 Some storage capacity in France is connected to the France-South region and some is connected to the France-Southwest region.

Regarding extra-EU supplies, the Advanced hydrogen infrastructure level has additional access to extra-EU supply potential compared to the PCI/PMI hydrogen infrastructure level:

- Regarding pipeline imports from extra-EU sources (see Table 5): The Advanced hydrogen infrastructure level includes access to North African (Algerian and Tunisian) supply in 2030 thanks to a project connecting Italy with this import source.
- Regarding hydrogen import terminals (see Table 6): The Advanced hydrogen infrastructure level has higher import capacity in the Netherlands and in Poland due to the inclusion of advanced hydrogen import terminals.

From Country	To Country	Hydrogen import capacity		Extra-EU hydrogen supply potential		Effective hydrogen import potential	
		2030	2040	2030	2040	2030	2040
Algeria	**Italy**	448.0	448.0	116.8	1,124.5	116.8	448.0
Morocco	**Spain**	0.0	106.0	0.0	106.2	0.0	106.0
Norway	**Germany**	0.0	432.0	146.3	724.52	0.0	432.0
Ukraine	**Slovakia**	0.0	218.4	85.0	878.9	0.0	218.4

Table 5: Extra-EU import capacities via pipelines considered in the Advanced hydrogen infrastructure level and extra-EU supply potential for the assessed years (unit: GWh/d).

Import capacities by ship to Country	2030	2040
Belgium	59.3	193.6
France	0.0	48.0
Germany	44.2	67.7
The Netherlands	136.3	222.6
Poland	17.7	17.7
Sum	**257.5**	**549.6**
Shipped supply potential	**2030**	**2040**
Extra-EU to EU	193.3	1327.4
Effective hydrogen import potential	**2030**	**2040**
Minimum of import capacities by ship and shipped supply potential	227.8	549.6

Table 6: Extra-EU import capacities via terminals considered in the advanced hydrogen infrastructure level and extra-EU supply potential by ship for the assessed years (unit: GWh/d).

TYNDP 2024 HYDROGEN PROJECTS – PCI AND ADVANCED STATUS (EXCLUDING ELECTROLYSERS)

HYDROGEN TRANSMISSION PIPELINES (H2T)

	H2T-F-468	National H2 Backbone	Gasunie	FID	PCI
★	H2T-F-899	mosaHYc - Mosel Saar Hydrogen Conversion	GRTgaz	FID	PCI
	H2T-A-443	Nordic-Baltic Hydrogen Corridor - FI section	Gasgrid	Advanced	PCI
	H2T-A-642	HyPipe Bavaria - The Hydrogen Hub	bayernets	Advanced	PCI
	H2T-A-757	H2 Backbone WAG + Penta West	Gas Connect Austria	Advanced	PCI
	H2T-A-788	H2 transmission system in Bulgaria	Bulgartransgaz	Advanced	PCI
★	H2T-A-906	Vlieghuis - Ochtrup	Gasunie, Thyssengas	Advanced	PCI
	H2T-A-909	Connection HY-FEN-GeoH2	GRTgaz	Advanced	PCI
★	H2T-A-926	Baltic Sea Hydrogen Collector – Offshore Pipeline (BHC) – Sweden	Nordion Energi	Advanced	PCI
	H2T-A-969	RHYn	GRTgaz	Advanced	PCI
	H2T-A-978	Portuguese Hydrogen Backbone	REN Gasodutos	Advanced	PCI
	H2T-A-986	H2 Readiness of the TAG pipeline system	TAG	Advanced	PCI
	H2T-A-987	MosaHYc (Mosel Saar Hydrogen Conversion) - Germany	GRTgaz	Advanced	PCI
	H2T-A-990	Czech H2 Backbone SOUTH (formerly CEHC, Czech part)		Advanced	PCI
	H2T-A-1001	Hyperlink 3 Danish-German Hydrogen Network - German part	Gasunie	Advanced	PCI
	H2T-A-1034	Czech H2 Backbone WEST (formerly CGHI, Czech part)		Advanced	PCI
	H2T-A-1035	Franco-Belgian H2 corridor (incl. WHHYN)	GRTgaz	Advanced	PCI
	H2T-A-1037	H2ercules Network North	OGE	Advanced	PCI
	H2T-A-1038	H2ercules Network West	OGE	Advanced	PCI
★	H2T-A-1052	H2ercules Network South-West	GRTgaz, OGE	Advanced	PCI
	H2T-A-1055	H2ercules Network South-East	GRTgaz, OGE	Advanced	PCI
	H2T-A-1075	H2ercules Network North-West	OGE	Advanced	PCI
	H2T-A-1096	RHYn Interco (Section 1-3)	badenovaNETZE, terranets bw, GRTgaz	Advanced	PCI
★	H2T-A-1136	Nordic Hydrogen Route – Bothnian Bay – Finnish section - Pipeline	Gasgrid	Advanced	PCI
	H2T-A-1137	Central European Hydrogen Corridor (CEHC) (UKR part)		Advanced	PCI
	H2T-A-1144	Nordic-Baltic Hydrogen Corridor - PL section	Gaz-System	Advanced	PCI
	H2T-A-1049	Spanish hydrogen backbone 2030	Enagas	Advanced	PCI
★	H2T-A-1056	H2Med/CelZa	REN Gasodutos	Advanced	PCI
	H2T-A-1171	Nordic Hydrogen Route- Bothnian Bay- Swedish part	Nordion Energi	Advanced	PCI
	H2T-A-1236	Danish Backbone West	Energinet	Advanced	PCI
	H2T-A-1264	Slovak Hydrogen Backbone	eustream	Advanced	PCI
	H2T-A-1280	Nordic-Baltic Hydrogen Corridor - LV section	Conexus	Advanced	PCI
	H2T-A-1310	Nordic-Baltic Hydrogen Corridor - DE section	Ontras	Advanced	PCI
	H2T-A-1311	Belgian Hydrogen Backbone	fluxys	Advanced	PCI
	H2T-A-1355	Baltic Sea Hydrogen Collector - Offshore Pipeline (BHC)	Nordion Energi, Gasgrid	Advanced	PCI
★	H2T-A-0	OGE H2ercules Central	bayernets, GRTgaz Deutschland, nowega, Thyssengas, OGE	Advanced	Non-PCI
★	H2T-A-66	Interconn. Croatia-Bosnia &Herzegov. (Slobodnica-Bosanski Brod)	Plinacro	Advanced	Non-PCI
★	H2T-A-68	H2 Ionian Adriatic Pipeline	Plinacro	Advanced	Non-PCI
★	H2T-A-70	Interconnection Croatia/Serbia (Slobodnica-Sotin-Bačko Novo Selo)	Plinacro	Advanced	Non-PCI
★	H2T-A-224	Northern Interconnection BiH/CRO	BH-Gas	Advanced	Non-PCI
★	H2T-A-302	Interconnection Croatia-Bosnia and Herzegovina (South)	Plinacro	Advanced	Non-PCI
★	H2T-A-303	Interconnection Croatia-Bosnia and Herzegovina (West)	Plinacro	Advanced	Non-PCI
	H2T-A-418	Connection Fiume Treste Livello F	snam	Advanced	Non-PCI
	H2T-A-443	Nordic-Baltic Hydrogen Corridor - FI section	Gasgrid	Advanced	Non-PCI
	H2T-A-444	HySoW Mediterranean (Hydrogen South West corridor of France)	Teréga	Advanced	Non-PCI
★	H2T-A-542	HyBRIDS	S.G.I.	Advanced	Non-PCI
	H2T-A-555	Apulia H2 Backbone	snam	Advanced	Non-PCI
	H2T-A-633	GETH2-IPCEI	nowega, OGE	Advanced	Non-PCI
	H2T-A-666	H2Coastlink	GTG Nord	Advanced	Non-PCI
★	H2T-A-735	North Africa Hydrogen Corridor	SeaCorridor	Advanced	Non-PCI
	H2T-A-779	Pomeranian Hydrogen Cluster	Gaz-System	Advanced	Non-PCI
	H2T-A-821	Hydrogen Highway - Northern Section	Gaz-System	Advanced	Non-PCI
	H2T-A-835	SK-HU H2 corridor	eustream	Advanced	Non-PCI
★	H2T-A-851	Southern Interconnection BiH/CRO	BH-Gas	Advanced	Non-PCI
★	H2T-A-876	IP Elten/Zevenaar - Cologne	Thyssengas	Advanced	Non-PCI
★	H2T-A-910	Western Interconnection BiH/CRO	BH-Gas	Advanced	Non-PCI
★	H2T-A-917	Emsbüren - Leverkusen	Thyssengas	Advanced	Non-PCI
	H2T-A-933	Hyperlink 4-5 Wilhelmshaven - Emsbüren	Thyssengas, Gasunie	Advanced	Non-PCI
	H2T-A-1000	Hyperlink 1-2	Gasunie	Advanced	Non-PCI
	H2T-A-1014	Giurgiu Nădlac hydrogen corridor with new H2 interconnector	Transgaz	Advanced	Non-PCI
★	H2T-A-1015	New Hydrogen pipeline from Black Sea area to Podişor	Transgaz	Advanced	Non-PCI
	H2T-A-1049	Spanish hydrogen backbone 2030	Enagas	Advanced	Non-PCI
	H2T-A-1065	HU hydrogen corridor I HU/UA	FGSZ	Advanced	Non-PCI
★	H2T-A-1091	Connection of DESFA's transmission system with East Med pipeline	desfa	Advanced	Non-PCI
★	H2T-A-1092	Metering and Regulating Station at UHS South Kavala	desfa	Advanced	Non-PCI
	H2T-A-1096	RHYn Interco (Sections 4-5)	badenovaNETZE, terranets bw	Advanced	Non-PCI
	H2T-A-1205	Italian H2 Backbone	snam	Advanced	Non-PCI
	H2T-A-1206	HU hydrogen corridor IV HU/SK	FGSZ	Advanced	Non-PCI
★	H2T-A-1250	NWH2	NWO	Advanced	Non-PCI
	H2T-A-1259	HU hydrogen corridor V HU/RO	FGSZ	Advanced	Non-PCI
	H2T-A-1291	Hynframed 1	GRTgaz	Advanced	Non-PCI
	H2T-A-1327	HySoW Atlantic (Hydrogen South West corridor of France)	Teréga	Advanced	Non-PCI
	H2T-N-569	HY-FEN H2 Corridor Spain France Germany connection	GRTgaz	Less-Adv.	PCI
	H2T-N-738	Delta Rhine Corridor H2	OGE	Less-Adv.	PCI
	H2T-N-796	FLOW – making hydrogen happen (East)	Gascade	Less-Adv.	PCI
	H2T-N-884	CHE Pipeline	equinor	Less-Adv.	PCI
	H2T-N-970	Dedicated H2 Pipeline	desfa	Less-Adv.	PCI
	H2T-N-991	AquaDuctus	fluxys, Gascade	Less-Adv.	PCI
	H2T-N-1122	Nordic-Baltic Hydrogen Corridor - EE section	elering	Less-Adv.	PCI
	H2T-N-1151	H2Med-BarMar	enagas, Teréga, GRTgaz	Less-Adv.	PCI
	H2T-N-1239	Nordic-Baltic Hydrogen Corridor - LT section	Amber Grid	Less-Adv.	PCI
	H2T-N-1324	H2Med-CelZa (Enagas)	enagas	Less-Adv.	PCI

HYDROGEN STORAGE FACILITIES (H2S)

★	H2S-F-887	H2CAST	Storag Etzel	FID	Non-PCI
	H2S-F-1304	HyPSTER (1st phase)	storengy	FID	Non-PCI
	H2S-A-508	H2 storage North-1	enagas	Advanced	PCI
	H2S-A-565	GeoH2	Géométhane	Advanced	PCI
	H2S-A-767	RWE H2 Storage expansion 2 Gronau-Epe	RWE	Advanced	PCI
	H2S-A-1152	H2 storage North-2	enagas	Advanced	PCI
	H2S-A-1238	DK Hydrogen Storage	Gas Storage Denmark	Advanced	PCI
	H2S-A-1279	Hystock	Gasunie	Advanced	PCI
	H2S-A-1284	RWE H2 Storage Gronau-Epe - 2nd expansion	RWE	Advanced	PCI
★	H2S-A-749	EWE Hydrogen Storage Huntorf	EWE	Advanced	Non-PCI
	H2S-A-761	JemgumH2	SEFE	Advanced	Non-PCI
	H2S-A-802	RWE H2 Storage expansion 1-2 Stassfurt	RWE	Advanced	Non-PCI
	H2S-A-805	HENRI (H2I-S&D)	nafta	Advanced	Non-PCI
	H2S-A-818	RWE H2 Storage expansion 1 Xanten	RWE	Advanced	Non-PCI
	H2S-A-839	Clean Hydrogen Coastline - Storage Huntorf	EWE	Advanced	Non-PCI
	H2S-A-1244	UST Hydrogen Storage Krummhörn	uniper	Advanced	Non-PCI
	H2S-A-1287	RWE H2 Storage expansion 1 Gronau-Epe	RWE	Advanced	Non-PCI
	H2S-A-1352	HySoW storage (Hydrogen South West corridor of France)	Teréga	Advanced	Non-PCI
	H2S-N-934	SaltHy Harsefeld	storengy	Less-Adv.	PCI

HYDROGEN RECEPTION FACILITIES (H2L)

	H2L-A-754	ACE Terminal	Gasunie	Ammonia	Advanced	PCI
★	H2L-A-665	Eemshaven H2	Gasunie	Ammonia	Advanced	Non-PCI
	H2L-A-1041	Ammonia terminal in Gdansk	Gaz-System	Ammonia	Advanced	Non-PCI
★	H2L-N-543	LH2.Rotterdam	Vopak	Ammonia	Less-Adv.	PCI
	H2L-N-664	Antwerp NH3 Import Terminal	fluxys	Ammonia	Less-Adv.	PCI
	H2L-N-820	Dunkerque New Molecules development	fluxys	Ammonia	Less-Adv.	PCI
	H2L-N-968	Green Wilhelmshaven Terminal/Storage/Cracker	uniper	Ammonia	Less-Adv.	PCI
	H2L-N-1099	Ammonia Import Terminal Brunsbuttel	RWE	Ammonia	Less-Adv.	PCI
	H2L-N-1100	Amplifhy Antwerp	vtti	Ammonia	Less-Adv.	PCI
	H2L-N-1127	Amplifhy Rotterdam	vtti	Ammonia	Less-Adv.	PCI
	H2L-N-1159	bp Wilhelmshaven Green Hydrogen Hub	bp	Ammonia	Less-Adv.	PCI
	H2L-N-1325	Zeebrugge New Molecules development	fluxys	Ammonia	Less-Adv.	PCI

Figure 2: Representation of the Advanced hydrogen infrastructure level.

DOWNLOAD THE MAP


KEYS
ENTSOG currently comprises 43 TSO members, 1 Associated Partner and 9 Observers from 32 European Countries
When the same point is affected by several projects, the point is shown with the highest project status (operational, FID, advanced, non-FID), the status from single projects can vary from that. The projects are shown with the planning status reported in their TYNDP 2024 submission.
Project information, initially based on TYNDP project collection conducted in Nov 2023 - Feb 2024.
All data provided on this map is for information purposes and shall be treated as indicative and non-contractual in nature, without pre-empting different outcomes of any possible discussion held at regional level. Under no circumstances shall it be regarded as information intended for commercial use.
Project status :
TRA-F-123
Infrastructure Project Name
BULGARTRANSGAZ
FID
PCI
Project ENTSOG code
Project Name
Project Promoter
Project status codes
Project not marked on map
Exact project location is not available or is marked as confidential
Exact project locations not marked on map
Project has several locations/points.
The indicated location is for representation purposes only and does not indicate the exact location of the project
Newly added project in TYNDP 2024
(additional to www.h2inframap.eu)
Project ENTSOG codes / color :
TRA-N-000
Project is part of 1st PCI/PMI list
Project is not part of 1st PCI/PMI list
Project status codes :
The project advancement status is based on the TYNDP project collection conducted in Nov. 2023 - Feb. 2024.
PCI
Non-PCI
PCI status (Project of Common Interest)
FID
Advanced
Less-Adv.
FID status (Final Investment Decision)
Advanced status is applied to all projects that, based on the information submitted, have:
Commissioning expected at the latest by 31 December 2029
AND the project fulfils at least one of the following criteria:
- Project has taken the final investment decision (FID) ahead of the TYNDP 2024 project collection
- Project is included in the NDP(s) of the respective country(ies) or in the national law
- Project has successfully consulted the market through a market test (including non-binding processes), which delivered positive results
Cross-border points / intra-country or intra balancing zone points
Cross-border interconnection point within Europe or export point to non-EU country
Cross-border interconnection point with third country (import)
Cross-border interconnection point within Europe or export point to non-EU country
Under construction or Planned
LNG Import terminal (operational)
LNG Export terminal (operational)
Intra-country or intra balancing zone points
Third country cross-border interconnection point
Cross-border interconnection point (Virtual Point)
Third country cross-border (Virtual Point / import)
Gas Reserve areas
Gas field
Drilling platform
Countries
EU Countries
Other Countries
Transport by pipeline
Existing infrastructure for natural gas :
Diameter < 600 mm
Diameter 600 - 900 mm
Diameter > 900mm
Not operational
Planned infrastructure for natural gas :
Project
Storage facilities
Acquifer
Salt cavity - cavern
Depleted (Gas) field on shore / offshore
Other type
Gas storage projects
Hydrogen Transmission Pipelines (H2T)
Project categories :
FID projects
Non-FID, advanced projects
Non-FID, less-advanced projects
Project is part of 1st PCI/PMI list :
FID projects
Non-FID, advanced projects
Hydrogen Storage Facilities (H2S)
Project categories :
FID projects
Non-FID, advanced projects
Non-FID, less-advanced projects
Project is part of 1st PCI/PMI list :
FID projects
Non-FID, advanced projects
Hydrogen Reception Facilities (H2L)
Project categories :
FID projects
Non-FID, advanced projects
Non-FID, less-advanced projects
Project is part of 1st PCI/PMI list :
FID projects
Non-FID, advanced projects
North Sea
Atlantic Ocean
Baltic Sea
Mediterranean Sea
Black Sea
Irish Sea
Bay of Biscay
UNITED KINGDOM
DENMARK
ESTONIA
LATVIA
LITHUANIA
RUSSIA
THE NETHERLANDS
BELGIUM
LUX.
GERMANY
POLAND
FRANCE
CZECH REPUBLIC
SLOVAKIA
AUSTRIA
HUNGARY
SWITZERLAND
SLOVENIA
CROATIA
ROMANIA
MOLDOVA
BOSNIA AND HERZEGOVINA
SERBIA
BULGARIA
ITALY
SPAIN
PORTUGAL
GREECE
TÜRKYE
MALTA
CORSICA
SARDINIA
LONDON
PARIS
BRUSSELS
AMSTERDAM
BERLIN
WARSAW
PRAGUE
VIENNA
BRATISLAVA
BUDAPEST
BERN
ROME
MADRID
LISBON
COPENHAGEN
STOCKHOLM
TALLINN
RIGA
VILNIUS
BUCHAREST
SOFIA
ATHENS
BELGRADE
SARAJEVO
ZAGREB
LJUBLJANA

1.2 INFRASTRUCTURE GAPS IDENTIFICATION (IGI) INDICATORS

The analysis is performed for 2030 and 2040 as simulation years for the TYNDP 2024 National Trends+ scenario. It covers both hydrogen infrastructure levels. Thereby, three indicators are used to identify regional hydrogen infrastructure gaps. IGI indicator 1 and IGI indicator 2.1 thereby use a reference weather year (i.e., 1995), while IGI indicator 2.2 uses a stressful weather year (i.e., 2009). The application of these IGI indicators is explained in the following paragraphs. Additional justifications and examples are available in section 5 of TYNDP 2024 Annex D2.

The IGI indicators identify the existence of an infrastructure gap through the existence of effects of such infrastructure gap. The non-identification of a certain infrastructure gap may be related to the infrastructure considered in the infrastructure levels of the energy sectors considered in the models. The effect of this infrastructure gap is either expressed at a border for IGI indicator 1 (see section 1.2.1) or at a country for IGI indicators 2.1 and 2.2 (see section 1.2.2 and section 1.2.3).

The reason for an infrastructure gap is an infrastructure bottleneck. An infrastructure bottleneck is a physical congestion of the network that can be observed based on full utilization rates of all relevant transmission infrastructure during certain periods of time. As a limited cooperation mode is used among countries in situations of hydrogen scarcity (see section 3.2.4 of the TYNDP 2024 Annex D1), the dominant infrastructure bottleneck is not necessarily located at a border of the country through which the IGI indicators demonstrated the existence of an infrastructure gap (see examples in section 5 of TYNDP 2024 Annex D2).

Also, besides the dominant bottleneck, non-dominant bottlenecks may exist at other locations that only unfold their effect once the dominant bottleneck is addressed. Additionally, an infrastructure bottleneck can in principle be solved by different projects and via different routes. Therefore, the infrastructure gaps identified by the IGI indicators identify regional infrastructure gaps, as the potential solution to it is not limited to the border of IGI indicator 1 or the country of IGI indicator 2. Potential solutions may in principle involve import projects, production projects, transmission projects, and storage projects.

Picture courtesy of FLUXYS BE

1.2.1 IGI INDICATOR 1: HYDROGEN MARKET CLEARING PRICE SPREADS IN DHEM

This IGI indicator aims at identifying hydrogen infrastructure gaps by assessing Zone 2 nodes of different countries based on differences in hydrogen market clearing prices between these nodes. Zone 2 nodes are areas of hydrogen production and/or storage and/or consumption within a country that are considered to be connected to the national hydrogen backbone. The hydrogen market clearing price spread is thereby based on the hourly hydrogen market clearing prices in the DHEM simulations. It is calculated for each combination of simulation year and hydrogen infrastructure level.

The hydrogen prices and flows in the DHEM are linked to the merit order of hydrogen supply options as well as hydrogen demand associated with end users' willingness to pay for hydrogen (i.e., WTP_{H2} as defined in TYNDP 2024 Annex D1). The merit order of hydrogen production has the following elements:

- **Hydrogen imports** have specific costs as defined in the TYNDP 2024 NT+ scenario;
- **Electrolytic hydrogen production** costs are linked to the price of the used electricity and the water price in the respective country as well as the process efficiency;
- **Hydrogen production from natural gas** within the EU is based on the TYNDP 2024 NT+ scenario and depends on the natural gas price, operating and maintenance costs, process efficiency, and Emissions Trading System (ETS) costs (thereby being differentiated between low-carbon and unabated hydrogen production from natural gas).

Especially the electrolytic hydrogen production thereby depends on the availability of RES and nuclear energy. Electrolysers that are connected to an electricity bidding zone or dedicated RES may be limited in their load factor by this availability. Also, the electricity price is subject to a merit order of electricity production as well as the end users' willingness to pay for electricity (e.g., VoLL). The electricity price is thereby influencing the cost of electrolytic hydrogen production.

As the DHEM aims at maximising the joint market rents in the electricity sector and in the hydrogen sector, it dispatches the European electricity and hydrogen supply options in an optimised way while respecting hard constraints like production and transport capacities. Thereby, the most expensive hydrogen supply source is usually defining the hydrogen market clearing price in a perfectly interconnected area. However, in case of hydrogen undersupply, the end users are competing for this supply up to their willingness to pay for hydrogen, thereby setting the hydrogen market clearing price at this level. From this dispatch of production options result hydrogen (and electricity) flows.

If countries are well connected, they share the same hydrogen market clearing price. If countries are not connected at all, the interdependency of their hydrogen market clearing prices is limited as these prices then depend on their own hydrogen supply options and hydrogen demand. A certain correlation may still be observed, e.g., due to one or several of the following reasons:

- The price and availability of electricity used for electrolytic hydrogen production may be correlated (e.g., due to similar weather conditions in these countries and/or sufficient cross-border capacity in the electricity system).
- The reliance on the same means of hydrogen production from natural gas may be correlated.
- The frequency of hydrogen demand curtailment may be correlated.

When countries are connected but the sum of connections between them is a bottleneck during certain periods of time, the hydrogen market clearing price is the same during periods of time when the interconnection is not acting as a bottleneck and is detached when the interconnection is acting as a bottleneck. Then, a limited price correlation can be observed. The less often the bottleneck is observed and the lower the resulting price spread during these periods of detachment is, the lower is the average price spread.

To define which hydrogen market clearing price spreads are a significant indication of a hydrogen infrastructure gap, one of the following thresholds must be passed:

- **Threshold 1:** This refers to a hydrogen market clearing price difference. It is calculated as the yearly average of the absolute hourly price differences between two Zone 2 nodes. The threshold is exceeded if this average difference is greater than 4 €/MWh.
- **Threshold 2:** A hydrogen market clearing price spread as the absolute average daily hydrogen market clearing price spread between two Zone 2 nodes of different countries of more than 20 €/MWh for more than 40 days per year.

If there is a hydrogen market clearing price spread above one of the thresholds, this indicates an infrastructure gap for the given assumptions.

More details are provided by TYNDP 2024 Annex D1 and TYNDP 2024 Annex D2.

1.2.2 IGI INDICATOR 2.1: CURTAILED HYDROGEN DEMAND IN DHEM AND DGM FOR REFERENCE WEATHER YEAR

This IGI indicator identifies infrastructure gaps by measuring the hydrogen demand curtailments of individual nodes during the reference weather year (i.e., 1995), and without infrastructure or source disruptions. The following simulation logic is applied for each combination of simulation year and hydrogen infrastructure level:

1. A DHEM simulation is run with the reference weather year data (i.e., the same simulation is used for IGI indicator 1).
2. Certain DHEM outputs from step 1 that influence the natural gas demand, hydrogen production, and hydrogen consumption are transferred into the DGM (see sections 2.4.5 and 2.4.6 of the TYNDP 2024 Annex D1).
3. A DGM simulation is run on the basis of step 2.
4. Per node, the combined hydrogen demand curtailment from the DHEM simulation and the additional hydrogen demand curtailment from the DGM are provided.

To define which hydrogen demand curtailments are a significant indication of a hydrogen infrastructure gap, the following threshold must be passed:

- Threshold: A yearly average hydrogen demand curtailment rate of more than 0 %.

If there is a hydrogen demand curtailment above the threshold, this indicates an infrastructure gap for the given assumptions.

In this draft TYNDP 2024 IGI report, the IGI indicator 2.1 is only based on the hydrogen demand curtailment from the DHEM simulations.

1.2.3 IGI INDICATOR 2.2: CURTAILED HYDROGEN DEMAND IN DHEM AND DGM FOR STRESSFUL WEATHER YEAR

This IGI indicator identifies infrastructure gaps by measuring the hydrogen demand curtailments of individual nodes under stressful weather conditions (i.e., 2009).

The following simulation logic is applied for each combination of simulation year and hydrogen infrastructure level:

1. A DHEM simulation is run with the stressful weather year data.
2. The DHEM outputs from step 1 that influence the natural gas demand, hydrogen production, and hydrogen consumption are transferred into the DGM (see sections 2.4.5 and 2.4.6 of the TYNDP 2024 Annex D1).
3. A DGM simulation is run on the basis of step 2.
4. Per node, the combined hydrogen demand curtailment from the DHEM simulation and the additional hydrogen demand curtailment from the DGM are provided.

To define which hydrogen demand curtailments are a significant indication of a hydrogen infrastructure gap, one of the following thresholds must be passed:

- **Threshold 1:** A yearly average hydrogen demand curtailment rate of more than 3 %.
- **Threshold 2:** A hydrogen demand curtailment rate of more than 5 % for at least one calendar month per year.

If there is a hydrogen demand curtailment above one of the thresholds, this indicates an infrastructure gap for the given assumptions.

In this draft TYNDP 2024 IGI report, the IGI indicator 2.2 is only based on the hydrogen demand curtailment from the DHEM simulations.

2 DISCLAIMERS

The results of the TYNDP 2024 IGI report are only related to infrastructure gaps that are based on the considered infrastructure levels. Therefore, the TYNDP 2024 IGI report cannot find that an infrastructure that is part of the smallest considered infrastructure level (i.e., the PCI/PMI hydrogen infrastructure level) is not addressing any infrastructure gap. Therefore, all the projects constituting the PCI/PMI hydrogen infrastructure level are to be treated as equally and jointly necessary for addressing the infrastructure gaps considered in the analysis.

The results of the TYNDP 2024 IGI report are related to the assessed scenario (i.e., NT+) and years (i.e., 2030 and 2040).

The lines depicted in the grid flow maps are derived from simulations used to identify infrastructure gaps within the assessed infrastructure levels and assessed years. These indicative lines do not reflect ENTSOG's expectations on how the European network will evolve during the simulated years. The report's primary objective is to identify gaps, not to predict the development of European infrastructure neither the future flows. Additionally, many projects included in the TYNDP are not part of the analysed infrastructure levels. Their commissioning could complement network flows compared to those presented in the report and potentially address some of the identified infrastructure gaps.

The term *"bottleneck"* in this report refers to situations where two conditions are met: (1) the capacity is being utilized to its maximum potential, and (2) no alternative routes are available. When a capacity is identified as a bottleneck, it signals the need for potential enhancements to that capacity at the specific fully utilized route and/or the development of new projects following other interconnections.

No generic hydrogen infrastructure projects are used in this TYNDP 2024 IGI report. Instead, only real projects that were submitted by project promoters are considered.

The representation of grid flows in the maps of this report is based on a schematic representation from capital to capital.

All values that refer to the energy content of molecules (e.g., GWh/d, €/MWh or TWh/y) are stated in terms of their Gross Calorific Value (GCV) in this IGI report. For hydrogen, the conversion factor from NCV to GCV is 1.176.

Picture courtesy of EDISON

3 ASSESSMENT FOR 2030

This section describes the evolution of the IGI indicators for the reference weather year (i.e., 1995) and the stressful weather year (i.e., 2009) for the analysed infrastructure levels (i.e., PCI/PMI and Advanced hydrogen infrastructure levels) for the simulation year 2030.

3.1 INFRASTRUCTURE GAPS IDENTIFICATION

In 2030, the PCI/PMI hydrogen infrastructure level's extra-EU imports are limited to shipped imports through the PCI reception terminals in Belgium, Germany and the Netherlands. The overall contribution of shipped hydrogen imports are rather limited when compared to the overall EU hydrogen demand. Therefore, in this infrastructure level, European hydrogen demand is mostly met by indigenous production through electrolysis or hydrogen production using natural gas which are not enough to fully cover the hydrogen demand. Therefore, curtailed hydrogen demand is significant.

In 2030, in the Advanced hydrogen infrastructure level, Europe will receive imports also from North Africa contributing to the reduction of hydrogen demand curtailment via higher utilisation rates of interconnected supply corridors.

3.1.1 ASSESSMENT OF PCI/PMI HYDROGEN INFRASTRUCTURE LEVEL

High-level results for reference weather year

The overall yearly supply-demand balance for the PCI/PMI hydrogen infrastructure level in 2030 for the reference weather year is presented in Table 7. As detailed in Table 7, electrolytic hydrogen production is the main source of hydrogen in Europe. This assessment results in an approximate share of 8.3 % of hydrogen demand curtailment in Europe.

Yearly hydrogen supply-demand balance	PCI/PMI IL
H_2 produced via electrolysis	310
H_2 produced using natural gas	229
H_2 shipped imports	29
H_2 pipeline imports	0
Curtailed H_2 demand	52
H_2 demand for power production	2
Total H_2 demand	**620**

Table 7: Supply and demand balance in the PCI/PMI hydrogen infrastructure level in 2030 for reference weather year (unit: TWh/y).

Figure 3 shows the hydrogen production via electrolysis in the different European countries for the PCI/PMI hydrogen infrastructure level in the 2030 assessment. The countries with highest electrolytic hydrogen production are Spain, Finland, Sweden, and Germany. Some countries have more than one source of electrolytic hydrogen production.

This is related to the intra-country assumptions, which can be summarized as it follows:

- Consideration of electrolytic hydrogen production from dedicated RES in Spain.
- Consideration of dedicated electrolytic production to satisfy regional hydrogen demand within the country (i.e., Zone 1). This is the case for Austria, Spain, Finland, Croatia, Ireland, Sweden, Slovenia, and the United Kingdom.
- Consideration of multiple production subzones within the main system of a country to reflect different geographical production areas and/or demand areas and/or storage areas stemming from internal transport bottlenecks. This is the case for Denmark, Italy, France, Finland, Sweden, and the United Kingdom.

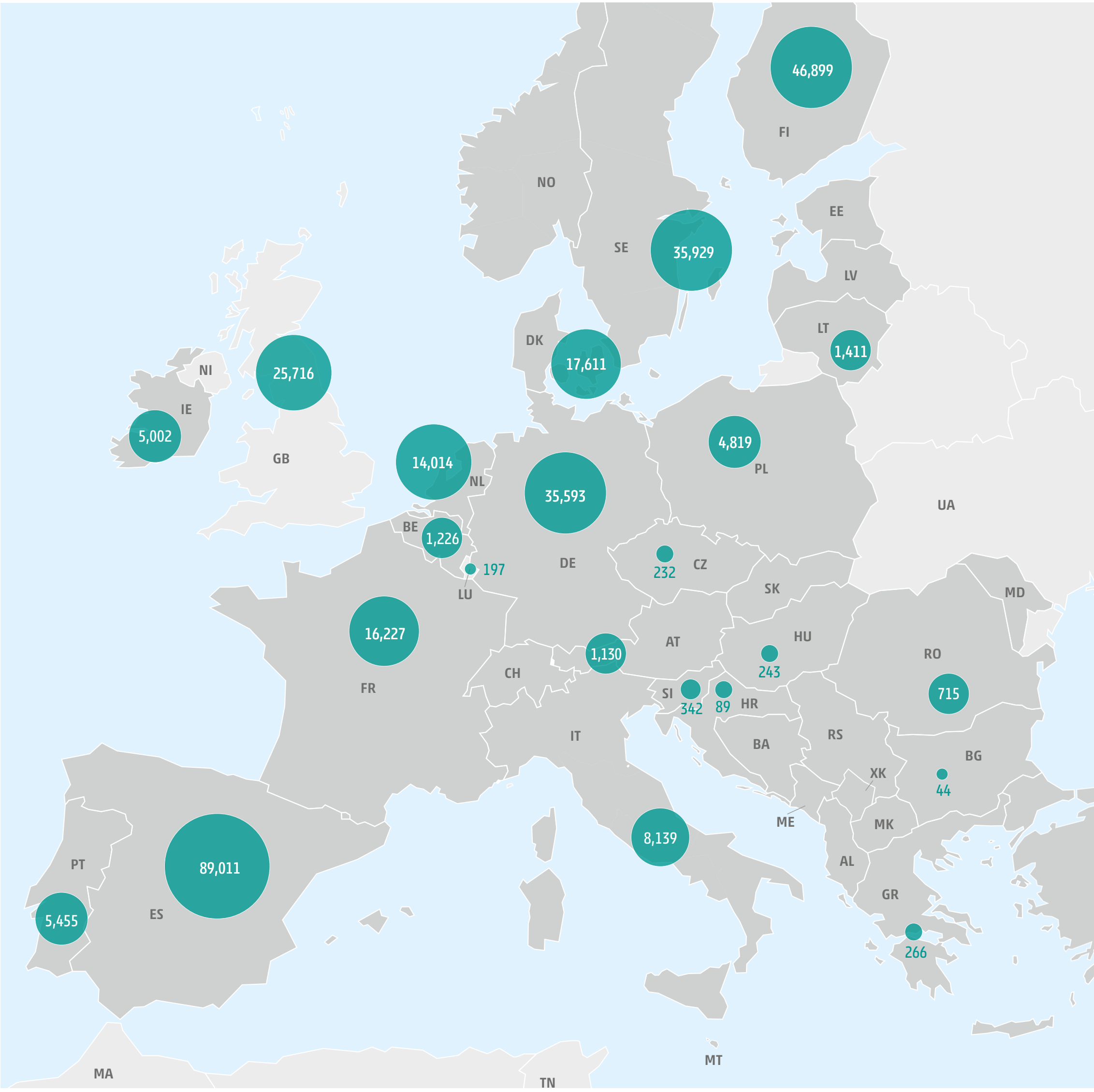

Figure 3: Distribution of hydrogen production via electrolysis in the PCI/PMI hydrogen infrastructure level in 2030 for reference weather year (unit: GWh/y).

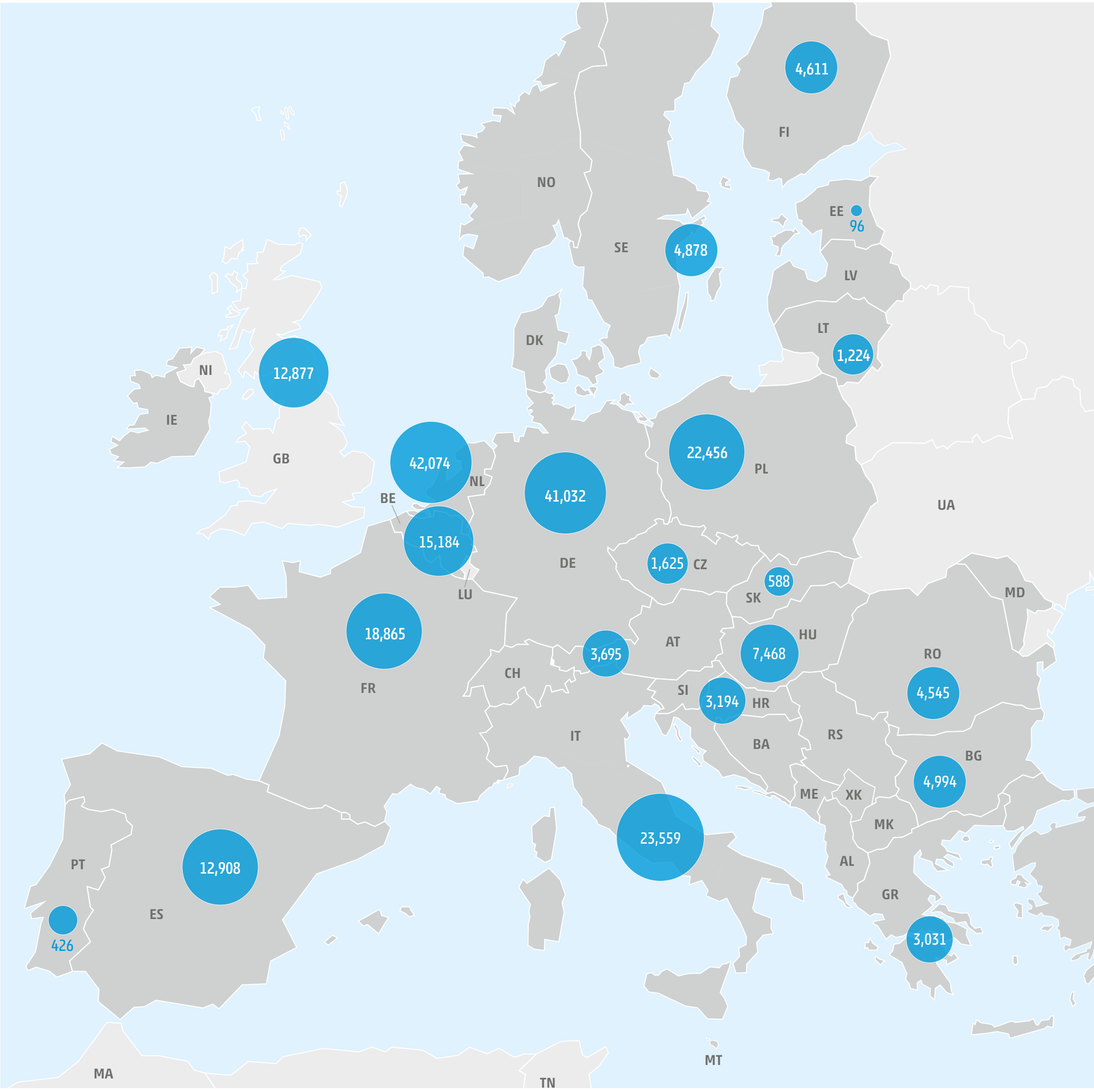

Figure 4: Distribution of hydrogen production from natural gas in the PCI/PMI hydrogen infrastructure level in 2030 for reference weather year (unit: GWh/y).

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	1,130	3,695	0	10,901
BE	1,226	15,184	9,793	30,970
BG	40	4,994	0	3,768
CZ	232	1,625	0	6,849
CY	0	0	0	329
DE	35,593	41,032	5,255	154,829
DK	17,611	0	0	13,241
EE	0	96	0	540
ES	89,011	12,908	0	61,128
FI	46,899	4,611	0	34,184
FR	16,227	18,865	0	47,735
GR	266	3,031	0	6,482
HR	89	3,194	0	3,283
HU	243	7,467	0	9,312
IE	5,002	0	0	6,222
IT	8,139	23,559	0	26,504
LT	1,411	1,224	0	3,977
LU	197	0	0	2,695
LV	0	0	0	997
MT	0	0	0	284
NL	14,014	42,074	13,943	59,194
PL	4,819	22,456	0	52,416
PT	5,455	426	0	2,922
RO	715	4,545	0	12,359
SE	35,929	4,878	0	23,107
SI	342	0	0	1,544
SK	0	588	0	2,767
UK	25,716	12,877	0	41,537

Table 8: Distribution of hydrogen production, demand and hydrogen imports per country in the PCI/PMI hydrogen infrastructure level in 2030 for reference weather year (unit: GWh/y).

Intra-EU cross-border flows emerge between different European countries due to limitations of available supplies and associated costs. Figure 5 shows these flows.

Two main transport corridors emerge in the PCI/PMI hydrogen infrastructure level in the 2030 assessment, one from the Iberian Peninsula towards Germany through France and one from Nordic countries to Germany.

This result is explained by the fact that these corridors are connecting countries with high availability of supply with other countries where hydrogen supplies might be limited or more expensive.

In addition, among the interconnected countries within the PCI/PMI hydrogen infrastructure level, Germany shows the highest demand and at the same time enables transport of supply to its neighbouring countries, acting as a hydrogen hub.

Figure 5: Grid flows* in the PCI/PMI hydrogen infrastructure level in 2030 for reference weather year (unit: GWh/y).

* Grid flows refer to simulations results and do not intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III.

In the 2030 PCI/PMI hydrogen infrastructure level assessment for the reference weather year, countries can be grouped in four different categories according to their supply-demand balance on a yearly basis:

1. **Countries that export more than they import:** Sweden, Finland, Denmark, Italy, Spain, Portugal and Bulgaria.
2. **Countries that import more than they export:** Belgium, Poland, Czechia, Greece, Lithuania.
3. **Transit countries that import more than they consume:** Germany, Austria, France, Belgium, The Netherlands, Estonia, Latvia and Lithuania.
4. **Isolated countries:** the United Kingdom, Ireland, Luxembourg, Hungary, Romania, Slovakia, Slovenia, Croatia, Malta, Cyprus, Switzerland[5] and the cluster Bulgaria-Greece.

While on a yearly basis some countries are net exporters and some countries are net importers, net exporters may be relying on net imports during certain shorter periods of time and net importers may be providing net exports during certain shorter periods of time. This can result in bidirectional flows at interconnections. This situation is caused by the seasonality of electrolytic hydrogen production and to some extent by the seasonality of hydrogen demand.

High-level results for stressful weather year

The overall yearly supply-demand balance for the PCI/PMI hydrogen infrastructure level in 2030 for the stressful weather year is presented in Table 9. As detailed in Table 9, electrolytic hydrogen production is the main source of hydrogen in Europe but it is reduced in comparison with the reference weather year. This assessment results in an approximate share of 11.1 % of curtailed hydrogen demand at European level. This represents an increase by 3 percentage points in comparison with the reference weather year.

Yearly hydrogen supply-demand balance	PCI/PMI IL
H_2 produced via electrolysis	270
H_2 produced using natural gas	245
H_2 shipped imports	36
H_2 pipeline imports	0
Curtailed H_2 demand	69
H_2 demand for power production	2
Total H_2 demand	**619**

Table 9: Supply and demand balance in the PCI/PMI hydrogen infrastructure level in 2030 for stressful weather year (unit: TWh/y).

Figure 6 shows the hydrogen production via electrolysis in the different European countries for the PCI/PMI hydrogen infrastructure level in the 2030 assessment. The countries with highest electrolytic hydrogen production are Spain, Finland, Sweden, and Germany.

Some countries have more than one source of electrolytic hydrogen production. This is related to the intra-country assumptions, which is explained in section 3.1.1.

5 IGI report does not consider hydrogen demand in Switzerland (based on TYNDP 2024 Draft Scenario report). However, there is no hydrogen infrastructure connecting Switzerland to any of its European neighbouring countries in the assessed infrastructure levels.

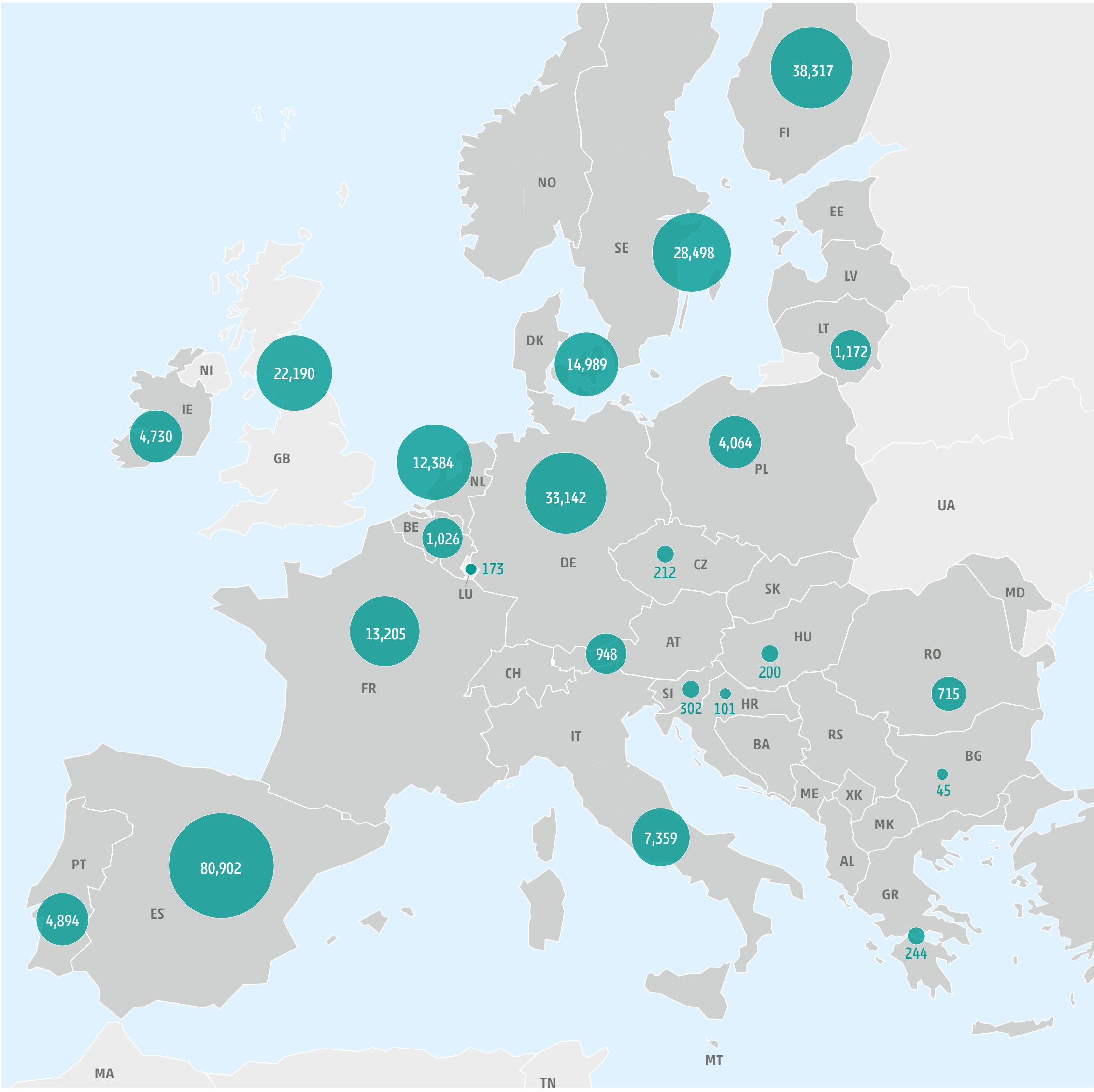

Figure 6: Distribution of hydrogen production via electrolysis in the PCI/PMI hydrogen infrastructure level in 2030 for stressful weather year (unit: GWh/y).

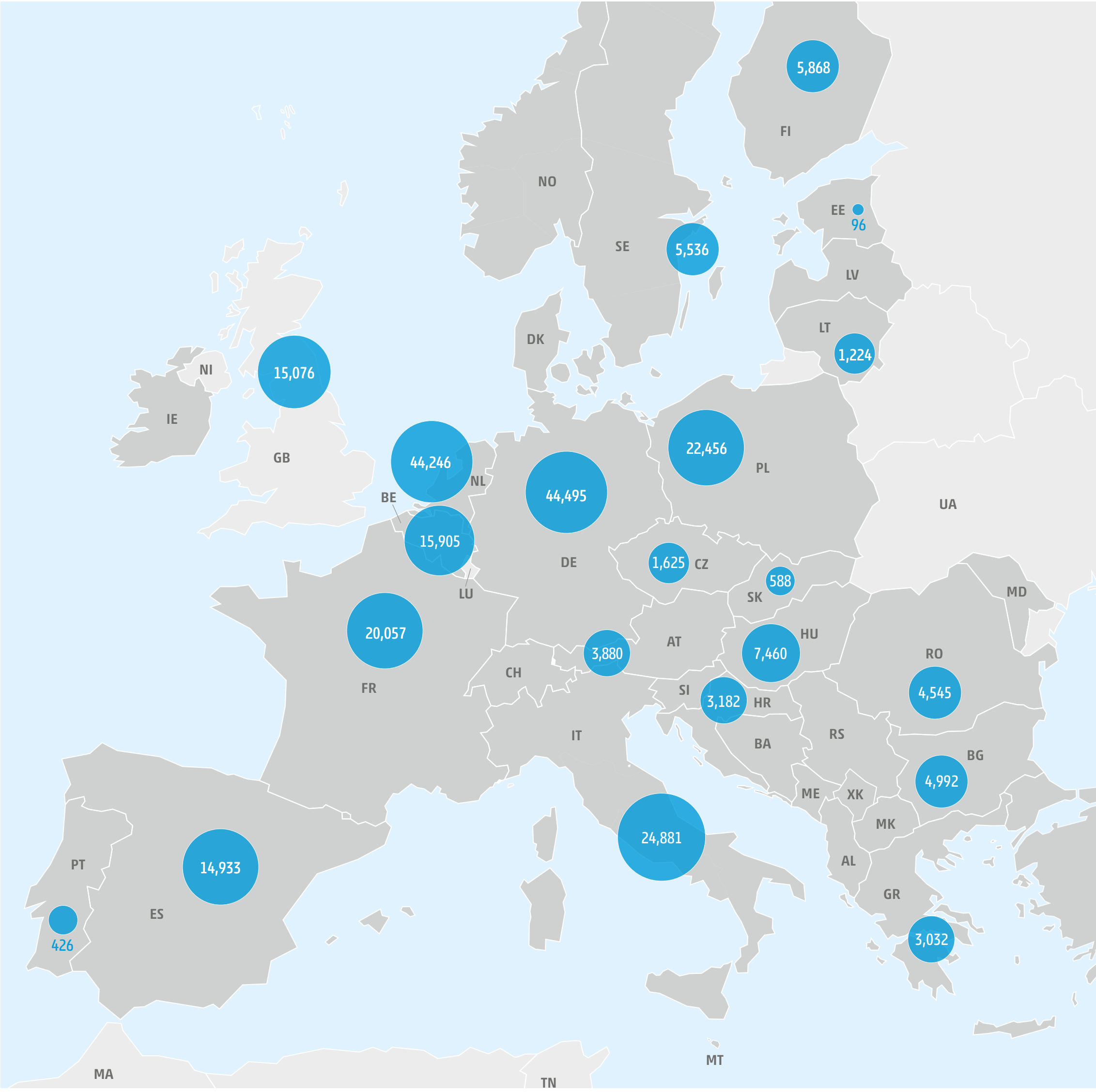

Figure 7: Distribution of hydrogen production from natural gas in the PCI/PMI hydrogen infrastructure level in 2030 for stressful weather year (unit: GWh/y).

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	948	3,880	0	10,901
BE	1,026	15,905	12,226	30,970
BG	45	4,992	0	3,768
CH	0	0	0	0
CZ	212	1,625	0	6,849
CY	0	0	0	329
DE	33,142	44,495	6,548	154,501
DK	14,989	0	0	13,241
EE	0	96	0	540
ES	80,902	14,933	0	61,128
FI	38,317	5,868	0	34,184
FR	13,205	20,057	0	47,735
GR	244	3,032	0	6,482
HR	101	3,182	0	3,283
HU	200	7,460	0	9,312
IE	4,730	0	0	6,222
IT	7,359	24,881	0	26,504
LT	1,172	1,224	0	3,977
LU	173	0	0	2,695
LV	0	0	0	997
MT	0	0	0	284
NL	12,384	44,246	17,859	59,020
PL	4,064	22,456	0	52,271
PT	4,894	426	0	2,922
RO	672	4,545	0	12,359
SE	28,498	5,536	0	23,107
SI	302	0	0	1,544
SK	0	588	0	2,767
UK	22,190	15,076	0	41,537

Table 10: Distribution of hydrogen production per country in the PCI/PMI hydrogen infrastructure level in 2030 for stressful weather year (unit: GWh/y).

Intra-European cross-border flows emerge between different European countries due to limitations of available supplies and associated costs. Figure 8 shows resulting yearly average flows under stressful weather conditions.

In comparison with the reference weather year, the export from countries that to a large extent base their hydrogen production on RES is reduced. This reduces the usage of the Iberian and of the Nordic corridor. At the same time, the import terminals must be used to a higher extent, increasing exports of countries and regions with such terminals. Germany maintains its role as hydrogen hub. Despite the overall reduction of electrolytic hydrogen production, under stressful weather conditions the countries with the highest electrolytic hydrogen production follow the same distribution as in the PCI/PMI hydrogen infrastructure level in 2030 for the reference weather year.

Figure 8: Grid flows* in the PCI/PMI hydrogen infrastructure level in 2030 for stressful weather year (unit: GWh/y).

* Grid flows refer to simulations results and don't intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III).

In the 2030 PCI/PMI hydrogen infrastructure level assessment for the stressful weather year, countries can be grouped in four different categories according to their supply-demand balance on a yearly basis:

1. **Countries that export more than they import:** Sweden, Finland, Denmark, Italy, Spain, Portugal.

2. **Countries that import more than they export:** Poland, Czechia, Greece, Lithuania.

3. **Transit countries that import more than they consume:** Germany, Austria, France, Belgium, The Netherlands, Estonia, Latvia, and Lithuania.

4. **Isolated countries:** the United Kingdom, Ireland, Luxembourg, Hungary, Romania, Slovakia, Slovenia, Croatia, Malta, Cyprus, Switzerland[6] and the cluster Bulgaria-Greece.

6 IGI report does not consider hydrogen demand in Switzerland (based on TYNDP 2024 Draft Scenario report). However, there is no hydrogen infrastructure connecting Switzerland to any of its European neighbouring countries in the assessed infrastructure levels.

While on a yearly basis some countries are net exporters and some countries are net importers, net exporters may be relying on net imports during certain shorter periods of time and net importers may be providing net exports during certain shorter periods of time. This can result in bidirectional flows at interconnections. This situation is caused by the seasonality of electrolytic hydrogen production and to some extent by the seasonality of hydrogen demand.

3.1.1.1 IGI INDICATOR 1: HYDROGEN MARKET CLEARING PRICE SPREADS FOR REFERENCE WEATHER YEAR

Overview: Hydrogen market clearing prices per country

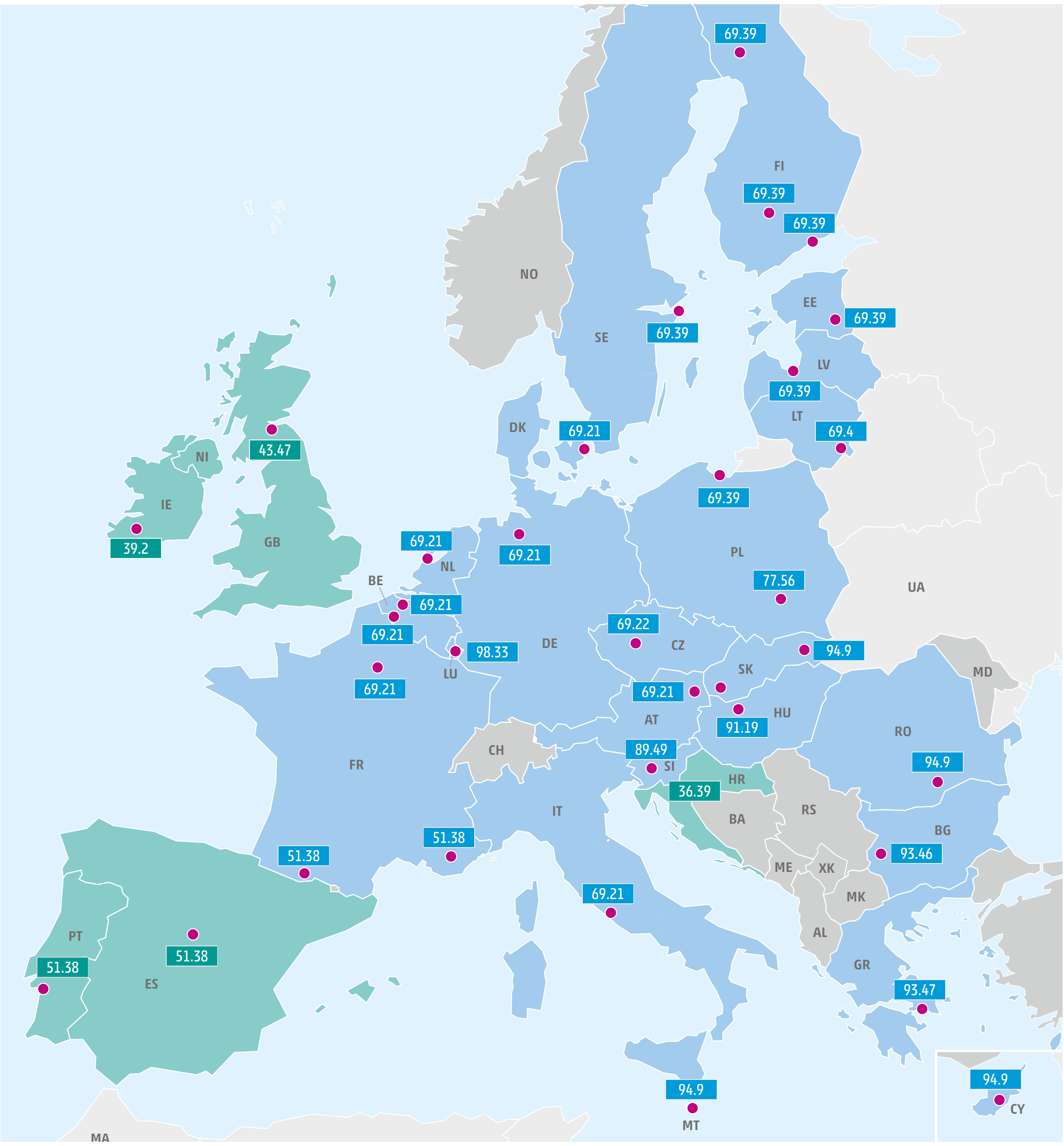

Figure 9: Average of the hourly hydrogen market clearing prices per country in the PCI/PMI hydrogen infrastructure level in 2030 (unit: €/MWh).

The price formation in the DHEM is based on the merit order of hydrogen production (see section 1.2.1). Several price groups stand out, while a signification correlation is understood here as a correlation above 0.7:

1. **Portugal, Spain, France-South region:** Portugal and Spain are producers and net exporters of electrolytic hydrogen from RES to other countries. While the France-South region is sufficiently connected to the Iberian Peninsula, price spreads appear with other groups of countries due to an internal bottleneck in France. The prices in this group show a significant correlation with the prices in groups 2, 3 and 4.

2. **France-Southwest region:** Local undersupply and isolated from other French regions. The prices in this group show significant correlations with prices in groups 1, 3 and 4.

3. **Belgium, the Netherlands, Denmark, Germany, Czechia, Austria, Italy:** Well interconnected countries that as group have own import terminals and national hydrogen production and are in the centre of two main supply corridors. The prices in this group show a nearly perfect correlation with the prices in group 4 and a significant correlation with the prices in groups 1 and 2.

4. **Sweden, Finland, Estonia, Latvia and Lithuania:** Composed of net exporting countries Sweden and Finland as well as countries that are well interconnected without bottlenecks. The prices are very similar to the prices in group 3 as the bottlenecks between the two groups play a minor role. The prices in this group show a nearly perfect correlation with the prices in group 3 and a significant correlation with the prices in groups 1 and 2.

5. **Ireland, the United Kingdom, Croatia, Poland-South region:** Isolated (regions of) countries without significant price correlations but with average prices below 100 €/MWh.

6. **Greece, Bulgaria:** Countries showing significant price correlation, jointly isolated from the other European countries.

7. **Slovenia, Hungary, Romania, Luxembourg, Cyprus, Slovakia, Malta:** Isolated countries without significant price correlations (except for Hungary and Slovenia due to a similar national hydrogen production constellation) and with average prices above 100 €/MWh.

The price correlations listed above are enabled by the infrastructure projects already considered in this hydrogen infrastructure level. However, price differences that led to the identification of the groups listed above are not necessarily describing an infrastructure gap. For this identification of infrastructure gaps, the thresholds of IGI indicator 1 are used.

Hydrogen market clearing price spreads

If one of the two thresholds of IGI indicator 1 is passed, a regional hydrogen infrastructure gap is assumed to be identified (see section 1.2.1). Table 11 lists the borders for which Threshold 1 and/or Threshold 2 were passed. In this case, both thresholds were always passed at the same borders.

Border	Threshold 1: Absolute average hourly hydrogen market clearing price spread above 4 €/MWh	Threshold 2: More than 40 days with hydrogen market clearing price spread above 20 €/MWh
DEh_2–PLh_2S	26	169
FRh_2–FRh_2S	26	168
FRh_2–FRh_2SW	12	66
FRh_2S–FRh_2SW	19	99
HUh_2–ATh_2	32	233
HUh_2–HRh_2	80	365
HUh_2–ROh_2	5	43
HUh_2–SKh_2E	5	43
ITh_2–HRh_2	50	293
NLh_2–UKh_2	42	228
PLh_2N–PLh_2S	25	167
PLh_2S–CZh_2	26	169
PLh_2S–SKh_2E	25	143
SIh_2–HRh_2	78	364
SKh_2E–PLh_2S	25	143
SKh_2W–ATh_2	38	266
SKh_2W–CZh_2	38	266
UKh_2–BEh_2	42	228
UKh_2–IEh_2	19	111

Table 11: List of borders in the PCI/PMI hydrogen infrastructure level that exceed (at least one of) the thresholds defined for IGI indicator 1 in 2030.

3.1.1.2 IGI INDICATOR 2.1: HYDROGEN DEMAND CURTAILMENT FOR REFERENCE WEATHER YEAR

As explained in section 1.2.2, this IGI indicator assesses infrastructure gaps by quantifying hydrogen demand curtailments at individual nodes during the reference weather year, assuming no disruptions of infrastructures or of supply sources. It involves a multi-step simulation process integrating DHEM and DGM[7] outputs to evaluate the combined curtailments across nodes. The assessment is performed for the PCI/PMI hydrogen infrastructure level in 2030.

Figure 10 and Table 12 show yearly average curtailment rates of hydrogen demand in the Zone 2 nodes of different European countries. For countries where the hydrogen market is divided into several sub-zones (i.e., nodes), the curtailment rate in the different sub-zones is presented. The yearly average hydrogen curtailment rates are thereby colour-coded in the map to indicate levels relative to the set threshold: blue signifies curtailment above the threshold, while green represents rates that are not above it.

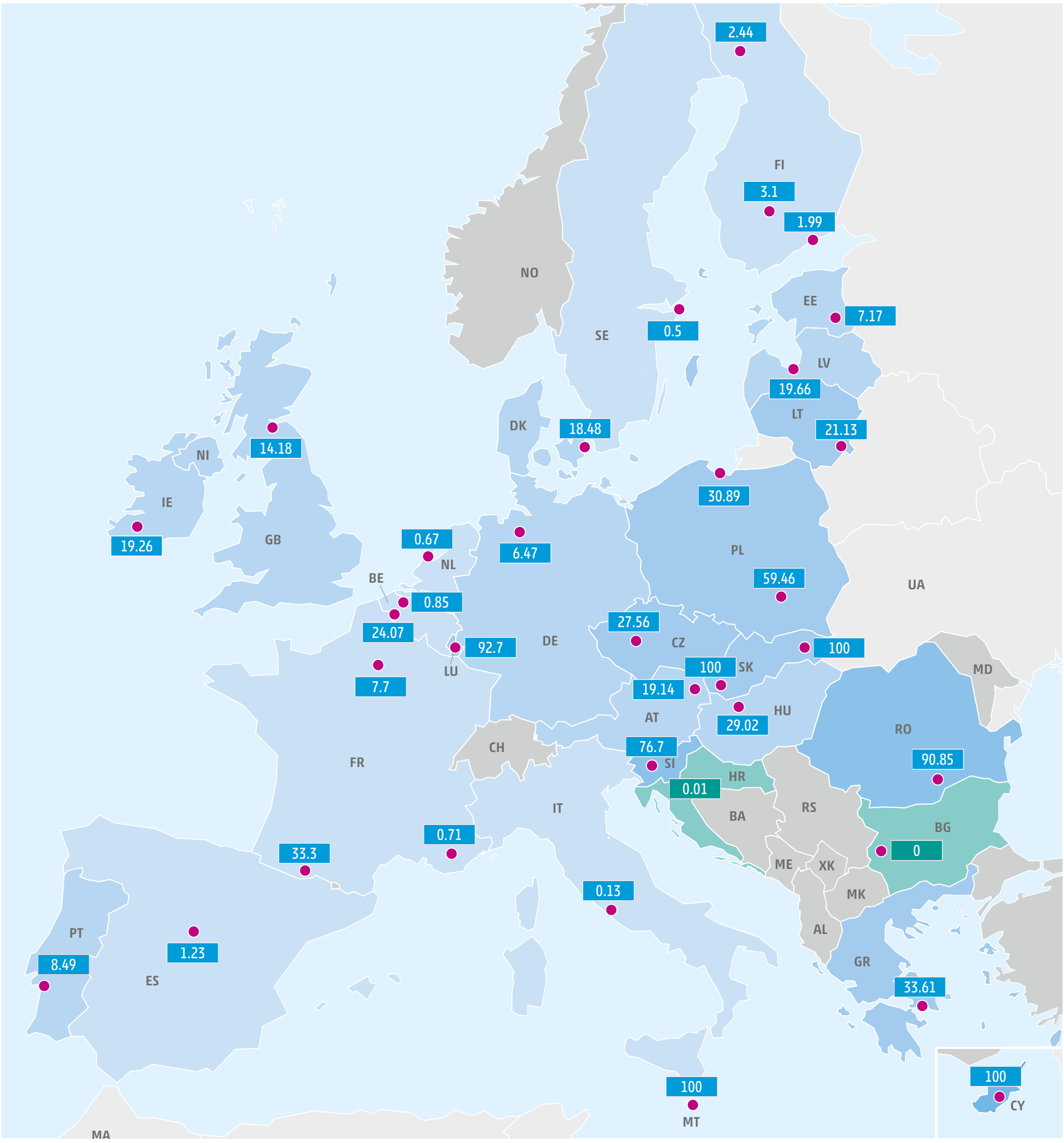

Figure 10: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the PCI/PMI hydrogen infrastructure level in 2030 for reference weather year (unit: %).

7 This draft TYNDP 2024 IGI report only includes the simulation results of the DHEM.

H_2 Demand Zone	Yearly average curtailment rate (%)	Threshold passed
ATh_2	19.1	YES
BEh_2	0.9	YES
BEh_2Mo	24.1	YES
BGh_2	0.0	NO
CYh_2	100.0	YES
CZh_2	27.6	YES
DEh_2	6.5	YES
DKh_2	18.5	YES
EEh_2	7.2	YES
ESh_2	1.2	YES
FIh_2	3.1	YES
FIh_2N	2.4	YES
FIH_2S	2.0	YES
FRh_2	7.7	YES
FRh_2S	0.7	YES
FRh_2SW	33.3	YES
GRh_2	33.6	YES
HRh_2	0.0	NO
HUh_2	29.0	YES
IEh_2	19.3	YES
ITh_2	0.1	YES
LTh_2	21.1	YES
LUh_2	92.7	YES
LVh_2	19.7	YES
MTh_2	100.0	YES
NLh_2	0.7	YES
PLh_2N	30.9	YES
PLh_2S	59.5	YES
PTh_2	8.5	YES
ROh_2	90.9	YES
SEh_2	0.5	YES
SIh_2	76.7	YES
SKh_2E	100.0	YES
SKh_2W	100.0	YES
UKh_2	14.2	YES

Table 12: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the PCI/PMI hydrogen infrastructure level in 2030 for reference weather year and check of the threshold of IGI indicator 2.1 (unit: %).

In the 2030 assessment of the PCI/PMI hydrogen infrastructure level, hydrogen demand is curtailed all over Europe. However, differences in the hydrogen curtailment rates between nodes are related to the level of infrastructure development and supply availability.

As explained in the description of the PCI/PMI hydrogen infrastructure level (see section 1.1 and Figure 1), with limited availability of extra-EU supplies, hydrogen demand is satisfied mainly with electrolytic hydrogen production and hydrogen production from natural gas.

Countries with higher availability of supply from those sources or from imports show lower curtailment rates. Only Bulgaria and Croatia hydrogen demand is completely undisrupted and the hydrogen demand curtailment in Italy is very low. All other countries including strong net exporters face (weather-induced) disruptions. In comparison with IGI indicator 1, this IGI indicator focusses on the availability of supplies.

As detailed in Figure 11, (regions of) countries can be aggregated in six different groups according to their average yearly hydrogen demand curtailment rates:

1. **Rates below 0.1 %:** Bulgaria, Croatia.
2. **Rates between 0.1 % and 5 %:** Italy, Belgium, Finland, France-South region, the Netherlands, Spain, Sweden.
3. **Rates between 5 % and 20 %:** France, Austria, Denmark, Estonia, Germany, Ireland, Latvia, Portugal, the United Kingdom.
4. **Rates between 20 % and 50 %:** Belgium-Mons region, Czechia, France-Southwest region, Hungary, Lithuania, Poland-North region, Greece.
5. **Rates between 50 % and 100 %:** Slovenia, Romania, Poland-South region, Luxembourg.
6. **Full curtailment of 100 %:** Slovakia, Cyprus, Malta.

Without the infrastructure already considered in the hydrogen infrastructure level, the overall hydrogen demand curtailment would be higher.

All countries of group 1 have high shares of hydrogen produced from natural gas to cover national demand.

Among the countries of group 2, Spain, Sweden and Finland receive a significant share of their supply from national electrolytic hydrogen production, while Belgium, and the Netherlands, have access to extra-EU import capacities. The France-South region benefits from potential supplies from the Iberian Peninsula but also from other parts of France. At the same time, while the average demand curtailment is comparably low, all relevant nodes at certain hours of the year hit very high curtailment rates between 84 % in Spain, 89 % in Germany, and 100 % in the other nodes.

Among the countries of group 3, some countries like Denmark, Portugal, the United Kingdom and Ireland, despite having significant electrolytic hydrogen production compared to the national demand, still cannot cover all demand when RES are not available. In the case of Denmark and Portugal, being peripheric countries, their neighbouring countries (i.e., Germany and Spain) can help to mitigate demand curtailment, whereas in the case of the United Kingdom and Ireland, being isolated from Europe leads to higher curtailment rates. Among the countries of group 3, some countries such as Austria, Estonia, Germany and Latvia, despite being well interconnected, show demand curtailment mainly due to the limited availability of supplies for the EU in general that are then rather consumed closer to the location of production or import. For France, different curtailment rates are observed between the different hydrogen nodes. The France-Southwest region is the area with higher curtailment (i.e., 33.3 %) as it is isolated and strictly depends on local production. Between the other two demand nodes in France (i.e., France and France-South regions) there is 7 % of difference in the demand curtailment due to privileged access of the France-South region to supply from the Iberian Peninsula.

Among the countries of group 4, some countries like Czechia and Lithuania show high curtailment rates (i.e., 27.6 % and 21.1 %), despite being connected to Germany, in case of Czechia and other Baltic Sea countries, in case of Lithuania. This is because both countries need significant imports from their neighbouring countries to satisfy demand while the neighbouring countries at certain periods of time do not have access to surplus supplies for export. In addition, national production in Lithuania represents a higher share of the demand in comparison with the Czech Republic. Greece shows a curtailment rate of 33.3 %, which can be explained by the fact that despite being interconnected with Bulgaria, both countries are isolated from the rest of Europe (see section 1.1 and Figure 1). Lastly, the Belgium-Mons region is designed to be an individual cluster only connected to France (Valenciennes production cluster) and not interconnected to the remaining Belgian grid in the PCI/PMI hydrogen infrastructure level in 2030. Due to this isolated situation, curtailment is significantly higher (i.e., 24.1 %) than in the rest of the country (i.e., 0.9 %).

Group 5 includes countries with very high curtailment rates of up to nearly 100 %. All the countries in this group are fully isolated and rely on national hydrogen supplies, mainly produced from natural gas. This is also the case for the Poland-South region that shows a curtailment rate of almost 60 %, whereas the Poland-North region has a curtailment rate of around 31 % due to higher hydrogen generation in that region.

Group 6 includes only isolated countries that have hydrogen demand but no national hydrogen production assets connected to Zone 2.

In Denmark, Finland, Ireland, Sweden, and Slovenia, on top of the hydrogen demand curtailments observed in Zone 2 nodes as described in the paragraphs above, hydrogen demand curtailments can be observed in Zone 1. While these curtailments are limited to a few months in Sweden and Finland, it is of relevance in every month in Ireland and reaches up to 86 % in December in Denmark and up to 96 % in December in Slovenia.

Picture courtesy of MOLDOVATRANSGAZ

3.1.1.3 IGI INDICATOR 2.2: HYDROGEN DEMAND CURTAILMENT FOR STRESSFUL WEATHER YEAR

Threshold 1: Average yearly hydrogen demand curtailment rate above 3 %

Figure 11 and Table 13 show the yearly average hydrogen demand curtailment rates in the Zone 2 nodes of various European countries for 2030, simulated under a stressful weather year. This weather scenario assumes adverse conditions, such as reduced wind and solar energy availability, which directly impacts hydrogen production. For countries with hydrogen markets divided into multiple sub-zones (i.e., nodes), curtailment rates are depicted individually for each sub-zone on the map. The yearly average hydrogen curtailment rates are thereby colour-coded to indicate levels relative to the set threshold 1: blue signifies curtailment above the threshold, while green represents rates that are not.

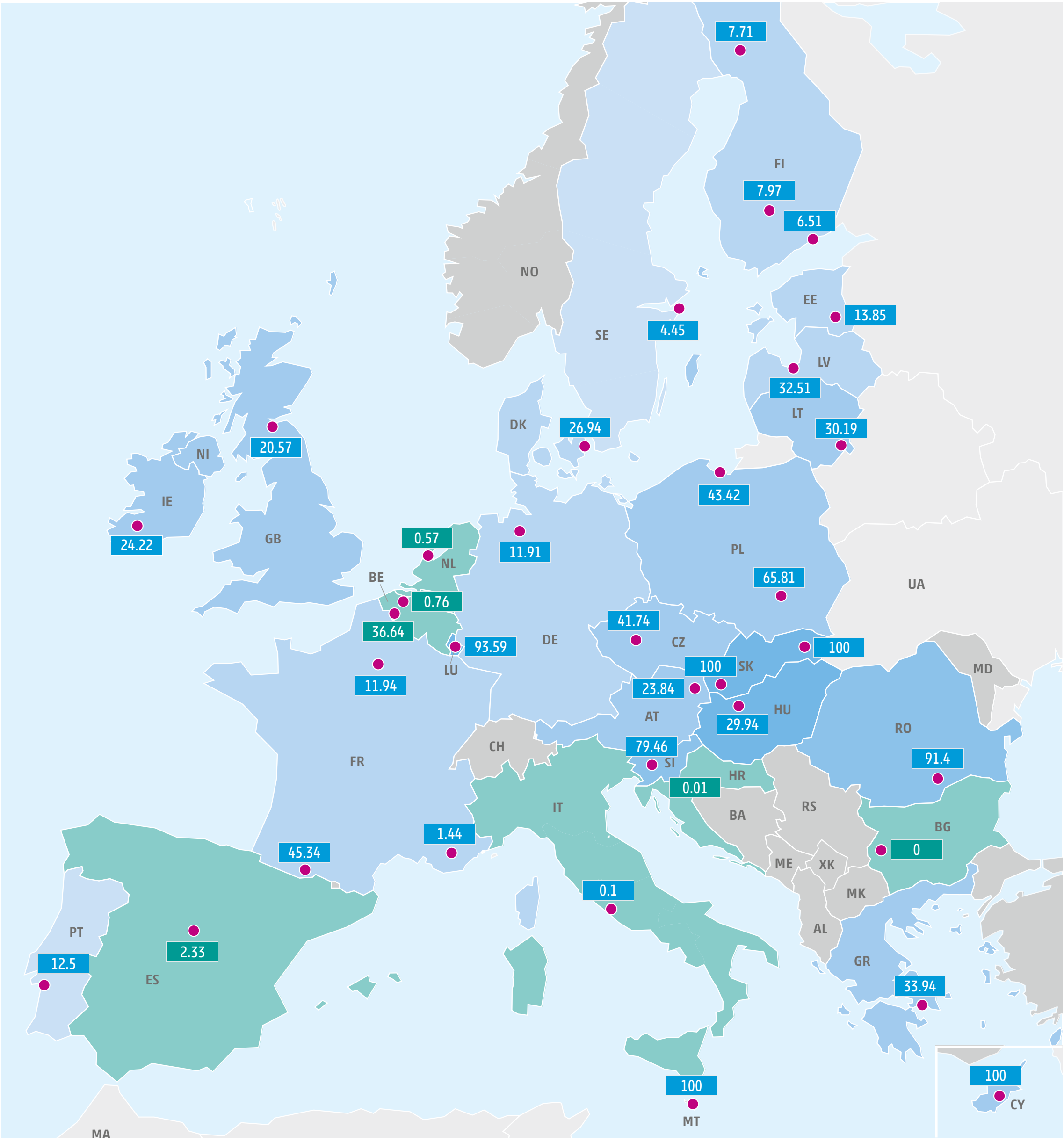

Figure 11: Yearly average hydrogen demand curtailment rate at country or node level in the PCI/PMI hydrogen infrastructure level in 2030 for stressful weather year (unit: %).

Country Node	Average yearly hydrogen demand curtailment (%)	Threshold 1 passed?
ATh_2	23.84	YES
BEh_2	0.76	NO
BEH_2Mo	36.64	YES
BGh_2	0	NO
CYh_2	100	YES
CZh_2	41.74	YES
DEh_2	11.91	YES
DKh_2	26.94	YES
EEh_2	13.85	YES
ESh_2	2.33	NO
FIh_2	7.97	YES
FIh_2N	7.71	YES
FIh_2S	6.51	YES
FRh_2	11.94	YES
FRh_2S	1.44	NO
FRh_2SW	45.34	YES
GRh_2	33.94	YES
HRh_2	0.01	NO
HUh_2	29.94	YES
IEh_2	24.22	YES
ITh_2	0.1	NO
LTh_2	30.19	YES
LUh_2	93.59	YES
LVh_2	32.51	YES
MTh_2	100	YES
NLh_2	0.57	NO
PLh_2N	43.21	YES
PLh_2S	65.81	YES
PTh_2	12.5	YES
ROh_2	91.4	YES
SEh_2	4.45	YES
SIh_2	79.46	YES
SKh_2E	100	YES
SKh_2W	100	YES
UKh_2	20.57	YES

Table 13: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the PCI/PMI hydrogen infrastructure level in 2030 for stressful weather year and check of threshold 1 of IGI indicator 2.2 (unit: %).

As detailed in Figure 11, countries can be aggregated in different groups according to their average yearly hydrogen demand curtailment rates:

1. **Rates below 3 %:** France-South region, Spain, the Netherlands, Croatia, Italy, Belgium, Bulgaria.
2. **Rates between 3 % and 20 %:** Sweden, Portugal, France, France-North region, Finland, Estonia, Germany.
3. **Rates above 20 % and below 50 %:** Belgium-Mons, Latvia, Lithuania, Ireland, Hungary, Greece, Denmark, Czechia, Austria, Poland North.
4. **Rates above 50 % and below 100 %:** Slovenia, Romania, Poland South, Luxembourg.
5. **Full curtailment of 100 %:** Slovakia, Cyprus, Malta.

Based on Table 13, the countries that have a yearly average hydrogen demand curtailment rate below 3 % in the stressful weather year are Spain, France-South region, the Netherlands, Croatia, Italy, Belgium, and Bulgaria.

The second group of countries includes Sweden, Portugal, France, the France-North region, Finland, Estonia, and Germany. These nations exhibit demand curtailment rates exceeding the defined threshold 1 but remaining at or below 20 %. This trend can be attributed to the composition of the composition of their hydrogen production means. For instance, Sweden, with a demand curtailment rate of 4.95 %, leverages a substantial share of wind and hydropower, ensuring greater stability in its hydrogen supply. Finland is comparable to Sweden, while France demonstrates a 12 % demand curtailment rate, where its reliance on nuclear energy mitigates dependence on fluctuating climatic conditions, enhancing supply availability. Germany benefits from its proximity to multiple supply options as it is in the centre of the Iberian and the Nordic corridor, has own import terminals, and has access to terminals in neighbouring countries.

The third group encompasses Belgium-Mons, Latvia, Lithuania, Ireland, Hungary, Greece, Denmark, Czechia, and Austria. This cohort includes countries like Greece (33.94 %) and Denmark (26.94 %) alongside others such as Czechia and Ireland, which face challenges stemming from their relative isolation within the hydrogen production and distribution topology. Geographic and infrastructural isolation increases reliance on domestically produced hydrogen, particularly from RES. Furthermore, dependency on imports from a single connected country—similarly affected by climatic stress—limits the availability of external hydrogen supplies. In such cases, countries prioritize domestic needs over exports, further constraining the import options for these isolated or peripheric regions.

The fourth group contains Slovenia, Romania, Poland and Luxembourg that show annual average hydrogen demand curtailment rates that exceed 50 % but remain below 100 % under the stressful weather year. The high curtailment rate observed in Luxembourg can be primarily attributed to the absence of interconnections with the neighbouring countries in the PCI/PMI hydrogen infrastructure level in combination with low national hydrogen production options. In Poland, which is divided into a northern region and a southern region, the southern region experiences notably higher curtailment rates under the stressful weather year due to lower hydrogen generation in the Poland-South region than in the Poland-North region. This disparity arises also due to a lack of sufficient PCI infrastructure which, combined with intensified weather impacts, significantly limits the ability to meet hydrogen demand. Romania and Slovenia also encounter substantial curtailments. In both countries, limited infrastructure in the PCI/PMI hydrogen infrastructure level in 2030 results in considerable hydrogen demand curtailment, regardless of weather variability. Consequently, while weather conditions play a role, they are not the primary factor in the persistently high curtailment rates observed in these countries.

Full demand curtailment under the stressful weather year has been identified for Slovakia, Malta and Cyprus, as has been the case for the reference weather year. These countries are fully isolated in the PCI/PMI hydrogen infrastructure level in 2030 and have no national hydrogen production assets connected to Zone 2.

Threshold 2: hydrogen demand curtailment rate of more than 5 % for at least one month per year

All the countries and regions that exceed threshold 1 also exceeded threshold 2.

3.1.2 ASSESSMENT OF ADVANCED HYDROGEN INFRASTRUCTURE LEVEL

High-level results for reference weather year

In 2030, compared to the PCI/PMI hydrogen infrastructure level, the advanced infrastructure level considers several new infrastructures (see section 1.1.2): Besides a connection between Algeria and Italy, Slovakia, Hungary and Romania are connected to Germany, Poland and Czechia instead of being isolated.

The overall yearly supply-demand balance for the advanced infrastructure level in 2030 for the reference weather year is presented in Table 14. As detailed in Table 14, electrolytic hydrogen production is the main source of hydrogen in Europe. This assessment results in an approximate share of 4.3 % of hydrogen demand curtailment in Europe. This is a significant decrease compared to the curtailment rate of 8.3 % for the PCI/PMI hydrogen infrastructure level. Thereby, electrolytic hydrogen production, hydrogen production from natural gas and imports via terminals are all slightly reduced on yearly average as Algerian supply is partially replacing these supplies due to the merit order besides decreasing the hydrogen demand curtailment.

Yearly hydrogen supply-demand balance	Advanced IL
H_2 produced via electrolysis	304
H_2 produced using natural gas	224
H_2 shipped imports	24
H_2 pipeline imports	42
Curtailed H_2 demand	27
H_2 demand for power production	2
Total H_2 demand	**620**

Table 14: Supply and demand balance in the Advanced hydrogen infrastructure level in 2030 for reference weather year (unit: TWh/y).

Figure 12 shows the hydrogen production via electrolysis in the different European countries for the Advanced hydrogen infrastructure level in the 2030 assessment. The countries with highest electrolytic hydrogen production are Spain, Finland, Sweden, and Germany. Some countries have more than one source of electrolytic hydrogen production. This is related to the intra-country assumptions, which is explained in section 3.1.1.

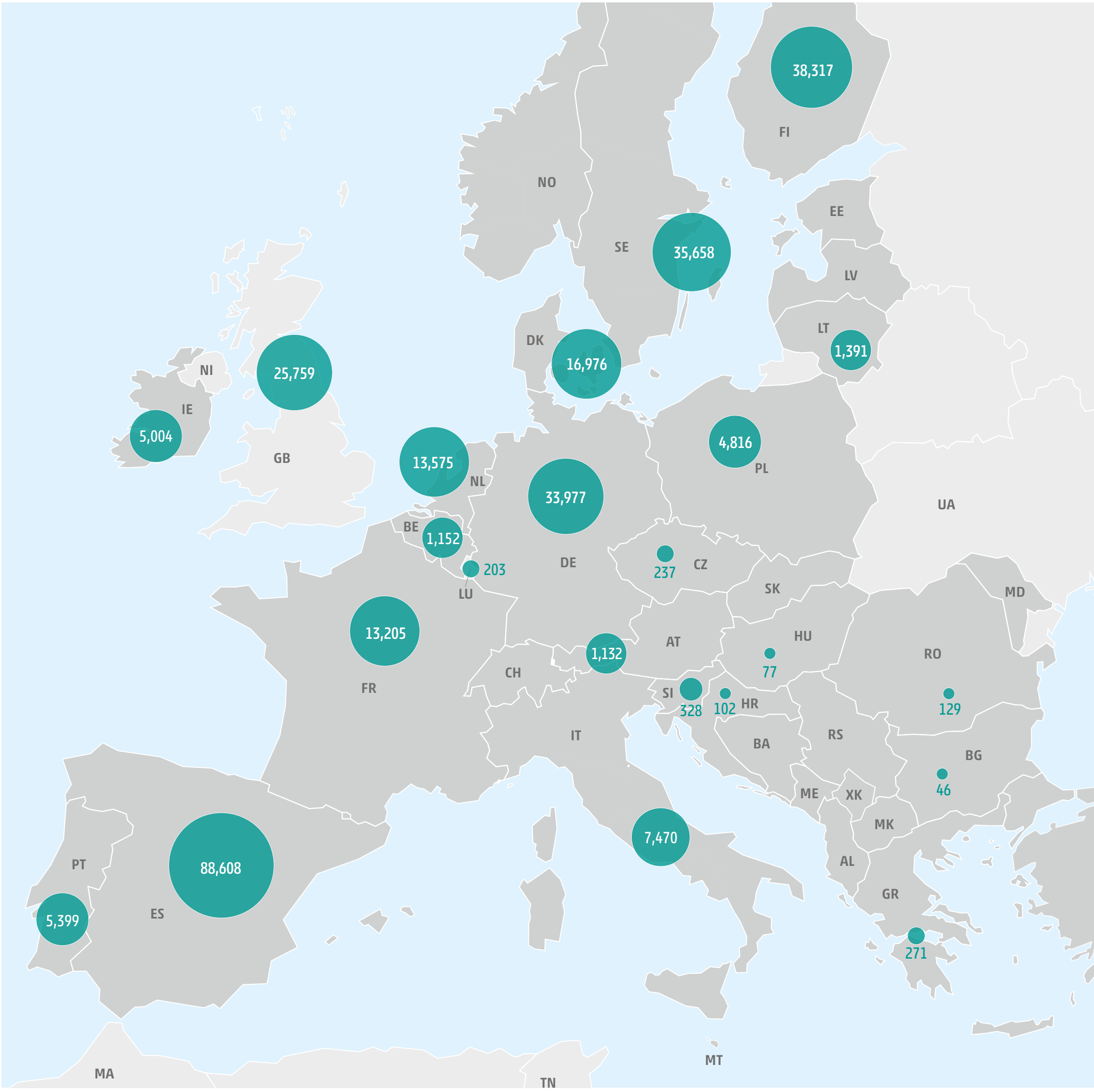

Figure 12: Distribution of hydrogen production via electrolysis in the Advanced hydrogen infrastructure level in 2030 for reference weather year (unit: GWh/y).

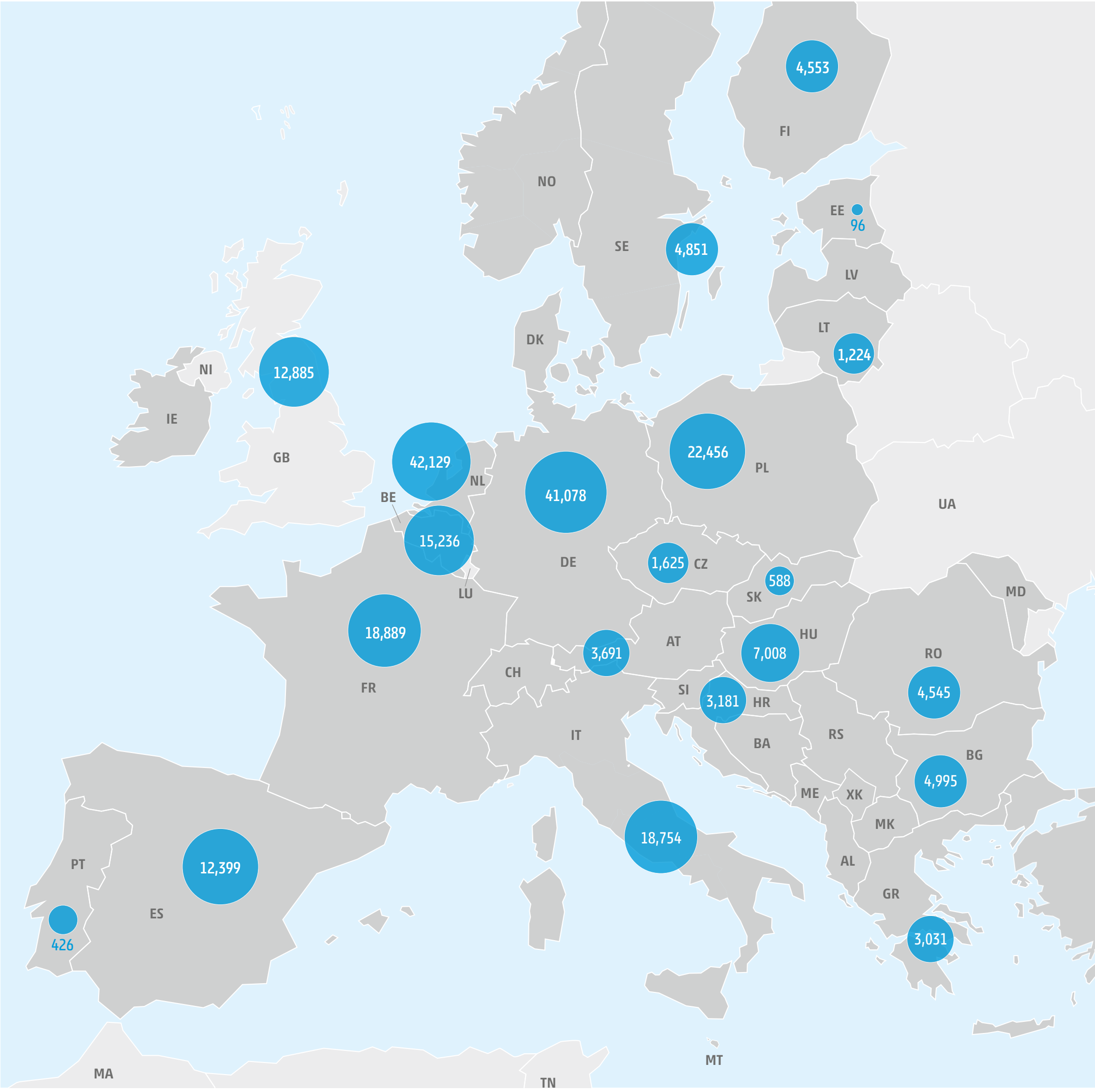

Figure 13: Distribution of hydrogen production from natural gas in the advanced infrastructure level in 2030 for reference weather year (unit: GWh/y).

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	1,132	3,691	0	10,901
BE	1,152	15,236	5,057	30,970
BG	46	4,995	0	3,768
CZ	237	1,625	0	6,849
CY	0	0	0	329
DE	33,977	41,078	5,443	154,844
DK	16,976	0	0	13,241
EE	0	96	0	540
ES	88,608	12,399	0	61,128
FI	46,746	4,553	0	34,184
FR	15,396	18,889	0	47,735
GR	271	3,031	0	6,482
HR	102	3,181	0	3,283
HU	77	7,008	0	9,312
IE	5,004	0	0	6,222
IT	7,470	18,754	41,799	26,504
LT	1,391	1,224	0	3,977
LU	203	0	0	2,695
LV	0	0	0	997
MT	0	0	0	284
NL	13,575	42,129	10,392	59,245
PL	4,816	22,456	2,633	52,434
PT	5,399	426	0	2,922
RO	129	4,545	0	12,359
SE	35,658	4,851	0	23,107
SI	328	0	0	1,544
SK	0	588	0	2,767
UK	25,759	12,885	0	41,537

Table 15: Distribution of hydrogen production, demand and hydrogen imports per country in the Advanced hydrogen infrastructure level in 2030 for reference weather year (unit: GWh/y).

Intra-EU cross-border flows emerge between different European countries due to limitations of available supplies and associated costs. Figure 14 shows these flows.

Compared to the PCI/PMI hydrogen infrastructure level, which contains the Iberian and the Nordic corridor, a new main corridor emerged in the advanced infrastructure level:

- North African corridor, transporting e.g. Algerian supplies to Italy, Austria, Germany and other countries.

In addition, among the interconnected countries within the advanced infrastructure level, new interconnections with Slovakia, Hungary and Romania enable new flows to these countries from German/Czechian and Austrian hubs.

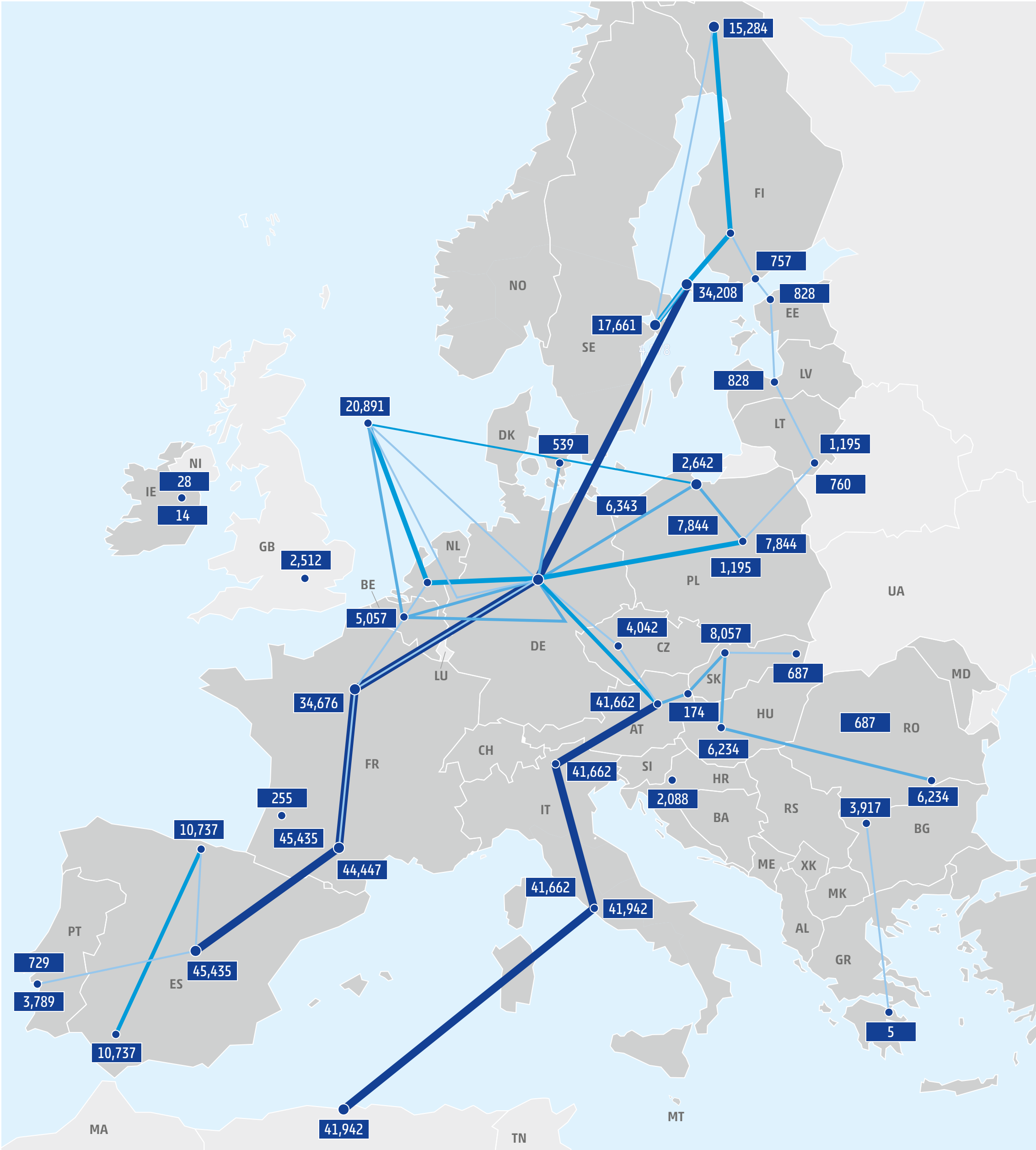

Figure 14: Grid flows* in the advanced infrastructure level in 2030 for reference weather year (GWh/y).

* Grid flows refer to simulations results and don't intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III).

In the 2030 Advanced infrastructure level assessment countries can be grouped in four different categories according to their supply-demand balance on a yearly basis:

1. **Countries that export more than they import:** Sweden, Finland, Denmark, Spain, Portugal and Bulgaria.
2. **Countries that import more than they export:** Poland, Czechia, Greece, Romania and Belgium.
3. **Transit countries that import more than they consume**: Germany, Italy, Austria, France, Netherlands, Estonia, Latvia, Lithuania, Slovakia, Hungary.
4. **Isolated countries:** The United-Kingdom, Ireland, Luxembourg, Slovenia, Croatia, Malta, Cyprus, Switzerland[8] and the cluster Bulgaria-Greece.

In comparison with the PCI/PMI hydrogen infrastructure level, Italy will change from exporting role to transit country due to the availability of North African supplies. In addition, Slovakia, Romania and Hungary could overcome isolation, and Austria changed from group 2 to group 3.

While on a yearly basis some countries are net exporters and some countries are net importers, net exporters may be relying on net imports during certain shorter periods of time and net importers may be providing net exports during certain shorter periods of time. This can result in bidirectional flows at interconnections. This situation is caused by the seasonality of electrolytic hydrogen production and to some extent by the seasonality of hydrogen demand.

High-level results for stressful weather year

The overall yearly supply-demand balance for the Advanced hydrogen infrastructure level in 2030 for the stressful weather year is presented in Table 16. As detailed in Table 16, electrolytic hydrogen production is the main source of hydrogen in Europe but it is reduced in comparison with the reference weather year and is partially compensated by increase used of SMR. This assessment results in an approximate share of 6.1 % of curtailed hydrogen demand at European level. This represents an increase by 2 percentage points in comparison with the reference weather year.

Yearly hydrogen supply-demand balance	Advanced IL
H_2 produced via electrolysis	265
H_2 produced using natural gas	241
H_2 shipped imports	35
H_2 pipeline imports	42
Curtailed H_2 demand	38
H_2 demand for power production	2
Total H_2 demand	**620**

Table 16: Supply and demand balance in the advanced infrastructure level in 2030 for stressful weather year (unit: TWh/y).

8 IGI report does not consider hydrogen demand in Switzerland (based on TYNDP 2024 Draft Scenario report). However, there is no hydrogen infrastructure connecting Switzerland to any of its European neighbouring countries in the assessed infrastructure levels.

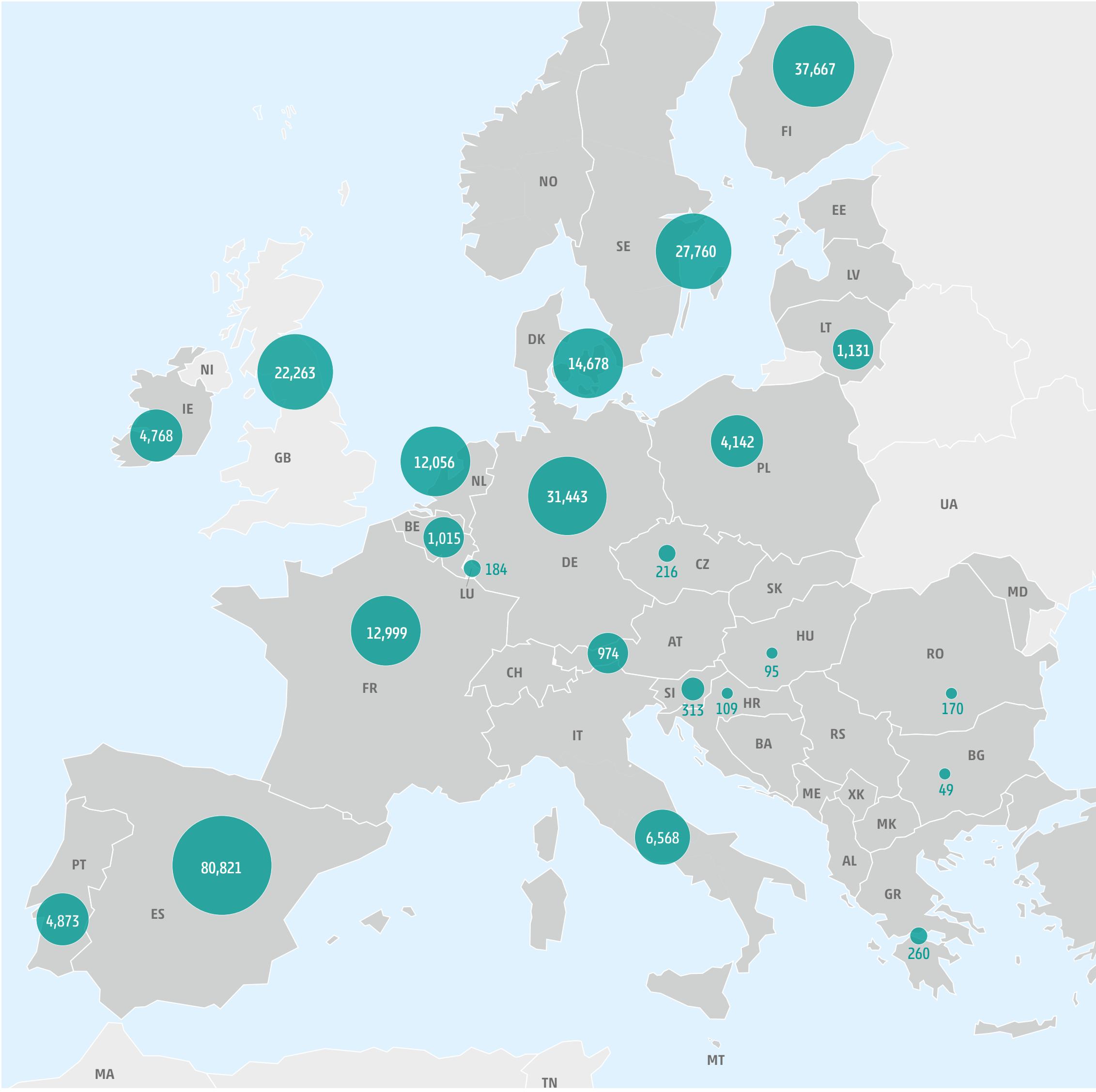

Figure 15: Distribution of hydrogen production via electrolysis in the advanced infrastructure level in 2030 for stressful weather year (unit: GWh/y).

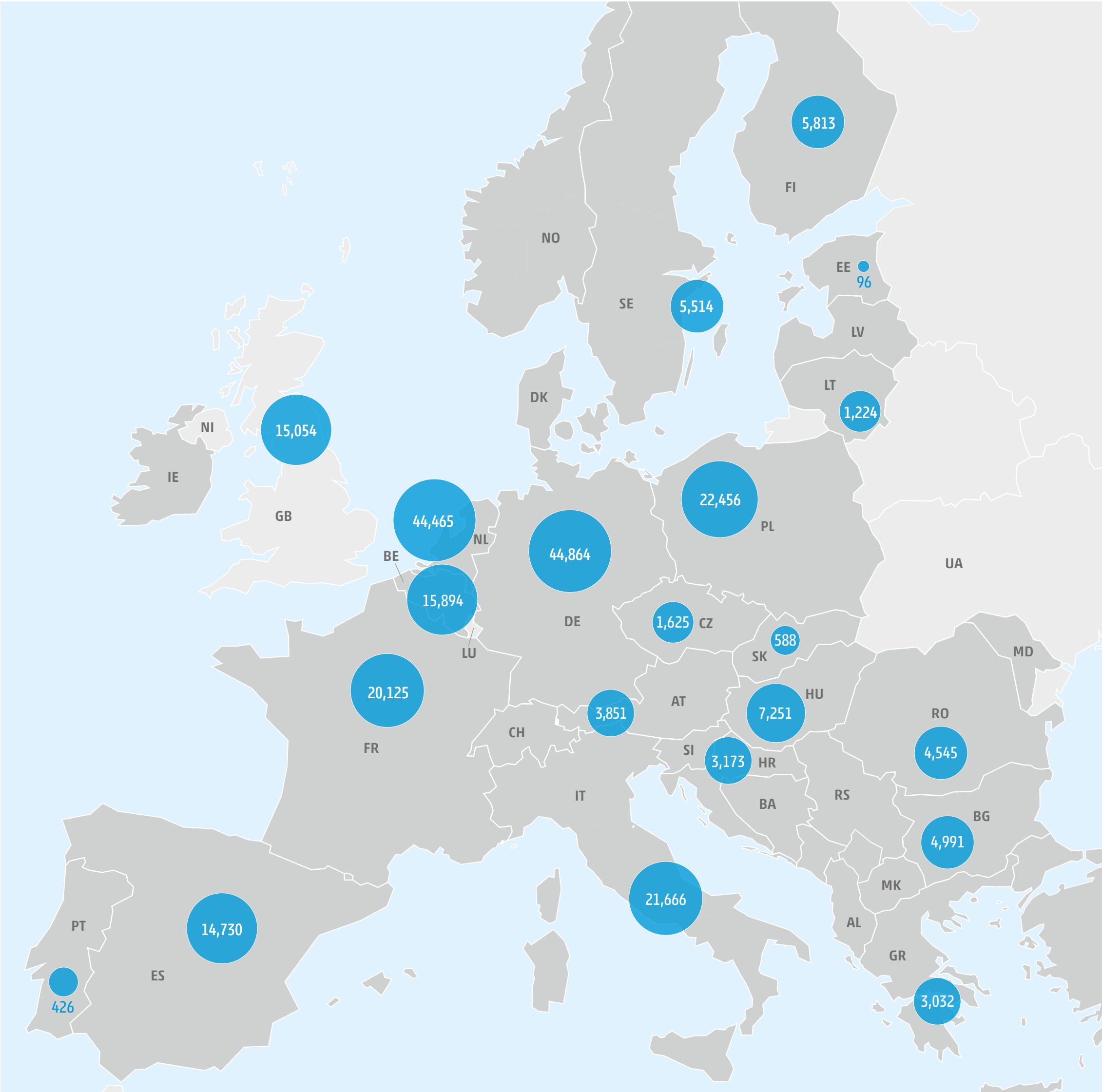

Figure 16: Distribution of hydrogen production from natural gas in the Advanced hydrogen infrastructure level in 2030 for stressful weather year (unit: GWh/y).

* Grid flows refer to simulations results and don't intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III).

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	974	3,851	0	10,901
BE	1,015	15,894	6,924	30,970
BG	49	4,991	0	3,768
CZ	216	1,625	0	6,849
CY	0	0	0	329
DE	31,443	44,864	7,847	154,500
DK	14,678	0	0	13,241
EE	0	96	0	540
ES	80,821	14,730	0	61,128
FI	37,667	5,813	0	34,184
FR	12,999	20,125	0	47,735
GR	260	3,032	0	6,482
HR	109	3,173	0	3,283
HU	95	7,251	0	9,312
IE	4,768	0	0	6,222
IT	6,568	21,666	42,075	26,504
LT	1,131	1,224	0	3,977
LU	184	0	0	2,695
LV	0	0	0	997
MT	0	0	0	284
NL	12,056	44,465	15,342	59,027
PL	4,142	22,456	3,539	52,283
PT	4,873	426	0	2,922
RO	170	4,545	0	12,359
SE	27,760	5,514	0	23,107
SI	313	0	0	1,544
SK	0	588	0	2,767
UK	22,263	15,054	0	41,537

Table 17: Distribution of hydrogen production, demand and hydrogen imports per country in the Advanced hydrogen infrastructure level in 2030 for stressful weather year (unit: GWh/y).

Picture courtesy of TERÉGA

As shown in Figure 17, flow characteristics are the same as for the reference weather year. Less availability of RES for electrolytic hydrogen production reduces flows from European exporting countries.

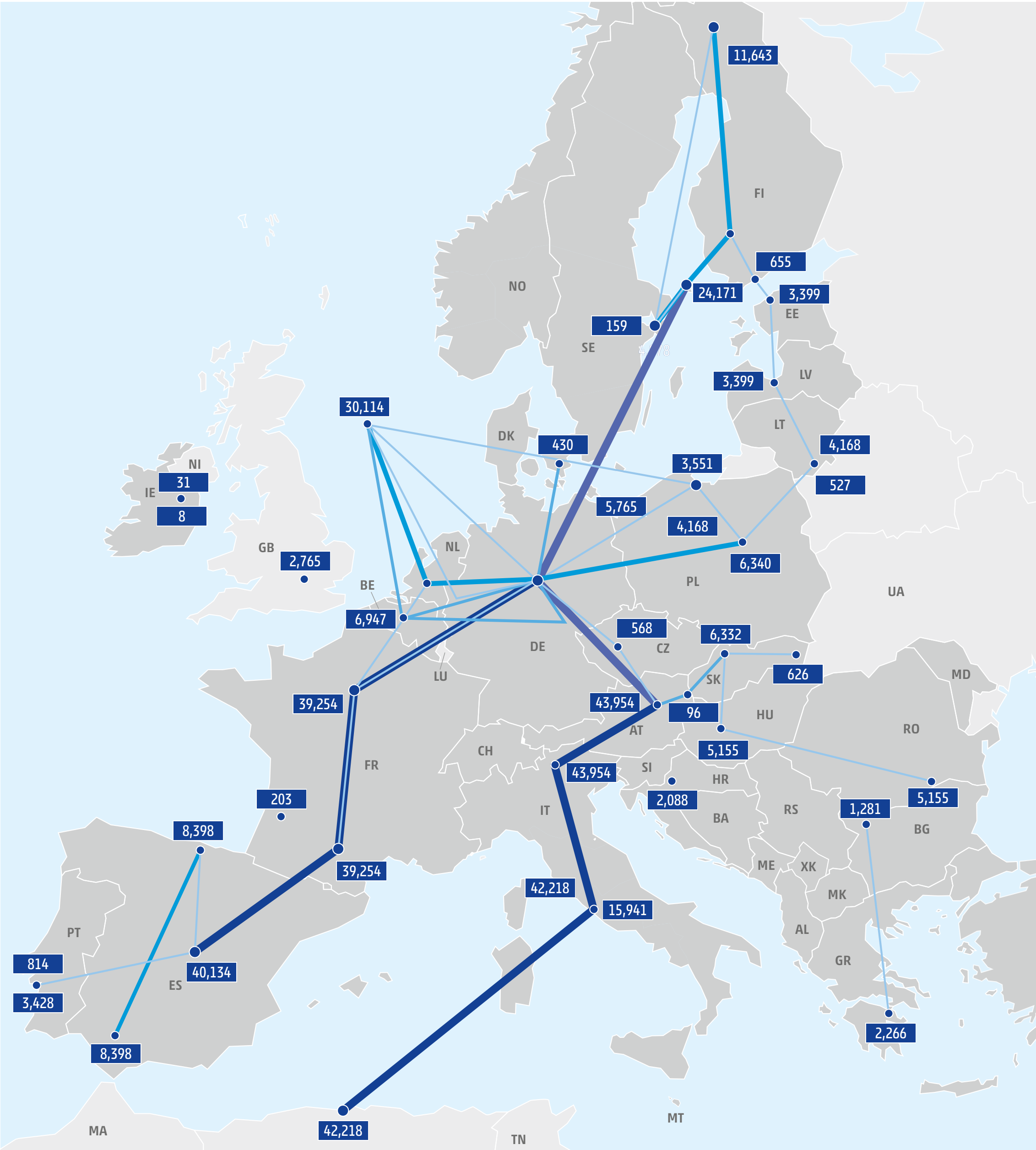

Figure 17: Grid flows in the Advanced hydrogen infrastructure level in 2030 for stressful weather year (GWh/y).

3.1.2.1 IGI INDICATOR 1: HYDROGEN MARKET CLEARING PRICE SPREADS FOR REFERENCE WEATHER YEAR

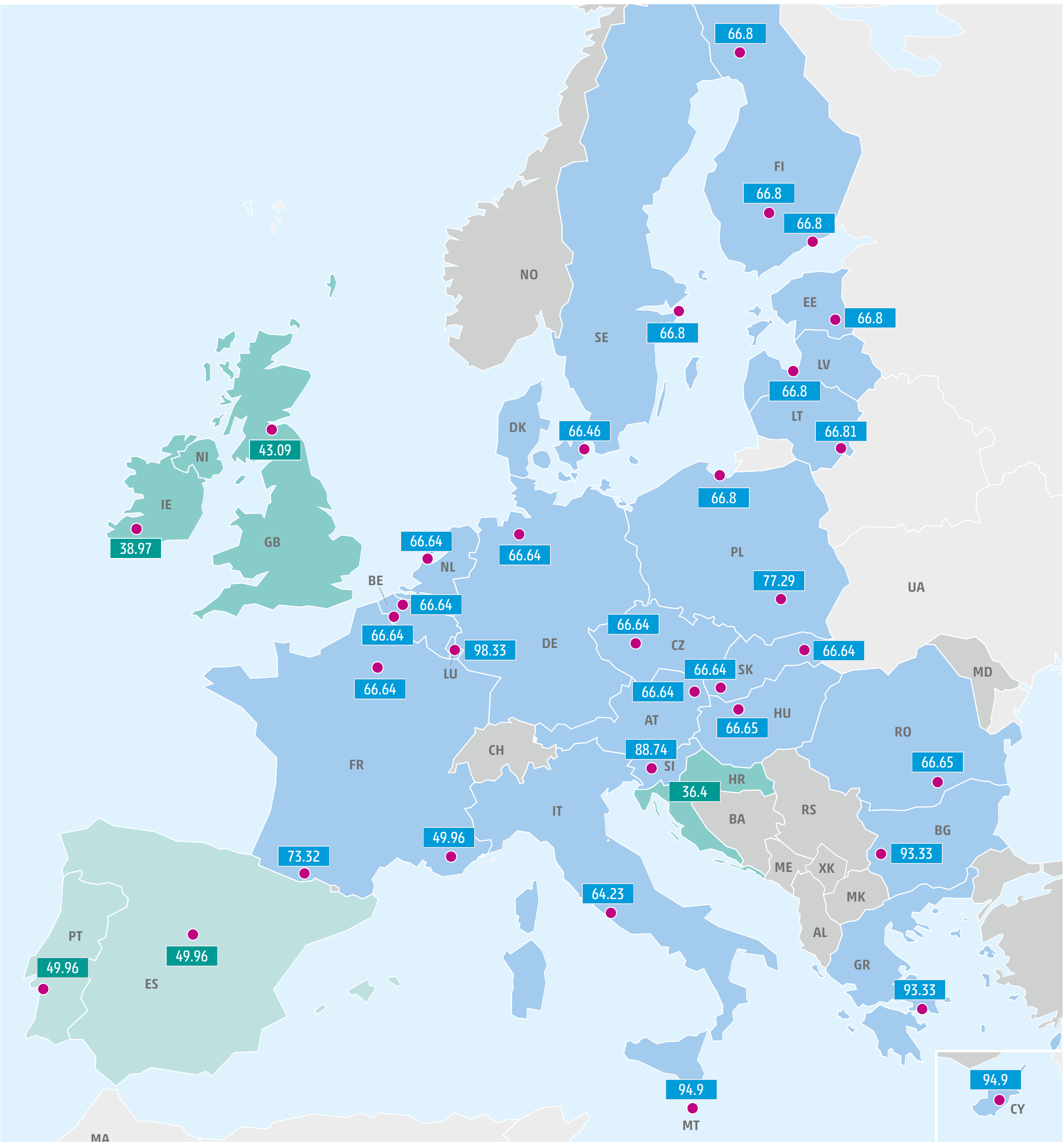

Figure 18: Average of the hourly hydrogen market clearing prices per country in the Advanced hydrogen infrastructure level in 2030 (unit: €/MWh).

The price formation in the DHEM is based on the merit order of hydrogen production (see section 1.2.1). Several price groups stand out, while a signification correlation is understood here as a correlation above 0.7:

1. **Portugal, Spain, France-South region:** Portugal and Spain are producers and net exporters of electrolytic hydrogen from RES to other countries. While the France-South region is sufficiently connected to the Iberian peninsula, price spreads appear with other groups of countries due to an internal bottleneck in France. It has a significant correlation with prices of groups 3 and 4.

2. **France-Southwest region:** Local undersupply and limited supply from other regions due to internal bottlenecks in France.

3. **Belgium, the Netherlands, Denmark, Germany, Czechia, Austria, Slovakia, Hungary Romania, Sweden, Finland, Estonia, Latvia, Lithuania, Poland-North region:** Well interconnected region within Europe. It represents a merger between group 3 and group 4 of the PCI/PMI hydrogen infrastructure level assessment with the exception of Italy. It has significant correlation with prices in group 1 and group 4.

4. **Italy:** Due to its access to Algerian imports and a capacity between Italy and Austria that sometimes acts as a bottleneck, meaning that capacity at this interconnection point is utilized at its maximum potential not allowing further exports (therefore, signalling needs for potential enhancements), Italy is an own price region. It has significant correlation with prices in group 1 and group 3.

5. **Ireland, the United Kingdom, Poland-South region:** Isolated (regions of) countries without significant price correlations but with average prices below 100 €/MWh.

6. **Greece, Bulgaria:** Countries showing significant price correlation, jointly isolated from the other European countries.

7. **Slovenia, Luxembourg, Croatia, Cyprus, Malta**: Isolated countries without significant price correlations and with average prices above 100 €/MWh.

The price correlations listed above are enabled by the infrastructure projects already considered in this hydrogen infrastructure level. However, price differences that led to the identification of the groups listed above are not necessarily describing an infrastructure gap. For this identification of infrastructure gaps, the thresholds of IGI indicator 1 are used.

Hydrogen market clearing price spreads

If one of the two thresholds of IGI indicator 1 is passed, a regional hydrogen infrastructure gap is assumed to be identified (see section 1.2.1). Table 18 lists the borders for which Threshold 1 and Threshold 2 were passed. In this case, both thresholds were always passed at the same borders.

Border	Threshold 1: Absolute average hourly hydrogen market clearing price spread above 4 €/MWh	Threshold 2: More than 40 days with hydrogen market clearing price spread above 20 €/MWh
DEh_2–PLh_2S	29	182
FRh_2–FRh_2S	24	158
FRh_2–FRh_2SW	58	322
FRh_2S–FRh_2SW	72	346
HUh_2–HRh_2	44	277
ITh_2–HRh_2	41	260
NLh_2–UKh_2	41	230
PLh_2N–PLh_2S	29	178
PLh_2S–CZh_2	29	182
PLh_2S–SKh_2E	29	182
ROh_2–BGh_2	39	273
SIh_2–HRh_2	77	364
SKh_2E–PLh_2S	29	182
UKh_2–BEh_2	41	230
UKh_2–IEh_2	19	112

Table 18: List of borders in the advanced infrastructure level that exceed (at least one of) the thresholds defined for IGI indicator 1 in 2030.

In comparison with the PCI/PMI hydrogen infrastructure level, the price spreads at the following borders decreased below the thresholds through the additional infrastructure of the Advanced hydrogen infrastructure level (see Figure 19):

- Hungary: Borders with Austria, Romania, Slovakia.
- Slovakia: Borders with Austria and Czechia.

3.1.2.2 IGI INDICATOR 2.1: HYDROGEN DEMAND CURTAILMENT FOR REFERENCE WEATHER YEAR

As explained in section 1.2.2, this IGI indicator assesses infrastructure gaps by quantifying hydrogen demand curtailments at individual nodes during the reference weather year, assuming no disruptions of infrastructures or of supply sources. It involves a multi-step simulation process integrating DHEM and DGM[9] outputs to evaluate the combined curtailments across nodes. The assessment is performed for the Advanced hydrogen infrastructure level in 2030.

Figure 19 and Table 19 show yearly average curtailment rates of hydrogen demand in the Zone 2 nodes of different European countries. For countries where the hydrogen market is divided into several sub-zones (i.e., nodes), the curtailment rate in the different sub-zones is presented. The yearly average hydrogen curtailment rates are thereby colour-coded in the map to indicate levels relative to the set threshold: blue signifies curtailment above the threshold, while green represents rates that are not above it.

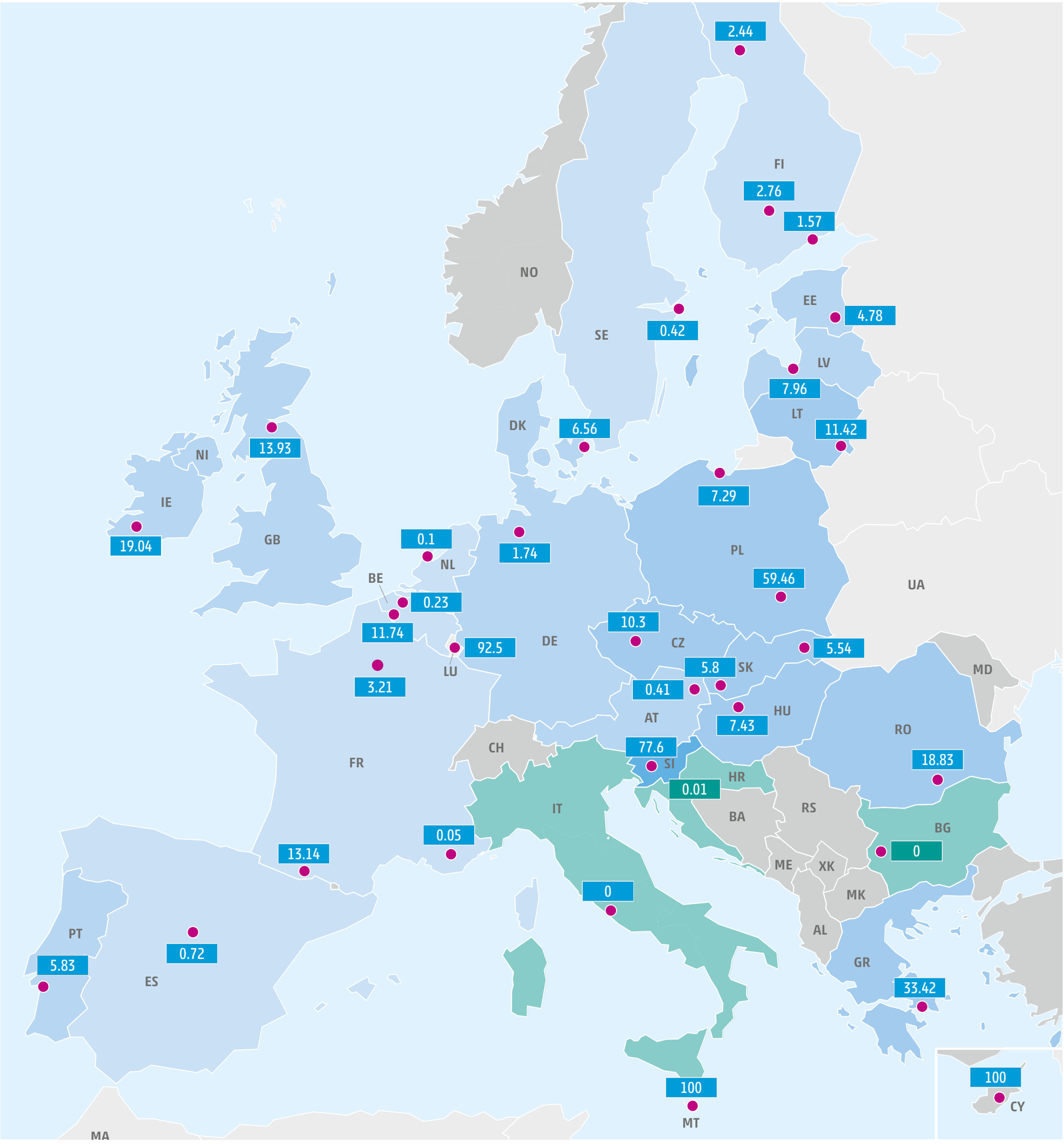

Figure 19: Yearly average hydrogen demand curtailment rate at country or node level in the advanced infrastructure level in 2030 for reference year (unit: %).

9 This draft TYNDP 2024 IGI report only includes the simulation results of the DHEM.

H_2 Demand Zone	Yearly average curtailment rate (%)	Threshold passed
ATh_2	0.4	NO
BEh_2	0.2	NO
BEh_2Mo	11.7	YES
BGh_2	0.0	NO
CYh_2	100.0	YES
CZh_2	10.3	YES
DEh_2	1.7	YES
DKh_2	6.6	YES
EEh_2	4.8	YES
ESh_2	0.7	YES
FIh_2	2.8	YES
FIh_2N	2.3	YES
FIH_2S	1.6	YES
FRh_2	3.2	YES
FRh_2S	0.0	NO
FRh_2SW	13.1	YES
GRh_2	33.4	YES
HRh_2	0.0	NO

H_2 Demand Zone	Yearly average curtailment rate (%)	Threshold passed
HUh_2	7.4	YES
IEh_2	19.0	YES
ITh_2	0.0	NO
LTh_2	11.4	YES
LUh_2	92.5	YES
LVh_2	8.0	YES
MTh_2	100.0	YES
NLh_2	0.1	NO
PLh_2N	7.3	YES
PLh_2S	59.5	YES
PTh_2	5.8	YES
ROh_2	18.8	YES
SEh_2	0.4	NO
SIh_2	77.6	YES
SKh_2E	5.8	YES
SKh_2W	5.5	YES
UKh_2	13.9	YES

Table 19: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the advanced infrastructure level in 2030 for reference weather year (unit: %).

In the 2030 assessment of the advanced infrastructure level, hydrogen demand is curtailed in most European countries.

As explained in the description of the Advanced hydrogen infrastructure level (see section 1.1.2), with limited availability of extra-EU supplies, hydrogen demand is satisfied mainly with electrolytic hydrogen production and hydrogen production from natural gas. Countries with higher availability of supply from those sources or from imports show lower curtailment rates. Most countries including strong net exporters face (weather-induced) disruptions. In comparison with IGI indicator 1, this IGI indicator focusses on the availability of supplies.

As detailed in Table 19, (regions of) countries can be aggregated in six different groups according to their average yearly hydrogen demand curtailment rates:

1. **Rates below 0.1 %:** Bulgaria, Croatia, Italy, France-South region, the Netherlands.
2. **Rates between 0.1 % and 5 %:** Belgium, Austria, Finland, Germany, Spain, Sweden, France, Estonia.
3. **Rates between 5 % and 20 %:** Denmark, Poland-North region, Hungary, Ireland, Latvia, Lithuania, Portugal, Belgium-Mons region, Czechia, Slovakia, France-Southwest region, Romania, the United Kingdom.
4. **Rates between 20 % and 50 %:** Greece.
5. **Rates between 50 % and 100 %:** Slovenia, Poland-South region, Luxembourg.
6. **Full curtailment of 100 %**: Cyprus, Malta.

Without the infrastructure already considered in the hydrogen infrastructure level, the overall hydrogen demand curtailment would be higher.

Compared with the PCI/PMI hydrogen infrastructure level, group 1 also includes the France-South region and the Netherlands. All countries in this group do not face any hydrogen demand disruption (i.e., 0 % curtailment rates). The very low curtailment of Italy in the PCI/PMI infrastructure level (i.e., 0.1 %) is completely removed due to the additional imports from North Africa. The France-South region can benefit from privileged access to Iberian supply. The Netherlands benefit from additional import capacities. Furthermore, Bulgaria, Croatia have high shares of hydrogen produced from natural gas to cover nation demand.

Compared to the PCI/PMI hydrogen infrastructure level, group 2 grows by France and Estonia. Among the countries of group 2, Spain, Sweden and Finland receive a significant share of their supply from national electrolytic hydrogen production, while Belgium, the Netherlands, Austria and Germany have their curtailment reduced thanks to (indirect) access to the extra-EU import capacities in North Africa unlocked in the Advanced level. Austria and Germany have (indirect) access to extra-EU import capacities. France benefits both from Iberian supply as well as imports to countries in its East, Estonia benefits from its proximity to Finland, and Austria benefits from its connections with both Germany and Italy.

Compared to the PCI/PMI hydrogen infrastructure level, group 3 grows by the Poland-North region, Hungary, the Belgium-Mons region, Czechia, Slovakia, the France-Southwest region, and Romania due to non-PCI projects with advanced status that provide additional capacities to supply these countries/regions. Among the countries of group 3, some countries like Denmark, Portugal, the United Kingdom and Ireland, despite having significant electrolytic hydrogen production compared to the national demand, still cannot cover all demand when RES are not available. In the cases of Denmark and Portugal, being peripheric countries, their neighbouring countries (i.e., Germany and Spain) can help to mitigate hydrogen demand curtailment. Lithuania and Latvia can receive hydrogen from Finland via Estonia and from Poland to mitigate demand curtailment. Estonia and Poland will both only provide hydrogen to Lithuania and Latvia when having access to surplus hydrogen quantities. In the case of the United Kingdom and Ireland, being isolated from Europe leads to higher curtailment rates due to limited options for cross-border balancing.

Within the same group 3, Slovakia, Hungary and Romania are benefiting from new interconnections. Thereby, Slovakia is the transit country to Hungary and Hungary is the transit country to Romania. While the France-Southwest region is still isolated and strictly depends on local production, the hydrogen demand curtailment is reduced compared to the PCI/PMI hydrogen infrastructure level. This is enabled by the additional hydrogen storage capacities in the France-Southwest region in the advanced infrastructure level. In addition, Czechia benefits from the fact that its western neighbours can share more hydrogen surplus.

In group 4, Greece shows a curtailment rate of 33.4 %, which can be explained by the fact that despite the new interconnections in the advanced infrastructure level in Eastern Europe, Greece and Bulgaria remained isolated and therefore their situation is not improved compared to the PCI/PMI hydrogen infrastructure level.

Group 5 includes countries with very high curtailment rates. All the countries in this group are fully isolated and rely on national hydrogen supplies mainly produced from natural gas.

Group 6 includes only isolated countries that have hydrogen demand but no national hydrogen production assets connected to Zone 2.

In Denmark, Finland, Ireland, Sweden, and Slovenia, on top of the hydrogen demand curtailments observed in Zone 2 nodes as described in the paragraphs above, hydrogen demand curtailments can be observed in Zone 1. While these curtailments are limited to a few months in Sweden and Finland, it is of relevance in every month in Ireland and reaches high levels in Denmark and Slovenia. Compared to the PCI/PMI hydrogen infrastructure level, these curtailments are slightly reduced due to higher availability of electricity for electrolytic hydrogen production due to additional imports (i.e., new availability of North African imports and import terminals).

3.1.2.3 IGI INDICATOR 2.2: HYDROGEN DEMAND CURTAILMENT FOR STRESSFUL WEATHER YEAR

Threshold 1: Average yearly hydrogen demand curtailment rate above 3 %

Table 20 shows the yearly average hydrogen demand curtailment rates in the Zone 2 nodes of various European countries for 2030, simulated under a stressful weather year. This weather scenario assumes adverse conditions, such as reduced wind and solar energy availability, which directly impacts electrolytic hydrogen production. For countries with hydrogen markets divided into multiple sub-zones (i.e., nodes), curtailment rates are depicted individually for each sub-zone on the map. The yearly average hydrogen curtailment rates are thereby colour-coded to indicate levels relative to the set threshold 1: blue signifies curtailment above the threshold, while green represents rates that are not.

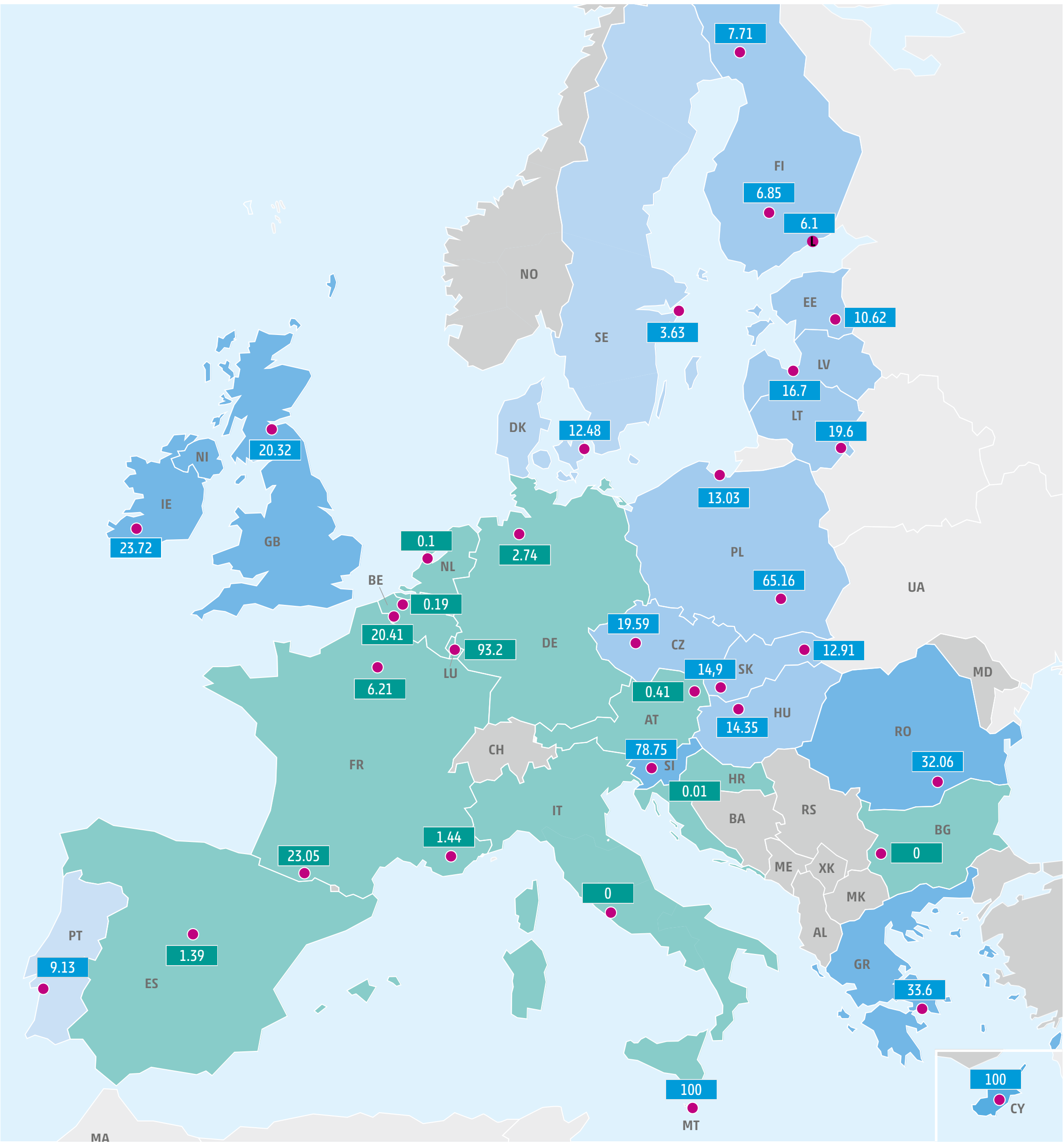

Figure 20: Yearly average hydrogen demand curtailment rate at country or node level in the advanced infrastructure level in 2030 for stressful weather year (unit: %).

In interconnected countries, the average hydrogen demand curtailment rates in Zone 2 are more or less doubled compared to the reference weather year as less hydrogen is available during stressful weather conditions.

H_2 Demand Zone	Yearly average curtailment rate (%)	Threshold 1 passed
ATh_2	0.4	YES
BEh_2	0.2	NO
BEh_2Mo	20.4	YES
BGh_2	0.0	NO
CYh_2	100.0	YES
CZh_2	19.6	YES
DEh_2	2.7	NO
DKh_2	12.5	YES
EEh_2	10.6	YES
ESh_2	1.4	NO
FIh_2	6.9	YES
FIh_2N	6.3	YES
FIH_2S	6.1	YES
FRh_2	6.2	YES
FRh_2S	0.3	NO
FRh_2SW	23.1	YES
GRh_2	33.6	YES
HRh_2	0.0	NO
HUh_2	14.4	YES
IEh_2	23.7	YES
ITh_2	0.0	NO
LTh_2	19.6	YES
LUh_2	93.2	YES
LVh_2	16.7	YES
MTh_2	100.0	YES
NLh_2	0.1	NO
PLh_2N	13.0	YES
PLh_2S	65.2	YES
PTh_2	9.1	YES
ROh_2	32.1	YES
SEh_2	3.6	YES
SIh_2	78.8	YES
SKh_2E	14.2	YES
SKh_2W	12.9	YES
UKh_2	20.3	YES

Table 20: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the advanced infrastructure level in 2030 for stressful weather year (unit: %).

As detailed in Table 20, (regions of) countries can be aggregated in different groups according to their average yearly hydrogen demand curtailment rates:

1. **Rates below 3 %:** Bulgaria, Croatia, Italy, the Netherlands, Belgium, Austria, Germany, Spain France-South region.

2. **Rates between 3 % and 20 %:** Sweden, France, Denmark, Finland, Poland-North region, Hungary, Latvia, Lithuania, Estonia, Portugal, Czechia, Slovakia.

3. **Rates between 20 % and 50 %:** Belgium-Mons region, France-Southwest region, Greece Ireland, Romania, the United Kingdom.

4. **Rates between 50 % and 100 %:** Slovenia, Poland-South region, Luxembourg.

5. **Full curtailment of 100 %:** Cyprus, Malta. Compared with the PCI/PMI hydrogen infrastructure level, group 1 grows by Germany and Austria, reducing these countries' hydrogen demand curtailment below the threshold of IGI indicator 2.2.

Threshold 2: hydrogen demand curtailment rate of more than 5 % for at least one month per year

All the countries and regions that exceed threshold 1 also exceeded threshold 2.

Picture courtesy of NATIONALGRID

3.2 COMPARISON BETWEEN PCI/PMI HYDROGEN INFRASTRUCTURE LEVEL AND ADVANCED INFRASTRUCTURE LEVEL

3.2.1 MAXIMUM UTILISATION OF INTERCONNECTIONS

Table 21 displays the maximum utilisation rates of hydrogen interconnections for both hydrogen infrastructure levels in 2030 for the reference weather year. Table 22 shows this information for the stressful weather year.

As stated in section 1.1, some countries are completely isolated from the hydrogen infrastructure:

- Countries and regions that are isolated in both hydrogen infrastructure levels: Slovenia, Ireland, the United Kingdom, Cyprus, Malta, France-Southwest region, Poland-South region, Luxembourg, Bulgaria and Greece are interconnected with each other but isolated from the main backbone.
- Countries that are only isolated in the PCI/PMI hydrogen infrastructure level: Slovakia, Hungary, Romania, Bosnia, Croatia and Poland-North region are interconnected with each other in the Advanced hydrogen infrastructure level but isolated from the main backbone.

When interpreting the tables, the strategic dimensioning of interconnections becomes more evident when also considering the data for 2040 as presented in section 4.2.1. As hydrogen pipelines have significant economies of scale, one early investment with a large pipeline diameter can represent an anticipatory investment.

Interconnection	Stated direction		Reverse direction		Comments
	PCI/PMI IL	ADV IL	PCI/PMI IL	ADV IL	
ATh_2 → DEh_2	60	100	48	48	As DZ supply is added in the ADV IL, flows from AT to DE increase as AT has more access to North African H_2 through Italy
ATh_2 → $IB\text{-}ITh_2$	44	9	63	100	As DZ supply is added in the ADV IL, the max. utilisation rate is reached.
ATh_2 → $IB\text{-}SKh_2W$		40		0	As no UA supply is available, AT supplies SK.
BAh_2 → HRh_2		0		0	The low utilisation is caused by low hydrogen supply to these jointly isolated countries, so BA and HR always need hydrogen supply themselves if the other country needs it.
BEh_2 → DEh_2	85	85	80	80	With additional supply options in ADV IL, DE's dependence on BE's supplies decreases.
BEH_2Mo → FRh_2Va	0	0	15	15	The flow direction is from FR to BE.
BEh_2 → NLh_2	0	0	100	100	The flow direction is from NL to BE.
BGh_2 → GRh_2	6	6	8	8	The low utilization is caused by the isolation of these countries along with the relatively low supply of hydrogen
CZh_2 → DEh_2	0	0	6	7	The flow direction is from DE to CZ as no UA supply is available.
DEh_2 → DKh_2	38	39	67	67	
DEh_2 → FRh_2	100	100	100	98	
DEh_2 → NLh_2	59	30	73	56	With additional supply options in ADV IL, the offered import flexibilities reduce max. utilisation.
DEh_2 → PLh_2N		100		0	The flow direction is from DE to PL.

Interconnection	Stated direction PCI/PMI IL	Stated direction ADV IL	Reverse direction PCI/PMI IL	Reverse direction ADV IL	Comments
DEh_2 → PLh_2nbc	100	76	3	0	The flow direction is from DE to PL. New terminal in PL and new connection from DE to PL (supplied by new supply options) in ADV IL reduce max. utilisation.
DEh_2ba → DEh_2		100			
DEh_2bp → DEh_2ba		0			
EEh_2 → FIh_2S	46	77	6	6	New terminal in PL and new connection from DE to PL (supplied by new supply options) in ADV IL increase max. utilisation.
EEh_2 → LVh_2	5	5	47	78	With additional supply options and connection from DE to PL in ADV IL West of LV, max. utilisation from LV to EE can be increased.
ESh_2 → FRh_2S	95	95	0	83	Capacity from ES to FR-South would be a bottleneck if FR-South to FR was not already restricting flows.
ESh_2 → PTh_2	9	9	22	22	
FIh_2 → FIh_2AI	26	17	10	10	
FIh_2 → FIh_2N	0	0	1	1	Very high capacities set in the model as this arc is not representing a bottleneck.
FIh_2 → FIh_2S	0.4	0.3	0.4	0.3	Very high capacities set in the model as this arc is not representing a bottleneck.
FIh_2AI → DEh_2	71	60			Flow direction is from FI to DE.
FIh_2AI → SEh_2	0	6	15	15	
FIh_2N → SEh_2	23	23	10	21	
FRh_2 → FRh_2S	100	100	100	100	Capacity from FR-South to FR is a bottleneck that limits supplies from ES.
FRh_2 → FRh_2Va	15	15	7	7	
HUh_2 → IB-SKh_2C		0		57	Flow direction is SK to HU. The max. utilisation would be higher if there was more hydrogen supply to Europe, allowing SK to transit more hydrogen to HU and downstream countries which remain having HCR.
HUh_2 → ROh_2		44		0	Flow direction is HU to RO. The max. utilisation would be higher if there was more hydrogen supply to Europe, allowing HU to transit more hydrogen to RO which remains having high HCR.
IB-ITh_2 → ITh_2	0	0	63	84	
IB-SKh_2C → SKh_2E		3		0	The max. utilisation would be higher if there was more hydrogen supply to Europe as countries in the area remain having HCR.
IB-SKh_2C → SKh_2W		46		42	The max. utilisation would be higher if there was more hydrogen supply to Europe as countries in the area remain having HCR.
IB-SKh_2E → SKh_2E		0		0	The max. utilisation would be higher if there was more hydrogen supply to Europe as countries in the area remain having HCR.
IB-SKh_2W → CZh_2		15			SK supplies hydrogen received from AT to CZ.
IB-SKh_2W → SKh_2W		40		0	The max. utilisation would be higher if there was more hydrogen supply to Europe as countries in the area remain having HCR.
LTh_2 → LVh_2	50	81	4	4	With additional supply options and connection from DE to PL in ADV IL West of LT, max. utilisation from LT to LV can be increased.

Interconnection	Stated direction		Reverse direction		Comments
	PCI/PMI IL	ADV IL	PCI/PMI IL	ADV IL	
LTh_2 → PLh_2nbc	3	0	52	88	With additional supply options and connection from DE to PL in ADV IL West of LT, max. utilisation from PL to LT can be increased.
PLh_2nbc → PLh_2N	54	23			New terminal in PL-North and new connection from DE to PL (supplied by new supply options) in ADV IL reduce max. utilisation.
DEh_2bp → DEh_2		100			Allows import through DEbp terminal in ADV IL.
DZh_2 → ITh_2		26			The max. utilisation is limited by the hydrogen supply potential of DZ as defined in TYNDP 2024 scenarios.
LH_2_Tk_BE → BEh_2	100	100			In PCI/PMI IL, terminal capacities are bottleneck for hydrogen imports as not reaching supply potentials as defined in TYNDP 2024 scenarios. Bottleneck is lifted in ADV IL.
LH_2_Tk_DE → DEh_2	100	100			In PCI/PMI IL, terminal capacities are bottleneck for hydrogen imports as not reaching supply potentials as defined in TYNDP 2024 scenarios. Bottleneck is lifted in ADV IL.
LH_2_Tk_DEbp → DEh_2bp	0	100			New connection allows utilisation of DEbp terminal in ADV IL.
LH_2_Tk_NL → NLh_2	100	100			In PCI/PMI IL, terminal capacities are bottleneck for hydrogen imports as not reaching supply potentials as defined in TYNDP 2024 scenarios. Bottleneck is lifted in ADV IL.
LH_2_Tk_PLN → PLh_2N		100			New terminal in ADV IL.

Table 21: Maximum utilisation rates of interconnections in the PCI/PMI hydrogen infrastructure level and in the Advanced hydrogen infrastructure level in 2030 for the reference weather year (unit: %).

Interconnection	Stated direction		Reverse direction		Comments on significant deviations from the maximum utilization rates compared with the reference weather year
	PCI/ PMI IL	ADV IL	PCI/ PMI IL	ADV IL	
ATh_2 → DEh_2	60	100	48	14	
ATh_2 → IB-ITh_2	44	0	64	100	
ATh_2 → IB-SKh_2W		52		100	
BAh_2 → HRh_2		0		0	
BEh_2 → DEh_2	85	85	80	80	
BEh_2 → NLh_2	0	0	100	100	
BEH_2Mo → FRh_2Va	0	0	15	15	
BGh_2 → GRh_2	6	6	8	5	
CZh_2 → DEh_2	0	0	7	6	
DEh_2 → DKh_2	39	39	66	57	
DEh_2 → FRh_2	95	80	100	98	
DEh_2 → NLh_2	58	31	73	56	
DEh_2 → PLh_2N	100	100		64	
DEh_2 → PLh_2nbc	100	100	3	0	Dependence of Nordic hydrogen production on RES and lower RES availability increase max. utilisation from DE to PL to decrease HCR in the Baltics.
DEh_2ba → DEh_2		0			
DEh_2bp → DEh_2ba		100			
EEh_2 → FIh_2S	46	83	6	6	Dependence of Nordic hydrogen production on RES and lower RES availability increase max. utilisation from EE to FI to decrease HCR in the Baltics.
EEh_2 → LVh_2	5	5	47	84	Dependence of Nordic hydrogen production on RES and lower RES availability increase max. utilisation from LV to EE to decrease HCR in the Baltics.
ESh_2 → FRh_2S	95	95	83	83	Dependence of Iberian hydrogen production on RES and lower RES availability increase max. utilisation from FR to ES to decrease HCR in ES and PT.
ESh_2 → PTh_2	10	10	22	22	
FIh_2 → FIh_2AI	26	17	10	6	
FIh_2 → FIh_2N	0	0	1	1	
FIh_2 → FIh_2S	0	0.2	1	0.4	
FIh_2AI → DEh_2	70	61			
FIh_2AI → SEh_2	0	7	15	16	
FIh_2N → SEh_2	23	23	29	29	
FRh_2 → FRh_2S	100	100	100	100	
FRh_2 → FRh_2Va	15	15	7	7	
HUh_2 → IB-SKh_2C		0		51	
HUh_2 → ROh_2		44		0	
IB-ITh_2 → ITh_2	64	0	60	84	
IB-SKh_2C → SKh_2E		3		0	
IB-SKh_2C → SKh_2W		0		38	
IB-SKh_2E → SKh_2E		0		0	
IB-SKh_2W → CZh_2		15			

Interconnection	Stated direction		Reverse direction		Comments on significant deviations from the maximum utilization rates compared with the reference weather year
	PCI/ PMI IL	ADV IL	PCI/ PMI IL	ADV IL	
IB-SKh$_2$W → SKh$_2$W		42		0	
LTh$_2$ → LVh$_2$	50	87	4	4	Dependence of Nordic hydrogen production on RES and lower RES availability increase max. utilisation from LT to LV to decrease HCR in the Baltics.
LTh$_2$ → PLh$_2$nbc	3	0	52	88	Dependence of Nordic hydrogen production on RES and lower RES availability increase max. utilisation from PL to LT to decrease HCR in the Baltics.
PLh$_2$nbc → PLh$_2$N	54	23			
DEh$_2$bp → DEh$_2$		100			
DZh$_2$ → ITh$_2$		26			
LH$_2$_Tk_BE → BEh$_2$	100	100			
LH$_2$_Tk_DE → DEh$_2$	100	100			
LH$_2$_Tk_DEbp → DEh$_2$bp	0	100			
LH$_2$_Tk_NL → NLh$_2$	100	100			
LH$_2$_Tk_PLN → PLh$_2$N		100			

Table 22: Maximum utilisation rates of interconnections in the PCI/PMI hydrogen infrastructure level and in the Advanced hydrogen infrastructure level in 2030 for the stressful weather year (unit: %).

3.2.2 ANALYSIS WITH HYPOTHETICAL INFRASTRUCTURE APPROACH

This section will be produced after the public consultation of the TYNDP 2024 Infrastructure Gaps Identification report in line with the methodology described by steps 2 to 3 in section 6 of the TYNDP 2024 Annex D2.

3.2.3 IDENTIFICATION OF PROJECTS THAT SOLVED OR MITIGATED INFRASTRUCTURE GAPS

Solved infrastructure gaps in Advanced hydrogen infrastructure level compared to PCI/PMI hydrogen infrastructure level

The additional projects of the advanced infrastructure level could solve the following indications of regional hydrogen infrastructure gaps:

- Borders as captured by IGI indicator 1: Hungary-Austria, Hungary-Romania, Hungary-Slovakia, Slovakia-Austria, Slovakia-Czechia.
- Countries and regions as captured by IGI indicator 2.1: France-South region, the Netherlands.
- Countries and regions as captured by IGI indicator 2.2: Austria, Germany.

Nevertheless, not all IGI indicators could be solved from a regional perspective even if the advanced hydrogen projects provide benefits.

Identification of advanced, non-PCI/PMI projects responsible for solving hydrogen infrastructure gaps by addressing hydrogen infrastructure bottlenecks

The following advanced, non-PCI/PMI projects contributed to mitigate the identified infrastructure gaps in the 2030 assessment:

- Pipeline imports
  - North African hydrogen corridor to Italy (North Africa hydrogen corridor)
- Intra-EU connections:
  - Austria to Slovakia (Slovak Hydrogen Backbone)
  - Netherlands to Germany (H_2Coastlink, IP Elten/Zevenaar – Cologne, Hyperlink and H_2ercules Network North-West)
  - Germany to Poland (Pomeranian Green Hydrogen Cluster)
  - Slovakia to Hungary (HU/SK hydrogen corridor and SK-HU H_2 corridor)
  - Hungary to Romania (Giurgiu Nădlac hydrogen corridor and HU/RO hydrogen corridor)
- Import terminals
  - New Ammonia terminal in Gdansk and Hydrogen Highway – Northern Section
  - Increased terminal capacity in the Netherlands (Eemshaven H_2)
- Hydrogen storages
  - Hydrogen storage projects in Germany (RWE H_2 Storage Gronau-Epe, UST Hydrogen Storage Krummhörn, RWE H_2 Storage Xanten, EWE Hydrogen Storage Huntorf, EWE Hydrogen Storage Jemgum, RWE H_2 Storage Staßfurt)
  - Hydrogen storage project in the France-Southwest region of France (HySoW storage)

Besides the projects listed above, the projects included in the PCI/PMI hydrogen infrastructure level also contribute to the solving and mitigation of infrastructure gaps.

4 ASSESSMENT FOR 2040

This section describes the evolution of the IGI indicators for the reference weather year (i.e., 1995) and the stressful weather year (i.e., 2009) for the analysed infrastructure levels (i.e., PCI/PMI and Advanced hydrogen infrastructure levels) for the simulation year 2040.

4.1 INFRASTRUCTURE GAPS IDENTIFICATION

4.1.1 ASSESSMENT OF PCI/PMI HYDROGEN INFRASTRUCTURE LEVEL

High-level results for reference weather year

The overall yearly supply-demand balance for the PCI/PMI hydrogen infrastructure level in 2040 is presented in Table 23. As detailed in Table 23, the overall hydrogen demand triples compared to the 2030 hydrogen demand level, leading to a yearly hydrogen demand of 1936 TWh/y in Europe. Electrolytic hydrogen production remains the main source of hydrogen in Europe, satisfying 56 % of the yearly hydrogen demand of Europe.

Despite i) the infrastructure development foreseen in the PCI/PMI hydrogen infrastructure level for 2040 (see section 1.1), ii) the increase of extra-EU supply potentials via terminals and pipelines, and iii) the significant increase of electrolytic hydrogen production (by approximately 246 %), this is not sufficient to satisfy the hydrogen demand in many European countries. Therefore, overall hydrogen demand curtailment rises compared to the 2030 values leading to an average hydrogen curtailment rate of 15 % in Europe.

Yearly hydrogen supply-demand balance	PCI/PMI IL 2030	PCI/PMI IL 2040
H_2 produced via electrolysis	310	1,074
H_2 produced using natural gas	229	162
H_2 shipped imports	29	83
H_2 pipeline imports	0	316
Curtailed H_2 demand	52	294
H_2 demand for power production	2	77
Total H_2 demand	**620**	**1,929**

Table 23: Supply and demand balance in the PCI/PMI hydrogen infrastructure level in 2030 and 2040 for reference weather year (unit: TWh/y).

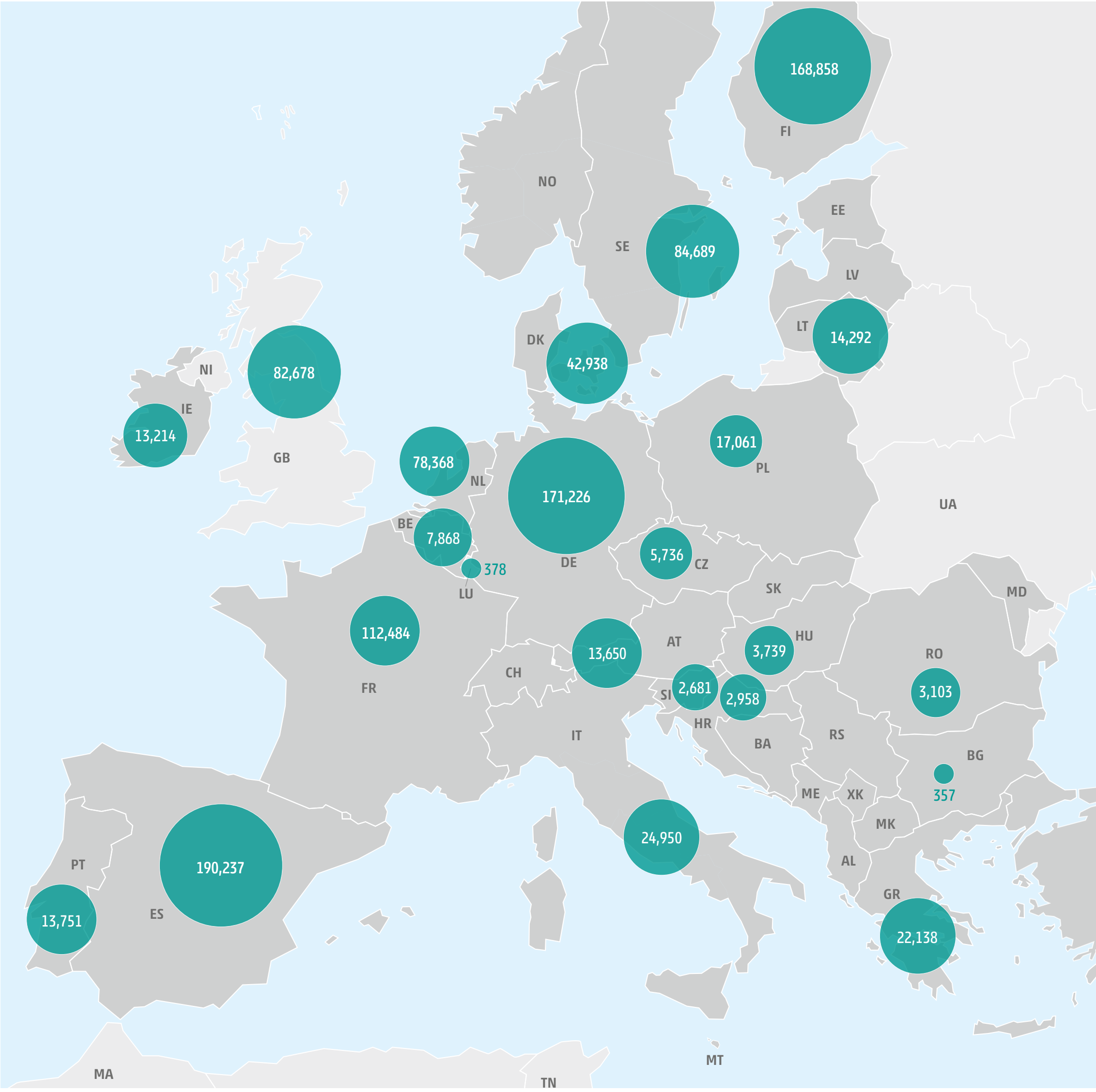

Figure 21: Distribution of electrolytic hydrogen production per country in the PCI/PMI hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

Figure 21 shows the hydrogen production via electrolysis in the different European countries for the PCI/PMI hydrogen infrastructure level in the 2040 assessment. European electrolytic production significantly increased compared to 2030 in most European countries. The countries with the highest electrolytic hydrogen production are: Spain, Germany, Finland, France and Sweden. Some countries have more than one source of electrolytic hydrogen production. This is related to the intra-country assumptions that are detailed in the description of the reference weather year in section 3.1.1.

Figure 22 shows the distribution of hydrogen production from natural gas in 2040. There is a reduction in hydrogen production from natural gas compared to 2030 as presented in Table 23. This reduction is explained by i) the 50 % reduction in the installed capacities for hydrogen production from natural gas as defined in the TYNDP 2024 NT+ scenario, ii) the higher electrolytic production as well as iii) the availability of new hydrogen supplies through imports from North Africa, Norway, Ukraine, and via terminals.

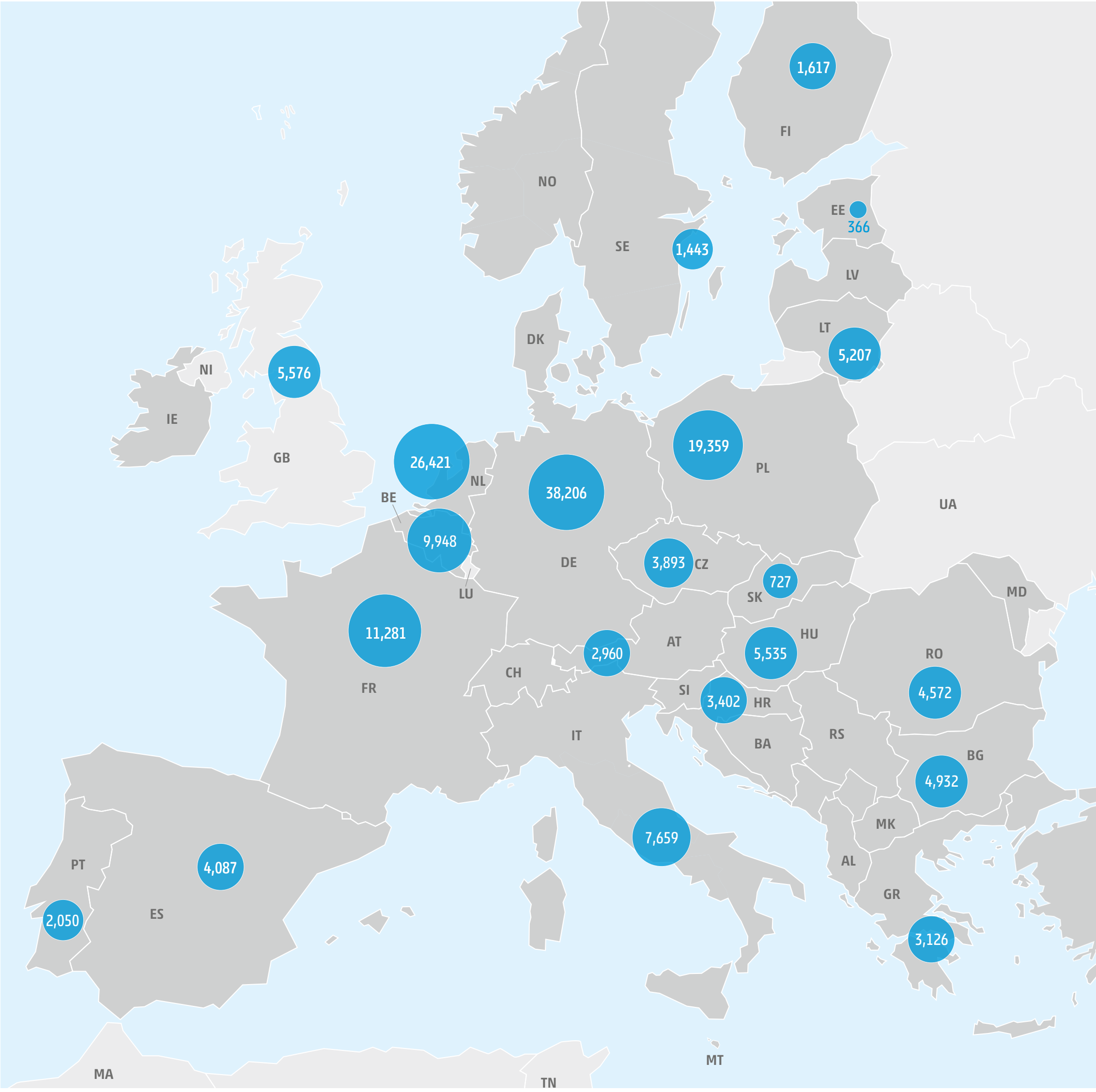

Figure 22: Distribution of hydrogen production from natural gas in the PCI/PMI hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	13,650	2,960	0	45,203
BE	7,868	9,948	35,748	85,036
BG	357	4,932	0	12,712
CZ	5,736	3,893	0	2,614
CY	0	0	0	46,404
DE	171,226	38,206	130,262	549,465
DK	42,938	0	0	31,337
EE	0	366	0	3,128
ES	190,237	4,087	17,505	156,348
FI	168,858	1,617	0	85,318
FR	112,484	11,281	7,429	166,472
GR	22,138	3,126	0	38,538
HR	2,958	3,402	0	8,168
HU	3,739	5,535	0	26,496
IE	13,214	0	0	14,439
IT	24,950	7,659	144,115	127,210
LT	14,292	5,207	0	22,242
LU	378	0	0	9,772
LV	0	0	0	4,042
MT	0	0	0	1,475
NL	78,368	26,421	30,469	128,848
PL	17,061	19,359	0	133,930
PT	13,751	2,050	0	19,628
RO	3,103	4,572	0	37,722
SE	84,689	1,443	0	71,263
SI	2,681	0	0	5,822
SK	0	727	34,591	9,549
UK	82,678	5,576	0	91,428

Table 24: Distribution of hydrogen production, imported hydrogen and demand per country in the PCI/PMI hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

Considering the supply and demand distribution presented in Table 24, the intra-EU transport corridors that already emerged in 2030, connecting the electrolytic hydrogen supply produced in the Iberian Peninsula and in the Nordic countries with the main European hydrogen hub in Germany, are even more needed in the 2040 PCI/PMI assessment due to the increase of hydrogen demand between 2030 and 2040. The Iberian corridor is thereby supported by imports from Morocco.

In addition, as presented in Figure 23, other intra-EU transport corridors emerge, mainly driven by the availability of extra-EU supplies in the 2040 assessment. Namely, the new corridors identified for 2040 are:

- North African corridor, transporting Algerian supplies to Italy, Austria, Germany and other countries.
- Norwegian corridor, transporting Norwegian supplies to Germany.
- Ukrainian corridor, transporting Ukrainian supplies to Slovakia and Czechia and other countries.

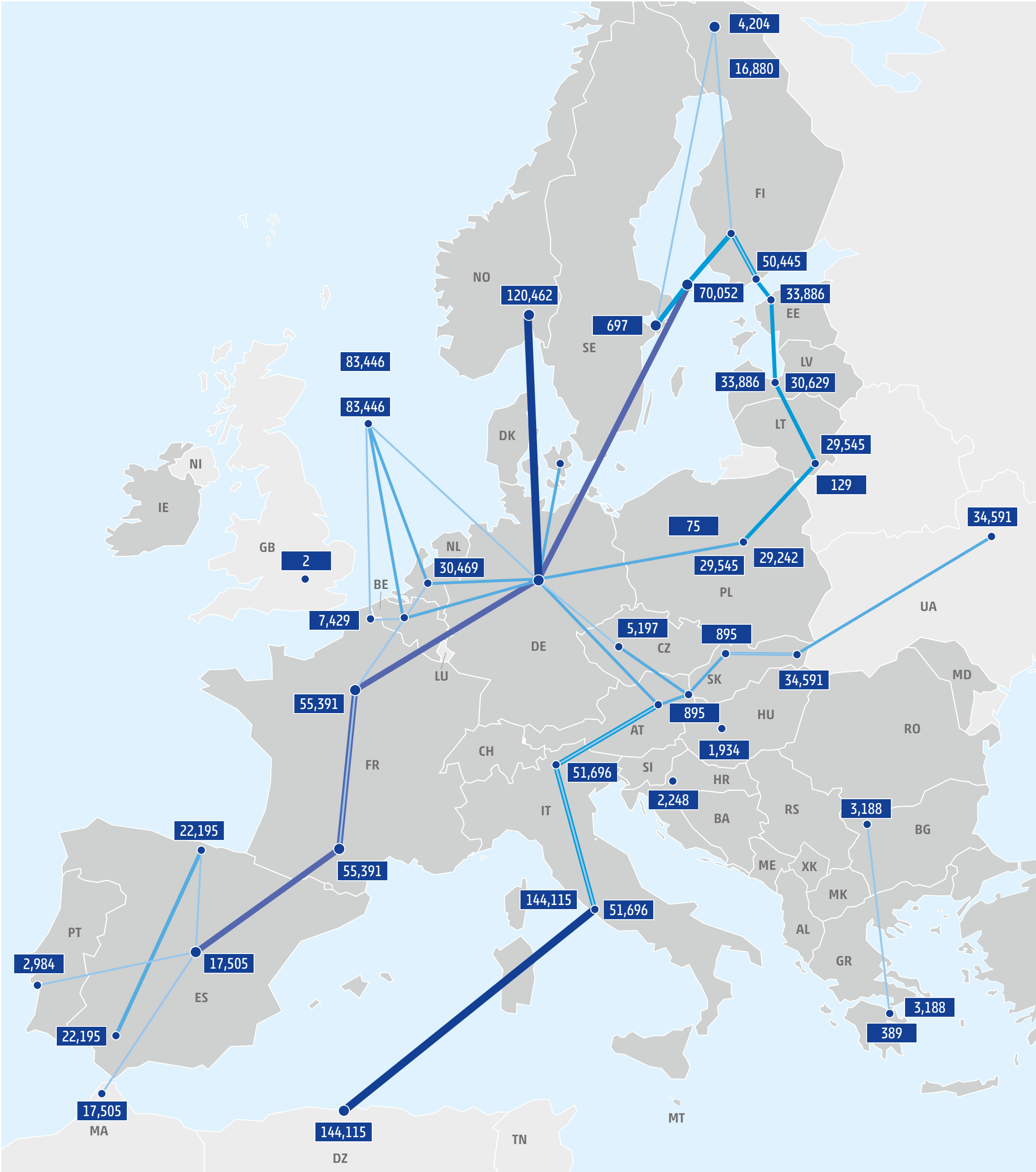

Figure 23: Grid flows* in the PCI/PMI hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

* Grid flows refer to simulations results and do not intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III).

In the 2040 PCI/PMI hydrogen infrastructure level assessment for the reference weather year, countries can be grouped in four different categories according to their supply-demand balance on a yearly basis:

1. **Countries which export more than they import:** Sweden, Finland, Denmark, Spain and Greece.
2. **Countries that import more than they export:** Poland, Bulgaria and Portugal.
3. **Transit countries that import more than they consume:** Italy, Germany, Slovakia, Austria, Estonia, Latvia, Lithuania, France and Netherlands.
4. **Isolated countries:** the United Kingdom, Ireland, Luxembourg, Hungary, Romania, Slovenia, Croatia, Malta, Cyprus, Switzerland[10] and the cluster Bulgaria-Greece.

10 IGI report does not consider hydrogen demand in Switzerland (based on TYNDP 2024 Draft Scenario report). However, there is no hydrogen infrastructure connecting Switzerland to any of its European neighbouring countries in the assessed infrastructure levels.

While on a yearly basis some countries are net exporters and some countries are net importers, net exporters may be relying on net imports during certain shorter periods of time and net importers may be providing net exports during certain shorter periods of time. This can result in bidirectional flows at interconnections. This situation is caused by the seasonality of electrolytic hydrogen production and to some extent by the seasonality of hydrogen demand.

High-level results for stressful weather year

The overall yearly supply-demand balance for the PCI/PMI hydrogen infrastructure level in 2040 for the stressful weather year is presented in Table 25. As detailed in Table 25, electrolytic hydrogen production is the main source of hydrogen in Europe but it is reduced in comparison with the reference weather year. To compensate the reduction of electrolytic hydrogen production, hydrogen import sources, both via ship and pipeline, increase in comparison with the reference weather year. The imports via terminals increase by 15 %. The consideration of a stressful weather year leads to an approximate rate of 18 % of hydrogen demand curtailment at European level. This represents an increase by 3 % in comparison with the reference weather year.

Yearly hydrogen supply-demand balance	PCI/PMI IL 2030	PCI/PMI IL 2040
H_2 produced via electrolysis	270	1,000
H_2 produced using natural gas	245	165
H_2 shipped imports	36	96
H_2 pipeline imports	0	320
Curtailed H_2 demand	69	352
H_2 demand for power production	2	75
Total H_2 demand	**619**	**1,933**

Table 25: Supply and demand balance in the PCI/PMI hydrogen infrastructure level in 2030 and 2040 for stressful weather year (unit: TWh/y).


Picture courtesy of FLUXSWISS

Figure 24 shows the distribution of hydrogen production via electrolysis in the different European countries for the PCI/PMI hydrogen infrastructure level in the 2040 assessment under stressful weather conditions. Despite the overall reduction of electrolytic hydrogen production, under stressful weather conditions the countries with the highest electrolytic hydrogen production follow the same distribution as in the PCI/PMI 2040 assessment for the reference weather year (see Figure 21). Some countries have more than one source of electrolytic hydrogen production. This is related to the intra-country assumptions that are detailed in the description of the reference weather year in section 3.1.1.

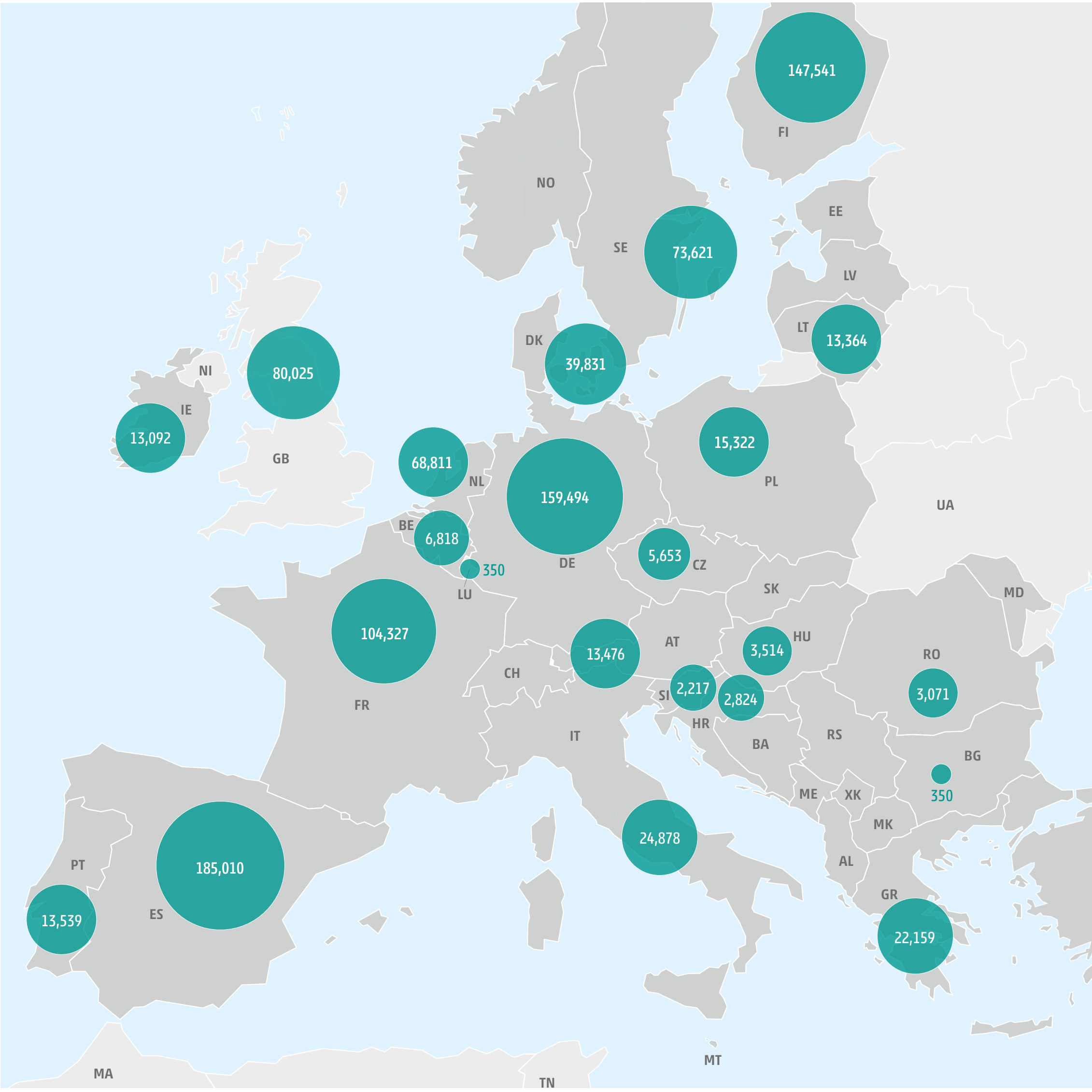

Figure 24: Distribution of hydrogen production via electrolysis in the PCI/PMI hydrogen infrastructure level in 2040 for stressful weather year (unit: GWh/y).

The distribution of hydrogen production produced from natural gas in the different European countries for the PCI/PMI hydrogen infrastructure level in the 2040 assessment under stressful weather conditions is presented in Figure 25. No significant change was observed in comparison to the reference weather year presented in Figure 22.

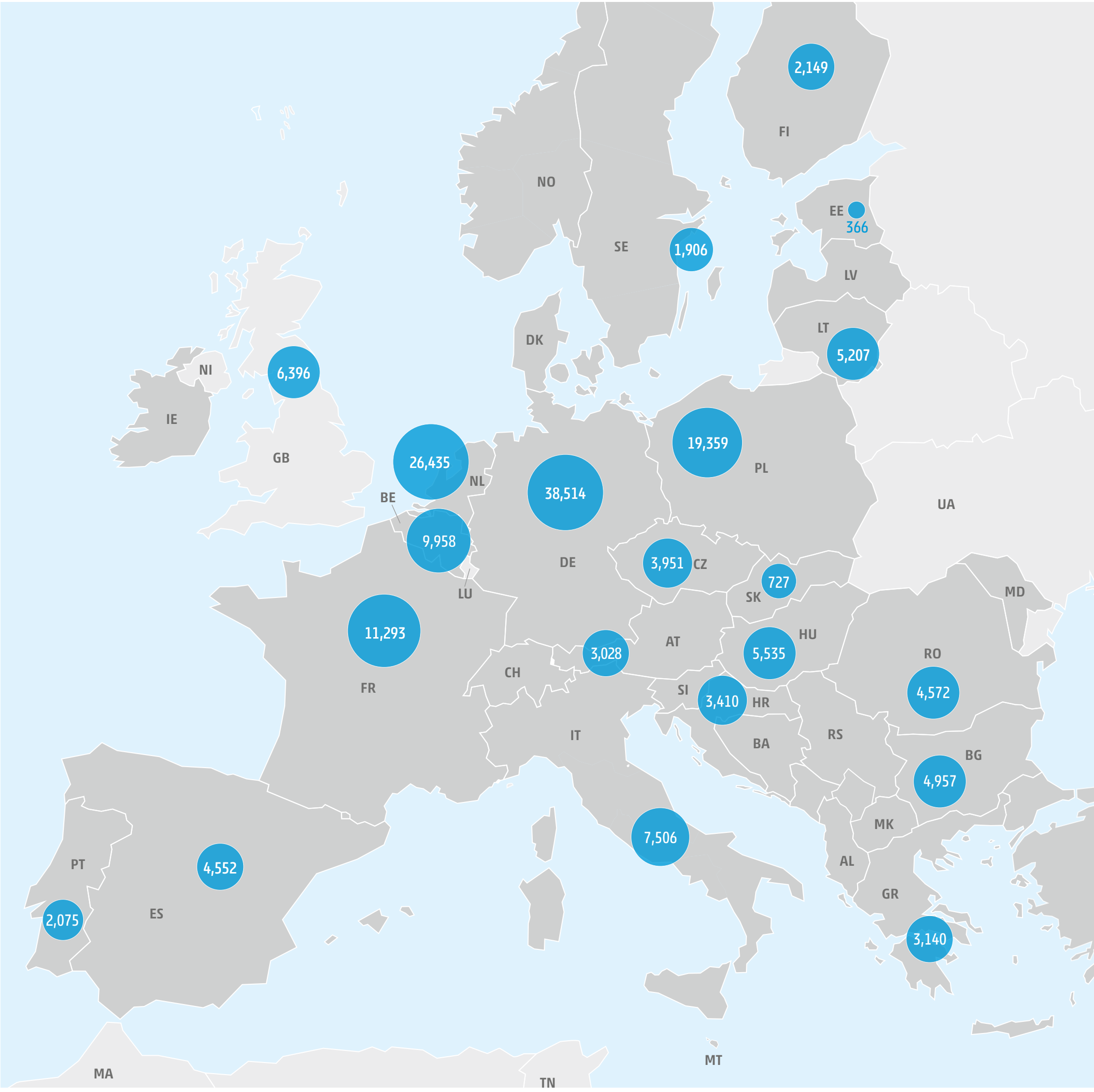

Figure 25: Distribution of hydrogen production from natural gas in the PCI/PMI hydrogen infrastructure level in 2040 for stressful weather year (unit: GWh/y).

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	13,476	3,028	0	45,867
BE	6,818	9,958	40,783	85,423
BG	350	4,957	0	12,712
CZ	5,653	3,951	0	2,614
CY	0	0	0	46,404
DE	159,494	38,514	131,595	548,503
DK	39,831	0	0	31,337
EE	0	366	0	3,128
ES	185,010	4,552	18,433	156,348
FI	147,541	2,149	0	85,318
FR	104,327	11,293	8,815	166,517
GR	22,159	3,140	0	38,538
HR	2,824	3,410	0	8,168
HU	3,514	5,535	0	26,496
IE	13,092	0	0	14,439
IT	24,878	7,506	144,927	127,210
LT	13,364	5,207	0	22,242
LU	350	0	0	9,772
LV	0	0	0	4,042
MT	0	0	0	1,475
NL	68,811	26,435	35,523	126,090
PL	15,322	19,359	0	134,041
PT	13,539	2,075	0	19,628
RO	3,071	4,572	0	37,722
SE	73,621	1,906	0	71,263
SI	2,217	0	0	5,822
SK	0	727	35,843	9,549
UK	80,025	6,396	0	91,428

Table 26: Distribution of hydrogen production, imported hydrogen and demand per country in the PCI/PMI hydrogen infrastructure level in 2040 for stressful weather year (unit: GWh/y).

As presented in Figure 26 and Table 26 the flows through the two corridors connecting electrolytic supply with German and European demand reduced in the stressful weather year assessment, driven by the overall reduction of available RES. This affects the Iberian and the Nordic corridor. The flows through intra-EU transport corridors that are supplied by Norway, North Africa and Ukraine therefore increase if possible.

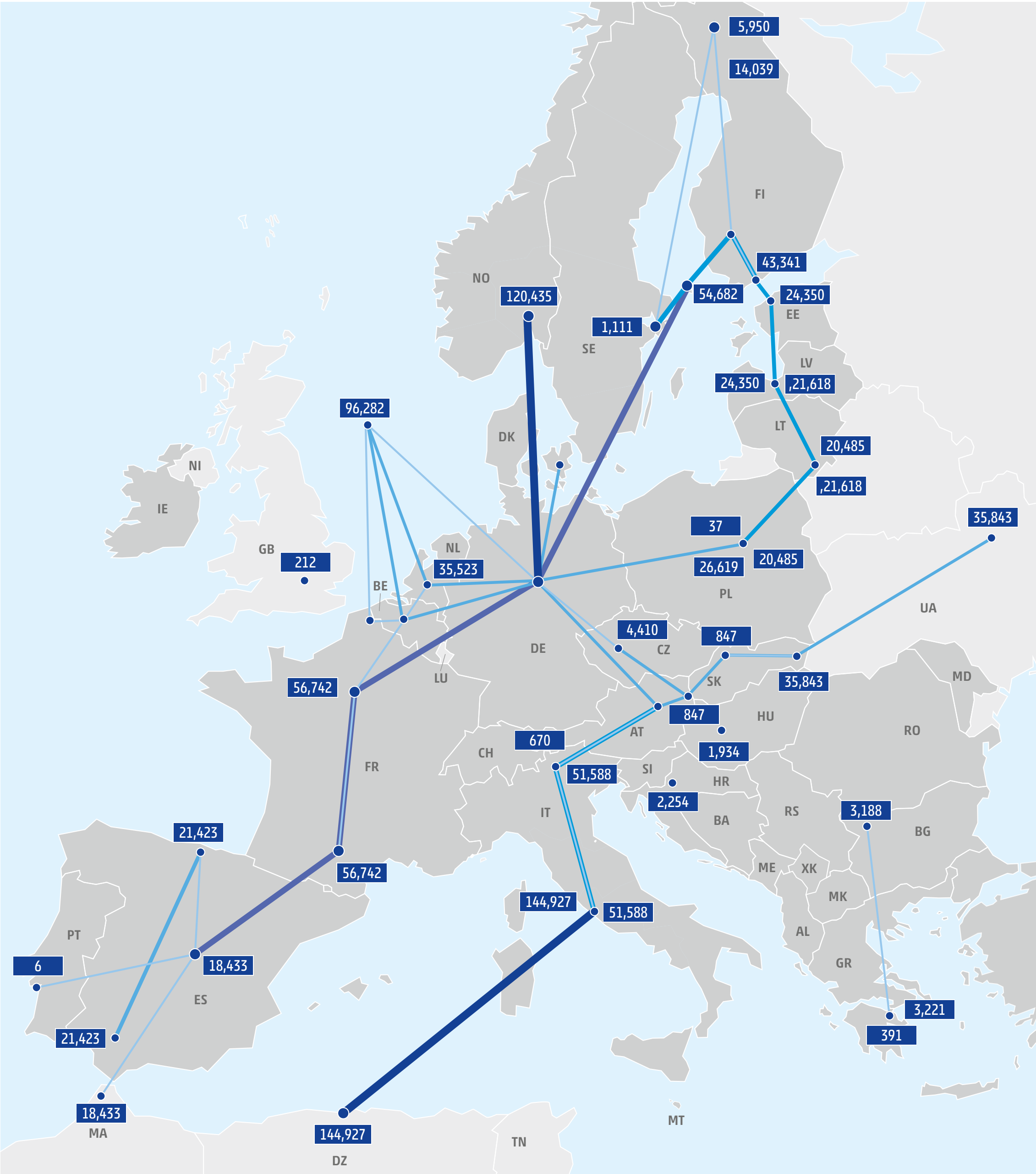

Figure 26: Grid flows* in the PCI/PMI hydrogen infrastructure level in 2040 for stressful weather year (unit: GWh/y).

* Grid flows refer to simulations results and do not intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III).

When comparing Figure 26 with Figure 23, most European countries show the same behaviour in terms of being a net exporter, a net importer or a transit country for the stressful as for the reference weather year. As expected under stressful climatic conditions, corridors based mainly on electrolytic production will see their exporting role slightly reduced due to the lower availability of RES (i.e., Iberian and Nordic corridors).

Consequently, also the transit through countries along these routes is reduced (e.g., transit through Baltic countries). On the contrary, both liquid imports and import corridors via pipeline, will maximize their flows to compensate the reduction on European electrolytic supplies.

4.1.1.1 IGI INDICATOR 1: HYDROGEN MARKET CLEARING PRICE SPREADS FOR REFERENCE WEATHER YEAR

Overview: Hydrogen market clearing prices per country

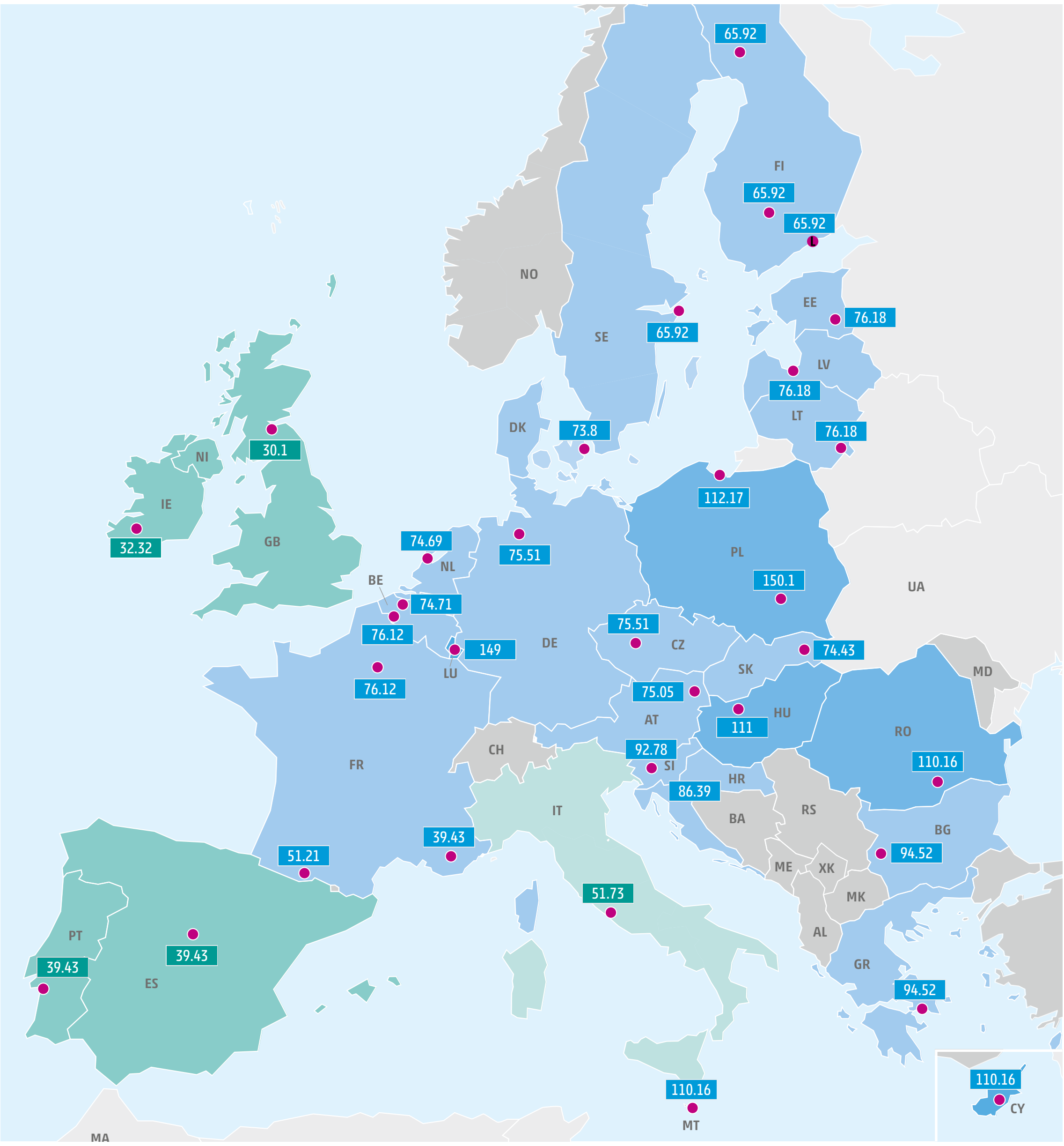

Figure 27: Average of the hourly hydrogen market clearing prices per country in the PCI/PMI hydrogen infrastructure level in 2040 (unit: €/MWh).

The increase of hydrogen demand considered in the 2040 assessment leads to a general increase of average hydrogen market clearing prices in Europe when compared to the 2030 assessment, as represented in Figure 27. This increase is connected to the higher rates of curtailed demand across Europe, and to a lesser extent to the use of more expensive hydrogen import sources to satisfy the hydrogen demand in the different European countries. In South-Eastern Europe, where most of the countries have limited connection to the European hydrogen network and rely on the local hydrogen production, the increase of hydrogen prices is more pronounced. This steep increase is explained by the increase of demand curtailment, as well as the use of more expensive hydrogen sources to satisfy hydrogen demand in order to avoid curtailment. As presented in Figure 27, this is particularly important as these countries are isolated in the PCI/PMI hydrogen infrastructure level. In addition, the cost of hydrogen production from natural gas increases significantly in the 2040 assessment due to the increase of the ETS price as stipulated in the TYNDP 2024 NT+ scenario.

Despite the increase of hydrogen market clearing prices in many countries in the 2040 assessment, there are other countries or areas where the average hydrogen market clearing price decreases compared to 2030:

- Due to higher availability of electrolytic hydrogen production: Spain, Portugal, France-South region, Finland, Sweden, the United Kingdom, Ireland.
- Due to new interconnections:
  - Italy, mainly driven by the availability of North African hydrogen supplies.
  - Slovakia, mainly driven by the connection to the European hydrogen network and the availability of Ukrainian hydrogen supplies.

The price formation in the DHEM is based on the merit order of hydrogen production (see section 1.2.1). Several price groups stand out, while a signification correlation is understood here as a correlation above 0.7:

1. **Portugal, Spain, France-South region:** Portugal and Spain are producers and net exporters of electrolytic hydrogen from RES to other countries. While the France-South region is sufficiently connected to the Iberian peninsula, price spreads appear with other groups of (regions of) countries due to an internal bottleneck in France. The prices in this group show no significant correlation with the prices in other groups.
2. **France-Southwest region:** The prices in this group show no significant correlation with the prices in other groups. The group exists due to bottlenecks within France.
3. **France-North region:** The prices in this group show significant correlations with prices in groups 4, 5, 6, 7, 11, 12. The group exists due to bottlenecks within France.
4. **France, Belgium-Mons region:** The prices in this group show significant correlations with prices in groups 3, 5, 7, 10, 11, 12. The group exists due to bottlenecks within France and Belgium.
5. **Belgium, the Netherlands:** The prices in this group show significant correlations with prices in groups 3, 4, 7, 10, 11, 12. The group exists due to bottlenecks with France and Germany.
6. **Denmark:** The prices in this group show significant correlations with prices in groups 3, 4, 5, 7, 10, 11, 12. The group exists due to a bottleneck from Denmark to Germany.
7. **Germany, Czechia, Austria:** Well interconnected countries. The prices in this group show significant correlations with prices in groups 3, 4, 5, 6, 10, 11, 12.
8. **Italy:** While being connected to Austria, the bottleneck between Italy and Austria is so dominant that Italy has no significant price correlation with any other (region of a) country.
9. **Poland-North region:** While being connected to Germany and Lithuania (via the Nordic-Baltic Hydrogen Corridor), the Poland-North region has no significant price correlation with any other (region of a) country due to the bottlenecks associated with both connections.
10. **Sweden, Finland:** The prices in this group show significant correlations with prices in groups 3, 4, 5, 6, 7, 11, 12. The group exists due to a bottleneck between Sweden/Finland and Germany and a bottleneck between Finland and Estonia.
11. **Estonia, Latvia, Lithuania:** The prices in this group show significant correlations with prices in groups 3, 4, 5, 6, 7, 10, 12. The group exists due to a bottleneck between Finland and Estonia as well as bottlenecks from Lithuania to Poland and within Poland.
12. **Slovakia:** The prices in this group show significant correlations with prices in groups 3, 4, 5, 6, 7, 10, 11. The group exists due to a bottleneck from Austria to Slovakia and a bottleneck from Slovakia to Czechia.
13. **Ireland, the United Kingdom:** Isolated countries without significant price correlations but with average prices below 100 €/MWh.
14. **Greece, Bulgaria:** Countries showing significant price correlation, jointly isolated from the other European countries.
15. **Romania, Hungary:** The group exists due to a bottleneck between Slovakia and Hungary (and no connection between Romania and Bulgaria).
16. **Croatia (only connected to Bosnia), Slovenia, Luxembourg, Cyprus, Malta, Poland-South region:** Isolated countries without significant price correlations (except for Croatia and Slovenia due to a similar national hydrogen production constellation) and with average prices above 100 €/MWh.

The price correlations listed above are enabled by the infrastructure projects already considered in this hydrogen infrastructure level. However, price differences that led to the identification of the groups listed above are not necessarily describing an infrastructure gap. For this identification of infrastructure gaps, the thresholds of IGI indicator 1 are used.

The IGI indicator 1 reveals in the 2040 assessment of the PCI/PMI hydrogen infrastructure level an increase of the price spreads at many European borders when compared to the 2030 assessment.

At the following borders, IGI indicator 1 identified additional significant price spreads in comparison with the 2030 assessment due to bottlenecks:

- Finland/Sweden and Germany: With the increase of electrolytic hydrogen production in Finland and Sweden, market clearing prices are reduced in these countries and the utilisation of the transport route to Germany increases. Thereby, the interconnection acts as a bottleneck.
- Finland and Estonia: With the increase of electrolytic hydrogen production in Finland, the utilisation of the interconnection between Finland and Estonia increases. Thereby, the interconnection acts as a bottleneck.
- Italy and Austria (and France and Germany): The availability of Algerian imports significantly increases the utilization of the Italy-Austria-Germany route. Thereby, the interconnection between Italy and Austria acts as a bottleneck. Besides, the hydrogen market clearing price spread between Italy on the one side and Germany or France on the other side is increasing over the threshold. No direct connection between Italy and Germany or France is available.
- Germany and Poland-North region: The net demand increase in the Poland-North region increases the utilisation of the interconnection between them. Thereby, the interconnection acts as a bottleneck.
- Lithuania and Poland-North region: The net demand increase in the Poland-North region increases the utilisation of the interconnection between them (via the Nordic-Baltic Hydrogen Corridor). Thereby, the interconnection acts as a bottleneck.

In the 2040 PCI/PMI assessment, there are some borders where the price spread has decreased compared to the 2030 assessment. At the following borders, the IGI indicator 1 therefore does not identify a significant price spread anymore:

- Slovakia, Austria, Czechia: The connection of Slovakia in the 2040 PCI/PMI hydrogen infrastructure level to Austria and Czechia allows the market clearing prices to converge in these countries.

Countries and regions that are isolated in 2040 in the PCI/PMI hydrogen infrastructure level, such as Hungary, Romania, cluster Greece-Bulgaria, Slovenia, Croatia, Luxembourg, Poland South, France South West, Ireland, the United Kingdom, Malta and Cyprus, remain showing significant price spreads with their neighbouring countries and regions, as identified by IGI indicator 1 in Table 27.

Border	Threshold 1: Absolute average hourly hydrogen market clearing price spread above 4 €/MWh	Threshold 2: More than 40 days with hydrogen market clearing price spread above 20 €/MWh
DEh_2–DKh_2	21	140
DEh_2–FIh_2	16	101
DEh_2–ITh_2	29	190
DEh_2–PLh_2N	50	274
DEh_2–PLh_2S	100	325
DEh_2–SEh_2	16	101
FIh_2–EEh_2	13	88
FRh_2–FRh_2S	46	283
FRh_2–FRh_2SW	31	197
FRh_2–ITh_2	30	197
FRh_2S–FRh_2SW	29	132
HUh_2–ATh_2	51	278
HUh_2–HRh_2	32	205
HUh_2–SKh_2E	51	277
ITh_2–ATh_2	29	188
ITh_2–HRh_2	50	282
LTh_2–PLh_2N	49	270
NLh_2–UKh_2	56	305
PLh_2N–PLh_2S	50	60
PLh_2S–CZh_2	100	325
PLh_2S–SKh_2E	101	325
ROh_2–BGh_2	22	127
SIh_2–HRh_2	11	42
SKh_2E–PLh_2S	101	325
UKh_2–BEh_2	56	305
UKh_2–IEh_2	25	133

Table 27: List of borders in the PCI/PMI hydrogen infrastructure level that exceed (at least one of) the thresholds defined for IGI indicator 1 in 2040.

4.1.1.2 IGI INDICATOR 2.1: HYDROGEN DEMAND CURTAILMENT FOR REFERENCE WEATHER YEAR

As explained in section 1.2.2, this IGI indicator assesses infrastructure gaps by quantifying hydrogen demand curtailments at individual nodes during the reference weather year, assuming no disruptions of infrastructures or of supply sources. It involves a multi-step simulation process integrating DHEM and DGM[11] outputs to evaluate the combined curtailments across nodes. The assessment is performed for the PCI/PMI hydrogen infrastructure level in 2040, showing the effects of matured infrastructure in 2040.

Figure 28 and Table 28 show yearly average curtailment rates of hydrogen demand in the Zone 2 nodes of different European countries. For countries where the hydrogen market is divided into several sub-zones (i.e., nodes), the curtailment rate in the different sub-zones is presented. The yearly average hydrogen curtailment rates are thereby colour-coded in the map to indicate levels relative to the set threshold: blue signifies curtailment above the threshold, while green represents rates that are not above it.

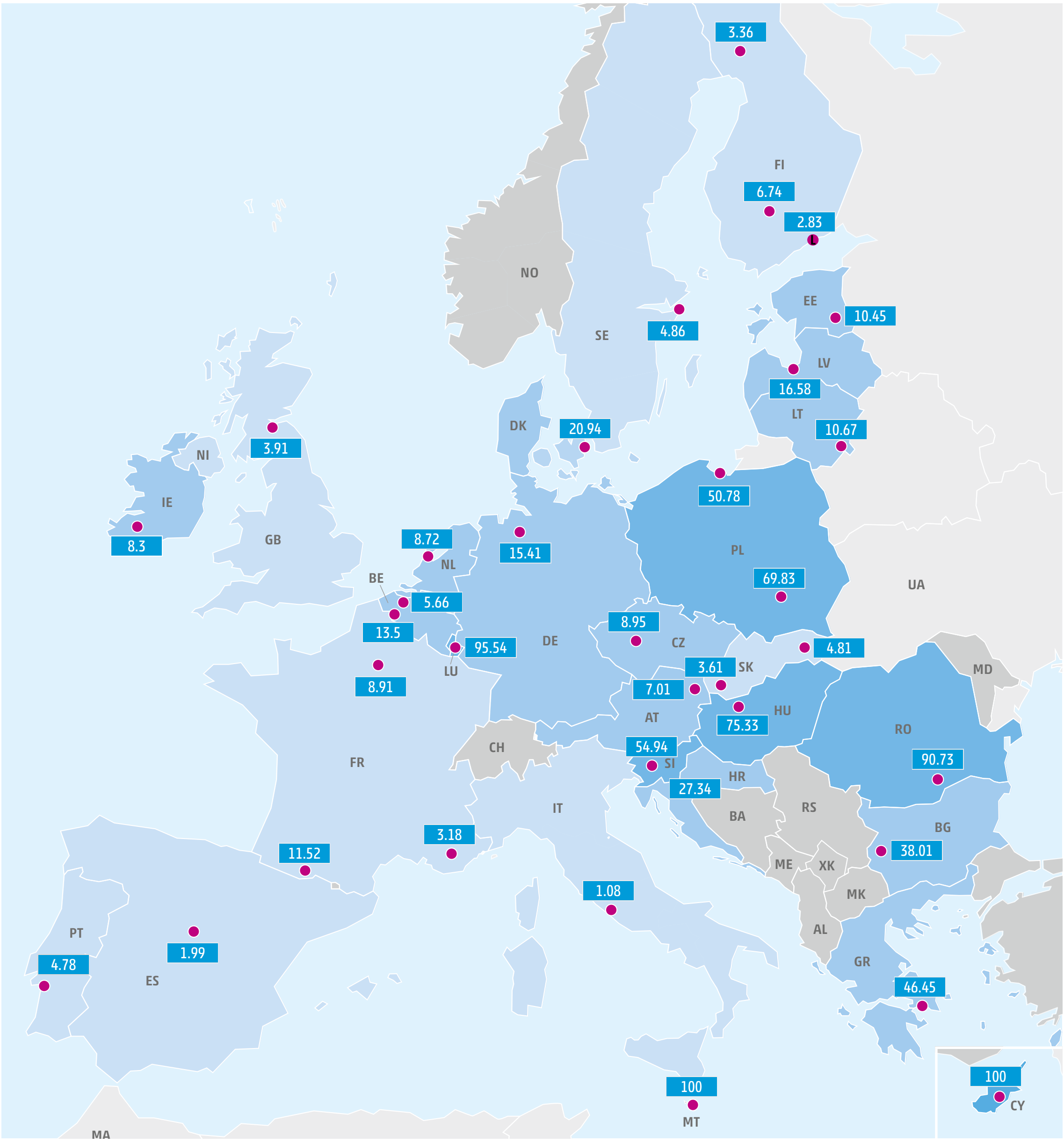

Figure 28: Yearly average hydrogen demand curtailment rate at country or node level in the PCI/PMI hydrogen infrastructure level in 2040 for reference year (unit: %).

11 This draft TYNDP 2024 IGI report only includes the simulation results of the DHEM.

Node	Demand curtailment rate (%)
ATh_2	7.01
BEh_2	5.66
BEH_2Mo	13.5
BGh_2	38.01
CYh_2	100
CZh_2	8.95
DEh_2	15.41
DKh_2	20.94
EEh_2	10.45
ESh_2	1.99
FIh_2	6.74
FIh_2N	3.36
FIh_2S	2.83
FRh_2	8.91
FRh_2S	3.18
FRh_2SW	11.52
GRh_2	46.45
HRh_2	27.34
HUh_2	75.33
IEh_2	8.3
ITh_2	1.08
LTh_2	10.67
LUh_2	95.54
LVh_2	16.58
MTh_2	100
NLh_2	8.72
PLh_2N	50.78
PLh_2S	69.83
PTh_2	4.78
ROh_2	90.73
SEh_2	4.86
SIh_2	54.94
SKh_2E	3.61
SKh_2W	4.81
UKh_2	3.91

Table 28: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the PCI/PMI hydrogen infrastructure level in 2040 for reference weather year (unit: %).

All European countries and regions overshoot the threshold of 0 % of IGI indicator 2.1 in the PCI/PMI hydrogen infrastructure level in 2040. However, differences in the hydrogen curtailment rates between nodes are related to the level of infrastructure development and supply availability. In comparison with IGI indicator 1, this IGI indicator focusses on the availability of supplies.

As detailed in Table 28, (regions of) countries can be aggregated in different groups according to their average yearly hydrogen demand curtailment rates:

1. **Rates below 5 %:** Portugal, Spain, Italy, the United Kingdom, Sweden, Finland-North region, Finland-South region, France-South region, Slovakia-West region, Slovakia-East region.
2. **Rates between 5 % and 20 %:** Finland, Austria, Belgium, Belgium-Mons region, Czechia, Germany, Estonia, France, France-Southwest region, Ireland, Lithuania, Latvia, the Netherlands.
3. **Rates between 20 % and 50 %:** Bulgaria, Denmark, Greece, Croatia.
4. **Rates between 50 % and 100 %:** Slovenia, Romania, Poland-North region, Poland-South region, Hungary, Luxembourg.
5. **Full curtailment of 100 %:** Cyprus, Malta.

Without the infrastructure already considered in the hydrogen infrastructure level, the overall hydrogen demand curtailment would be higher.

Even though the threshold has been surpassed, countries and regions of group 1 exhibit hydrogen demand curtailment rates below 5 % average yearly curtailment rate, meaning that for a large share of the year their demand is fully covered. Portugal, Slovakia and the United Kingdom show decreased curtailment rates compared to the PCI/PMI hydrogen infrastructure level assessment for 2030. This is particularly evident for Slovakia due to its connection to the European backbone and to Ukrainian hydrogen supplies in 2040. For the other countries and regions in this group, hydrogen curtailment rates increase with the general trend of increased hydrogen curtailment rates in 2040. The primary driver behind this increase is the rising demand for hydrogen within these individual countries, which surpasses the current capacity of available infrastructure. Despite advancements in PCI/PMI hydrogen infrastructure level, the rapid growth in hydrogen consumption highlights the need for further investment and development to meet the increasing demand. This trend underlines the evolving challenges of balancing infrastructure enhancements with accelerating demand.

Group 2 of countries and regions also contains those that show decreased hydrogen curtailment rates, i.e., Austria, the Belgium-Mons region, Czechia, the France-Southwest region, Ireland, Lithuania, and Latvia. Additionally, countries such as Lithuania and France not only benefit from improved import infrastructure but also experience increased their electrolytic production in 2040, which further mitigates curtailment rates. These developments highlight the effectiveness of infrastructure expansion and technological advancements in reducing hydrogen demand curtailment. At the same time, there is slight increases of hydrogen curtailment rates in Germany, Finland and France caused by increases of hydrogen demand in 2040.

Group 3, comprising Bulgaria, Denmark, Greece and Croatia, shows demand curtailments greater than 20 % but below 50 %. Within this category, curtailment rates are observed to rise from 2030 to 2040, driven by the increase of hydrogen demand in these countries and limited cross-border interconnections. The growing demand outpaces infrastructure improvements, leaving national markets unable to fully satisfy their hydrogen demand.

Group 4, experiencing hydrogen demand curtailment rates exceeding 50 % but remaining below 100 %, includes Slovenia and Romania, which have managed to reduce their hydrogen curtailment rates compared to 2030 while remaining isolated. Slovenia achieves a notable reduction from 76.6 % to 54.9 %, whereas Romania shows only a marginal reduction of 0.2 %. Conversely, the Poland-North region, the Poland-South region and Hungary experience increases in hydrogen demand curtailment rates, as significant growth in national demand outstrips the available capacity of the PCI/PMI hydrogen infrastructure as well as hydrogen production options in 2040. Luxembourg remains as isolated in 2040 as in 2030 in the PCI/PMI hydrogen infrastructure level.

Finally, Malta and Cyprus, due to their geographically isolated locations, continue to experience a demand curtailment of 100 % at the PCI/PMI hydrogen infrastructure level in 2040. The absence of connections with broader European hydrogen infrastructure underscores the challenges faced by island nations in integrating into the continental hydrogen network.

In the Poland-North Region, France and Czechia, on top of the curtailments observed in Zone 2 nodes as described in the paragraphs above, hydrogen demand curtailments can be observed in Zone 1 that increase during the winter months.


Picture courtesy of TAP

4.1.1.3 IGI INDICATOR 2.2: HYDROGEN DEMAND CURTAILMENT FOR STRESSFUL WEATHER YEAR

Threshold 1: A yearly average hydrogen demand curtailment rate of more than 3 %

Figure 29 and Table 29 show the yearly average hydrogen demand curtailment rates in the Zone 2 nodes of various European countries for 2040, simulated under a stressful weather year. This weather scenario assumes adverse conditions, such as reduced wind and solar energy availability, which directly impacts hydrogen production. For countries with hydrogen markets divided into multiple sub-zones (i.e., nodes), curtailment rates are depicted individually for each sub-zone on the map. The yearly average hydrogen curtailment rates are thereby colour-coded to indicate levels relative to the set threshold 1: blue signifies curtailment above the threshold, while green represents rates that are not.

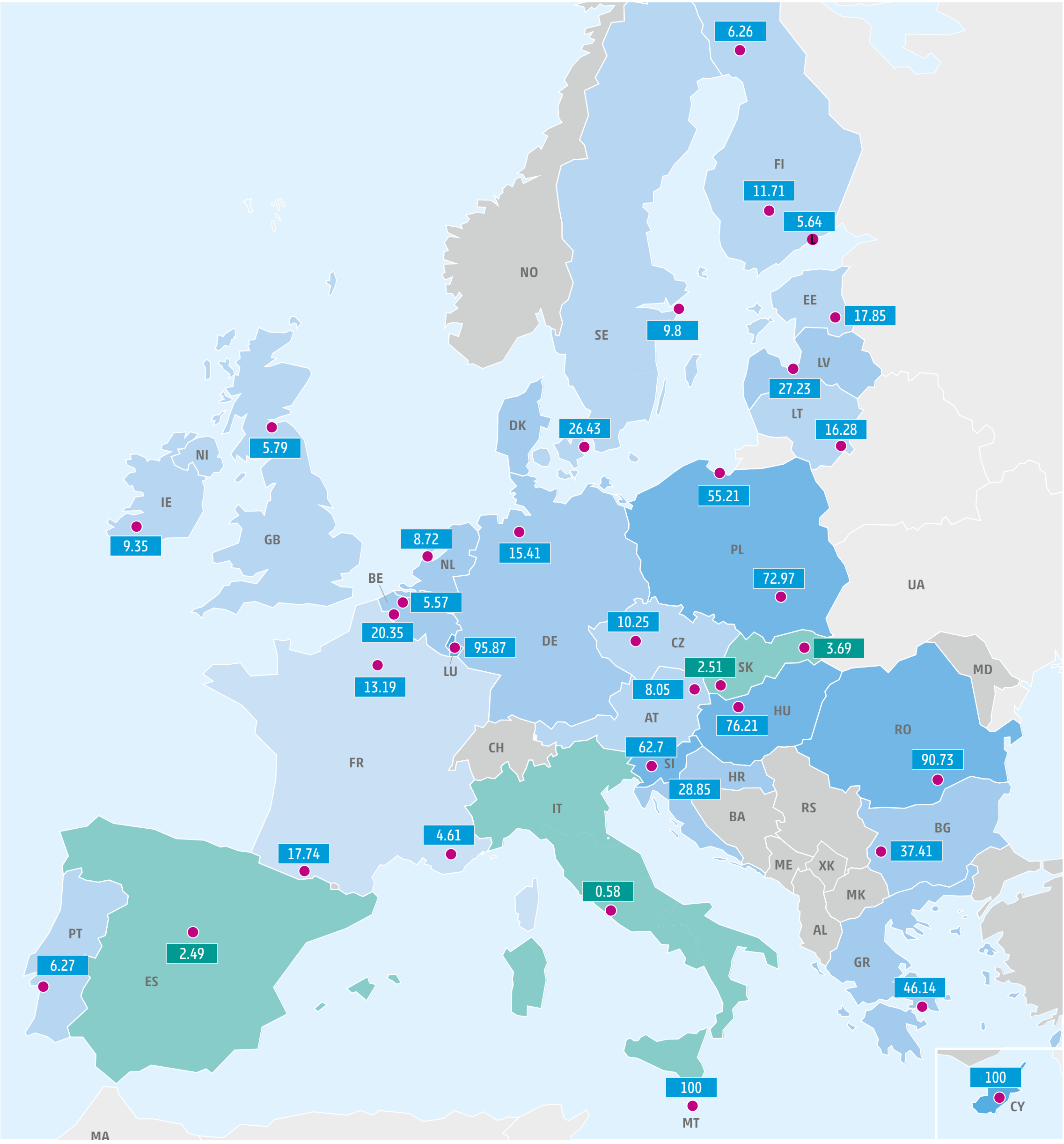

Figure 29: Yearly average hydrogen demand curtailment rate at country or node level in the PCI/PMI hydrogen infrastructure level in 2040 for stressful weather year (unit: %).

Node	Demand curtailment rate (%)
ATh_2	8.05
BEh_2	5.57
BEH_2Mo	20.35
BGh_2	37.41
CYh_2	100.00
CZh_2	10.25
DEh_2	20.98
DKh_2	26.43
EEh_2	17.85
ESh_2	2.49
FIh_2	11.71
FIh_2N	6.26
FIh_2S	5.64
FRh_2	13.19
FRh_2S	4.61
FRh_2SW	17.74
GRh_2	46.14
HRh_2	28.85

Node	Demand curtailment rate (%)
HUh_2	76.21
IEh_2	9.35
ITh_2	0.58
LTh_2	16.28
LUh_2	95.87
LVh_2	27.23
MTh_2	100.00
NLh_2	10.85
PLh_2N	55.21
PLh_2S	72.97
PTh_2	6.27
ROh_2	90.73
SEh_2	9.80
SIh_2	62.70
SKh_2E	2.51
SKh_2W	3.69
UKh_2	5.79

Table 29: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the PCI/PMI hydrogen infrastructure level in 2040 for stressful weather year (unit: %).

Countries are grouped into five categories based on their average yearly hydrogen demand curtailment rates:

1. **Rates below 3 %:** Italy, Spain, Slovakia-East region.

2. **Rates between 3 % and 20 %:** Belgium, Slovakia-West region, Portugal, Sweden, Ireland, Finland, Estonia, the Netherlands, Austria, Czechia, Lithuania, France, France-North region, France-South region, France-Southwest region, Latvia.

3. **Rates above 20 % and below 50 %:** Belgium-Mons region, Greece, Denmark, Croatia, sGermany, Bulgaria.

4. **Rates above 50 % and below 100 %:** Slovenia, Romania, Luxembourg, Poland-North region, Poland-South region, Hungary.

5. **Full curtailment of 100 %:** Cyprus, Malta.

Countries and regions with hydrogen curtailment rates below 3 % in 2040 include Italy, Spain, Slovakia East Region. These countries and regions demonstrate remarkable resilience even under stressful weather conditions. For instance, Spain achieves a low curtailment rate of 2.5 %, owing to its robust hydrogen production and storage system. The Slovakia-East region, at 2.5 %, benefits from enhanced import capabilities from Ukraine that effectively mitigates supply disruptions during adverse weather.

Group 2 includes the Belgium, Slovakia-West region, Portugal, Sweden, Ireland, Finland, Estonia, the Netherlands, Austria, Czechia, Lithuania, France, France-North region, France-South region, France-Southwest region, Latvia. Their curtailment rates exceed the 3 % threshold but remain below 20 %. Slovakia-West, for example, reports a curtailment rate of 3.7 %, reflecting its reliance on imports to bridge domestic production gaps. Similarly, Finland's regions show slight variations, driven by reduced wind and hydropower outputs during the stressful weather year.

Belgium-Mons region, Greece, Denmark, Croatia, Germany, Bulgaria are part of group 3, exhibiting more significant curtailment challenges. Greece, with a curtailment rate of 46.1 %, struggles due to its limited domestic production and dependency on solar energy, which is significantly affected by the stressful weather year. The Belgium-Mons region, at 20.4 %, reflects the localised nature of its hydrogen supply challenges, as this region operates as a distinct hydrogen cluster. Germany, with a hydrogen demand curtailment rate of 21.4 %, faces increasing hydrogen demand in its industrial and transportation sectors, exacerbated by reduced renewable output in a stressful weather year.

Countries in group 4 experience severe curtailment challenges under adverse weather conditions. Slovenia's hydrogen demand curtailment rate improves slightly from 76.6 % in 2030 to 62.7 % in 2040 but remains high due to inadequate infrastructure and limited renewable energy supply. Poland shows a clear regional disparity, with the Southern region exhibiting a higher curtailment rate (73 %) compared to the Northern region (55.2 %). Hungary, at 76.2 %, faces significant constraints driven by its growing hydrogen demand and insufficient cross-border capacity to meet needs during stressful weather periods. Luxembourg's hydrogen demand curtailment rate of 95.9 % underscores its continued need for connection and lack of domestic production, which are further impacted during adverse weather.

Malta and Cyprus experience full curtailment of 100 % in 2040, as these countries remain entirely isolated and have no hydrogen production assets.

Threshold 2: hydrogen demand curtailment rate of more than 5 % for at least one month per year

All the countries and regions that exceed threshold 1 also exceeded threshold 2.

4.1.2 ADVANCED HYDROGEN INFRASTRUCTURE LEVEL

High-level results for reference weather year

The overall yearly supply-demand balance for the advanced hydrogen infrastructure level in 2040 is presented in Table 30. As detailed in Table 30, overall hydrogen demand more than triples compared to the 2030 hydrogen demand level, leading to a yearly hydrogen demand of 1936 TWh/y in Europe.

Whereas the overall foreseen hydrogen demand does not vary between the analysed infrastructure levels, there are significant differences between them in terms of i) hydrogen demand curtailment and ii) availability of the different supplies.

The advanced infrastructure level shows a lower overall hydrogen demand curtailment rate in Europe. The reduction in the demand curtailment in this infrastructure level is related to the higher availability of hydrogen shipped imports and the maximization of the use of pipeline imports, more specifically Norwegian, North African and Ukrainian imports. The maximization of imports is possible thanks to the consideration of non-PCI/PMI advanced infrastructure that enables transport to countries that were isolated in the PCI/PMI infrastructure level, through the SK/HU/RO hydrogen corridor, as well as, the maximization of national production (both from electrolytic and natural-gas based) through a higher utilization of PCI/PMI infrastructure.

Despite i) the infrastructure development foreseen in the Advanced hydrogen infrastructure level for 2040 (see section 1.1.2), ii) the increase of extra-EU supply potentials via terminals and pipelines, and iii) the significant increase of electrolytic hydrogen production (by approximately 250 % compared to 2030), this is not sufficient to satisfy the hydrogen demand in many European countries and therefore, overall hydrogen demand curtailment rises compared to the 2030 values leading to an average hydrogen curtailment of 12 % in Europe. This is lower than the 15 % average hydrogen demand curtailment in Europe in the PCI/PMI hydrogen infrastructure level. This reduction is related to the higher availability of hydrogen terminals and the maximization of the use of pipeline imports from Norway, North Africa and Ukraine. The maximization of imports is possible thanks to the consideration of non-PCI/PMI advanced infrastructure that enables transport to countries that were isolated in the PCI/PMI hydrogen infrastructure level. This relates to the transit route through Slovakia, Hungary and Romania as well as the maximisation of national hydrogen production enabled by increased capacities.

Yearly hydrogen supply-demand balance	Advanced IL 2030	Advanced IL 2040
H_2 produced via electrolysis	304	1,080
H_2 produced using natural gas	224	168
H_2 shipped imports	24	110
H_2 pipeline imports	42	335
Curtailed H_2 demand	27	237
H_2 demand for power production	2	77
Total H_2 demand	**620**	**1,929**

Table 30: Supply and demand balance in the Advanced hydrogen infrastructure level in 2030 and 2040 for reference weather year (unit: TWh/y).

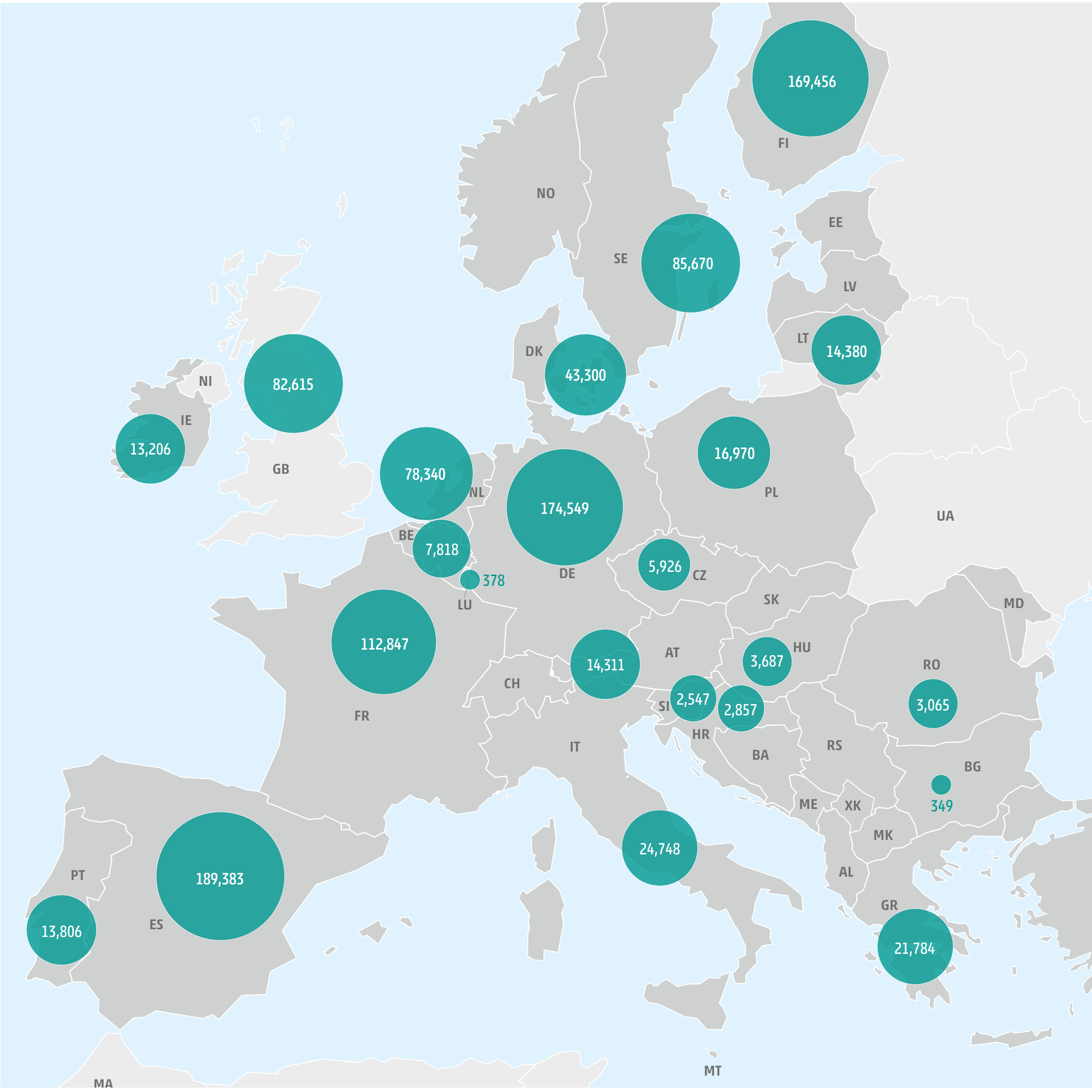

Figure 30: Distribution of electrolytic hydrogen production in the Advanced hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

Figure 30 shows the electrolytic hydrogen production in the different European countries for the Advanced hydrogen infrastructure level in the 2040 assessment. The European electrolytic production significantly increased compared to 2030 in most European countries. The electrolytic production slightly varies country to country in comparison to the PCI/PMI hydrogen infrastructure level, being slightly higher for the Advanced hydrogen infrastructure level in 2040. However, the overall distribution across Europe is rather similar.

Figure 31 shows the distribution of hydrogen production from natural gas in 2040. There is a reduction in hydrogen production from natural gas compared to 2030. The reasons for this are explained in section 4.1.1.

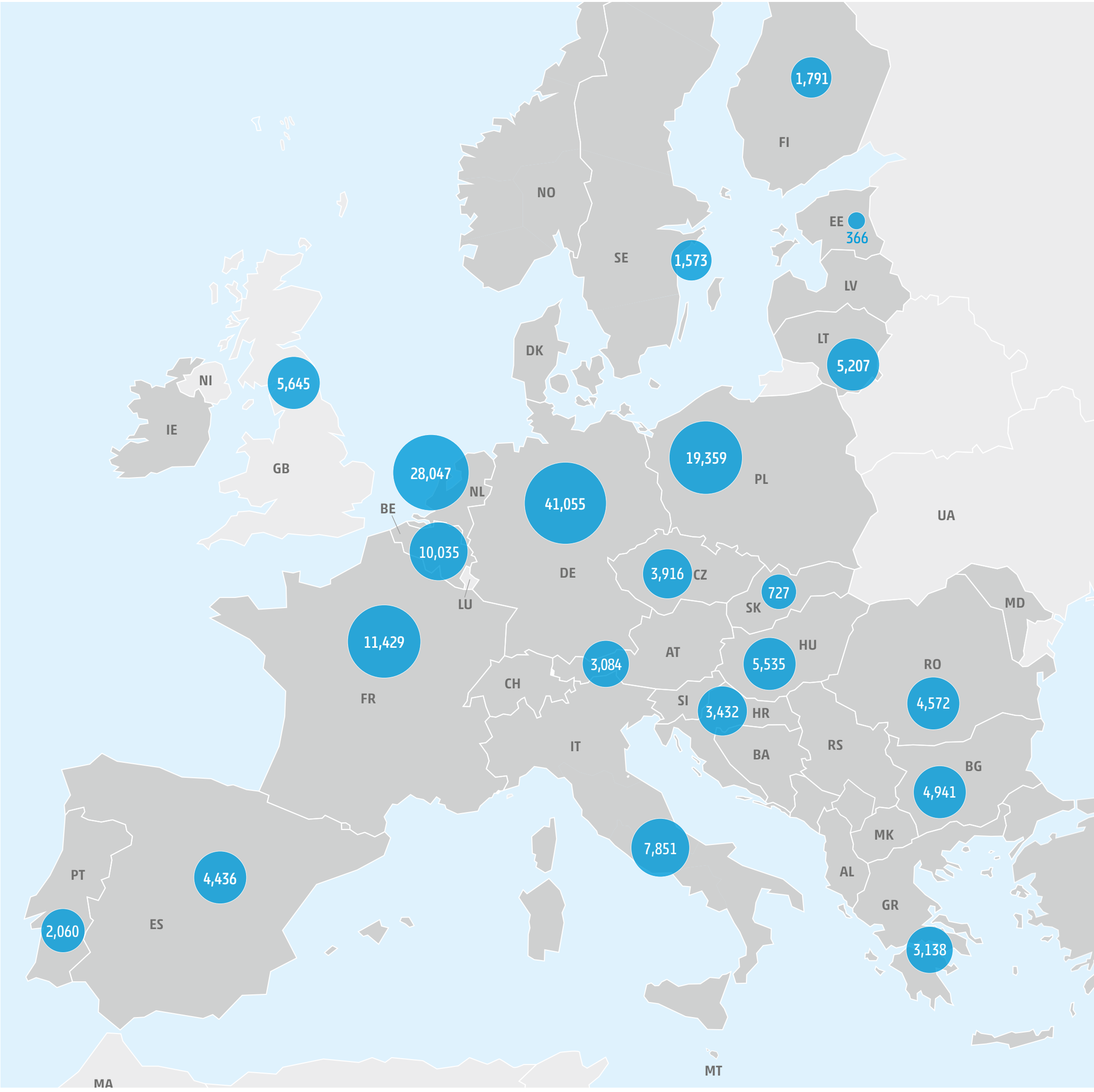

Figure 31: Distribution of hydrogen production from natural gas in the Advanced hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	14,311	3,084	0	44,764
BE	7,818	10,035	40,326	85,007
BG	349	4,941	0	12,712
CZ	5,926	3,916	0	2,614
CY	0	0	0	46,404
DE	174,549	41,055	145,961	549,452
DK	43,300	0	0	31,337
EE	0	366	0	3,128
ES	189,383	4,436	17,607	156,348
FI	169,456	1,791	0	85,318
FR	112,847	11,429	8,027	166,556
GR	21,784	3,138	0	38,538
HR	2,857	3,432	0	8,168
HU	3,687	5,535	0	26,496
IE	13,206	0	0	14,439
IT	24,748	7,851	148,174	127,210
LT	14,380	5,207	0	22,242
LU	378	0	0	9,772
LV	0	0	0	4,042
MT	0	0	0	1,475
NL	78,340	28,047	41,541	128,923
PL	16,970	19,359	6,439	133,926
PT	13,806	2,060	0	19,628
RO	3,065	4,572	0	37,722
SE	85,670	1,573	0	71,263
SI	2,547	0	0	5,822
SK	0	727	38,184	9,549
UK	82,615	5,645	0	91,428

Table 31: Distribution of hydrogen production, imported hydrogen and demand per country in the advanced hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

Considering the supply and demand distribution presented in Table 31, the intra-EU transport corridors that already emerged in the 2030 assessment of the Advanced hydrogen infrastructure level as well as new supply corridors are even more needed in the 2040 assessment due to the increase of hydrogen demand between 2030 and 2040. These corridors are the Iberian and the Baltic corridors as well as the North African corridor with the main European hydrogen hub in Germany.

In addition, as presented in Figure 32, other intra-EU transport corridors emerge, mainly driven by the availability of extra-EU supplies in the 2040 assessment. Namely, the new corridors identified for 2040 are:

- Norwegian corridor, transporting Norwegian supplies to Germany.
- Ukrainian corridor, transporting Ukrainian supplies to Slovakia and Czechia and other countries.

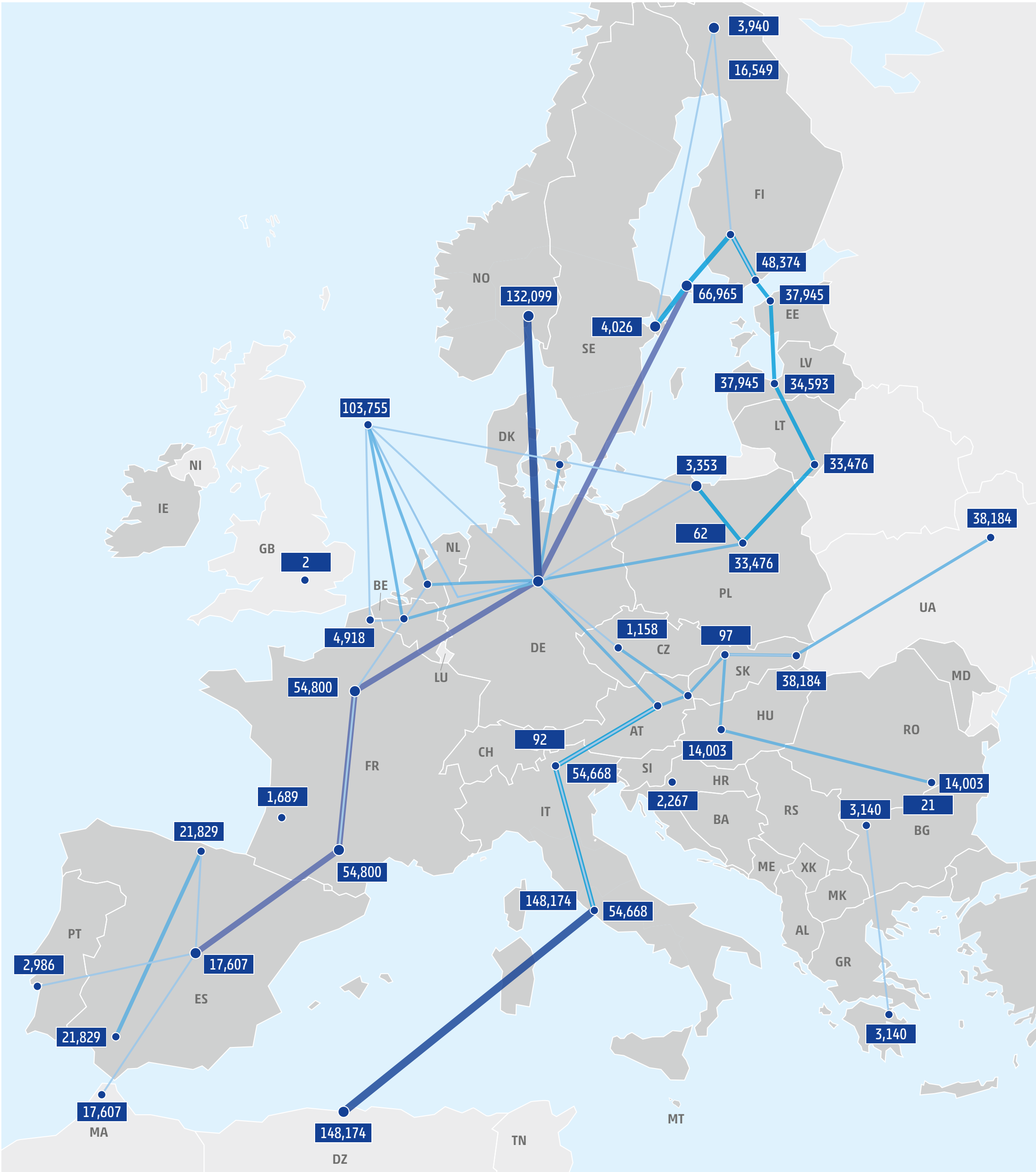

Figure 32: Grid flows* in the Advanced hydrogen infrastructure level in 2040 for reference weather year (unit: GWh/y).

* Grid flows refer to simulations results and do not intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III).

In the 2040 Advanced hydrogen infrastructure level assessment for the reference weather year, countries can be grouped in four different categories according to their supply-demand balance on a yearly basis:

1. **Countries which export more than they import:** Sweden, Finland, Denmark, the Netherlands, Spain, Portugal, Greece.
2. **Countries that import more than they export:** Belgium, Poland, Czechia, Bulgaria and Romania.
3. **Transit countries that import more than they consume:** Italy, Austria, Germany, Slovakia, Estonia, Latvia, Lithuania and France.
4. **Isolated countries:** the United Kingdom, Ireland, Luxembourg, Slovenia, Croatia, Malta, Cyprus, and the cluster Bulgaria-Greece.

With the exception of Hungary and Romania, that are integrated in the European hydrogen network through the Slovakia-Hungary-Romania hydrogen route, among the previously interconnected countries, the exporting/importing and transit roles did not change significantly in comparison to the PCI/PMI hydrogen infrastructure level assessment for 2040 (see Figure 26).

High-level results for stressful weather year

The overall yearly supply-demand balance for the Advanced hydrogen infrastructure level in 2040 for the stressful weather year is presented in Table 32. Electrolytic hydrogen production is the main source of hydrogen in Europe but it is reduced in comparison with the reference weather year. To compensate the reduction of electrolytic hydrogen production, hydrogen import sources, mainly via ship, increase in comparison with the reference weather year. The imports via terminals increase by 10 %. Pipeline imports however hardly increase as the effective import potential is limited by the import capacities of import pipelines (see Table 5) and by EU-internal bottlenecks (see section 4.2.1), there already were high utilisations in the reference weather year, and there is missing hydrogen storage infrastructure.

The consideration of a stressful weather year leads to an approximate rate of 15 % of hydrogen demand curtailment at European level. This is an increase compared to the 12 % for the reference weather year with the Advanced hydrogen infrastructure level and a reduction compared to the 18 % for the stressful weather year with the PCI/PMI hydrogen infrastructure level.

Yearly hydrogen supply-demand balance	Advanced IL 2030	Advanced IL 2040
H_2 produced via electrolysis	265	1,002
H_2 produced using natural gas	241	170
H_2 shipped imports	35	121
H_2 pipeline imports	42	336
Curtailed H_2 demand	38	298
H_2 demand for power production	2	75
Total H_2 demand	**620**	**1,927**

Table 32: Supply and demand balance in the advanced infrastructure level in 2030 and 2040 for stressful weather year (unit: TWh/y).

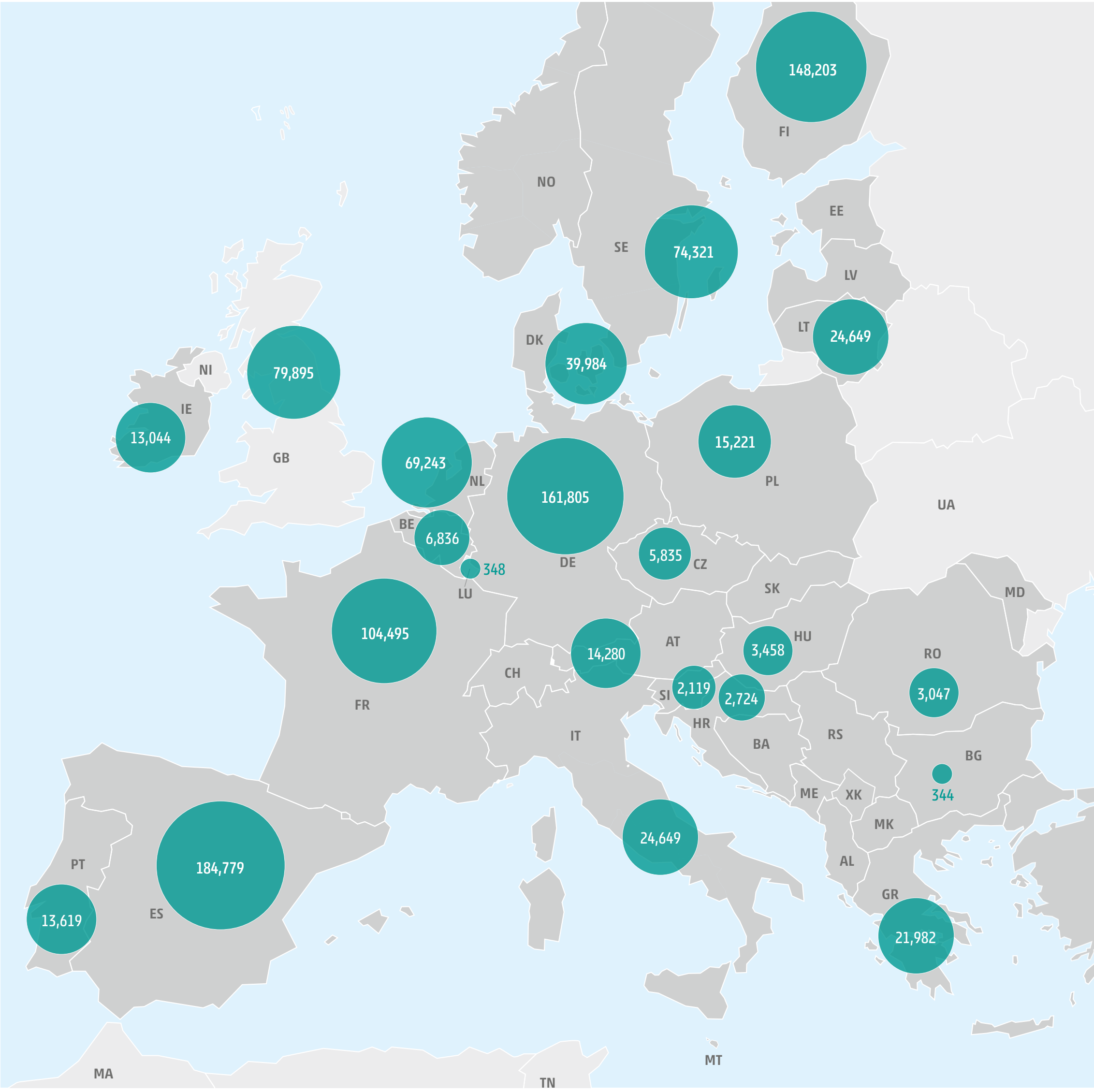

Figure 33: Distribution of electrolytic hydrogen production from natural gas in the Advanced hydrogen infrastructure level in 2040 for stressful weather year (unit: GWh/y).

Figure 33 shows the distribution of electrolytic hydrogen production in the different European countries for the Advanced hydrogen infrastructure level in the 2040 assessment under stressful weather conditions. While keeping the same overall distribution as in the reference case, the electrolytic production was reduced all over Europe.

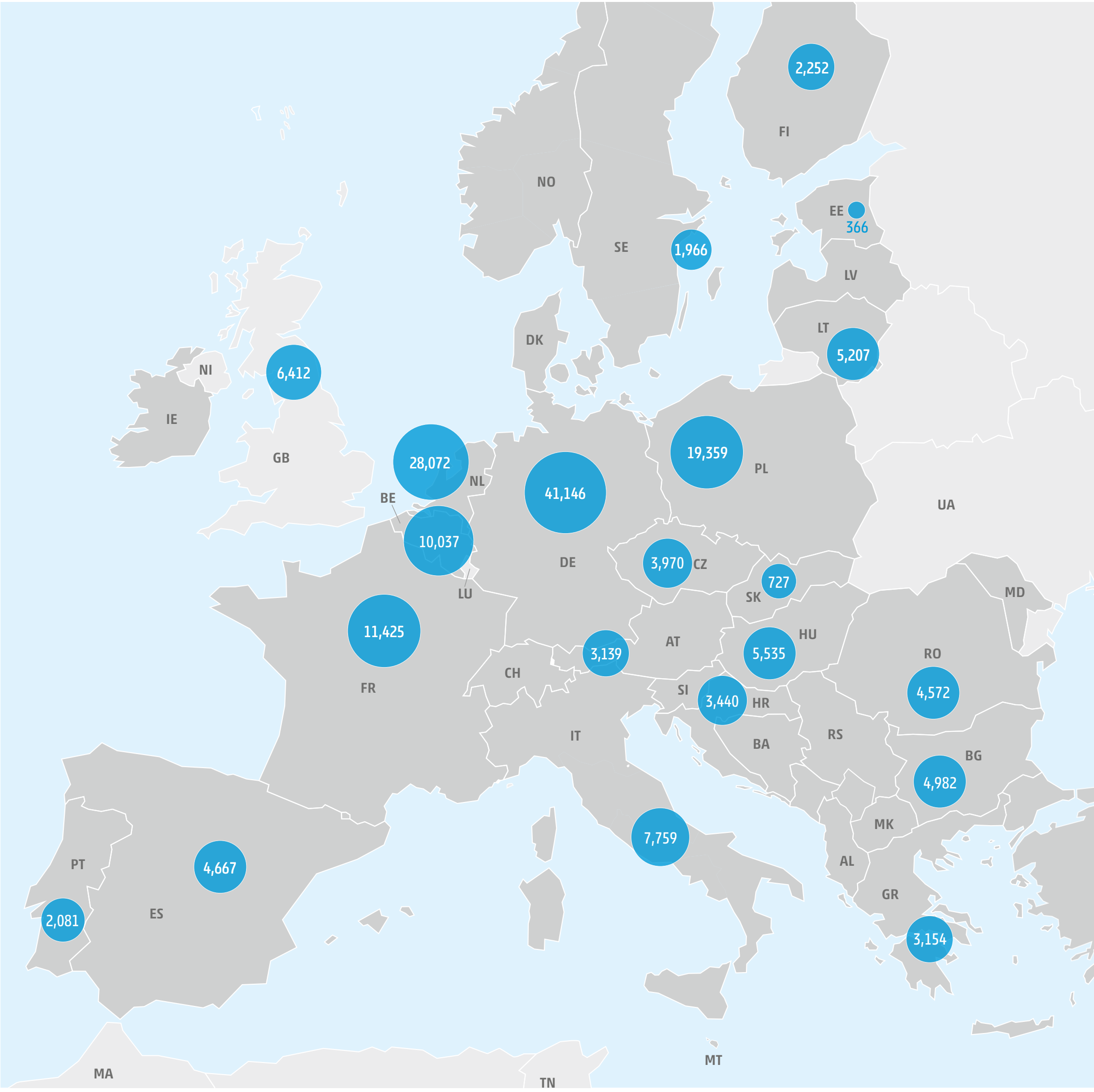

Figure 34: Distribution of hydrogen production from natural gas in the advanced infrastructure level in 2040 for stressful weather year (unit: GWh/y).

Figure 34 shows the distribution of natural-gas based hydrogen production in the different European countries for the Advanced hydrogen infrastructure level in the 2040 assessment under stressful weather conditions. No significant change was observed in comparison to the reference weather year presented in Figure 31.

Country	H_2 Production via electrolysis	H_2 Production using natural gas	H_2 extra-EU imports by pipeline & ship	H_2 demand
AT	14,280	3,139	0	45,604
BE	6,836	10,037	43,781	85,407
BG	344	4,982	0	12,712
CZ	5,835	3,970	0	2,614
CY	0	0	0	46,404
DE	161,805	41,146	146,590	548,308
DK	39,984	0	0	31,337
EE	0	366	0	3,128
ES	184,779	4,667	18,432	156,348
FI	148,203	2,252	0	85,318
FR	104,495	11,425	9,456	166,517
GR	21,982	3,154	0	38,538
HR	2,724	3,440	0	8,168
HU	3,458	5,535	0	26,496
IE	13,044	0	0	14,439
IT	24,649	7,759	148,695	127,210
LT	13,441	5,207	0	22,242
LU	348	0	0	9,772
LV	0	0	0	4,042
MT	0	0	0	1,475
NL	69,243	28,072	47,369	126,569
PL	15,221	19,359	6,439	134,042
PT	13,619	2,081	0	19,628
RO	3,047	4,572	0	37,722
SE	74,321	1,966	0	71,263
SI	2,119	0	0	5,822
SK	0	727	38,527	9,549
UK	79,895	6,412	0	91,428

Table 33: Distribution of hydrogen production, imported hydrogen and demand per country in the Advanced hydrogen infrastructure level in 2040 for stressful weather year (unit: GWh/y).

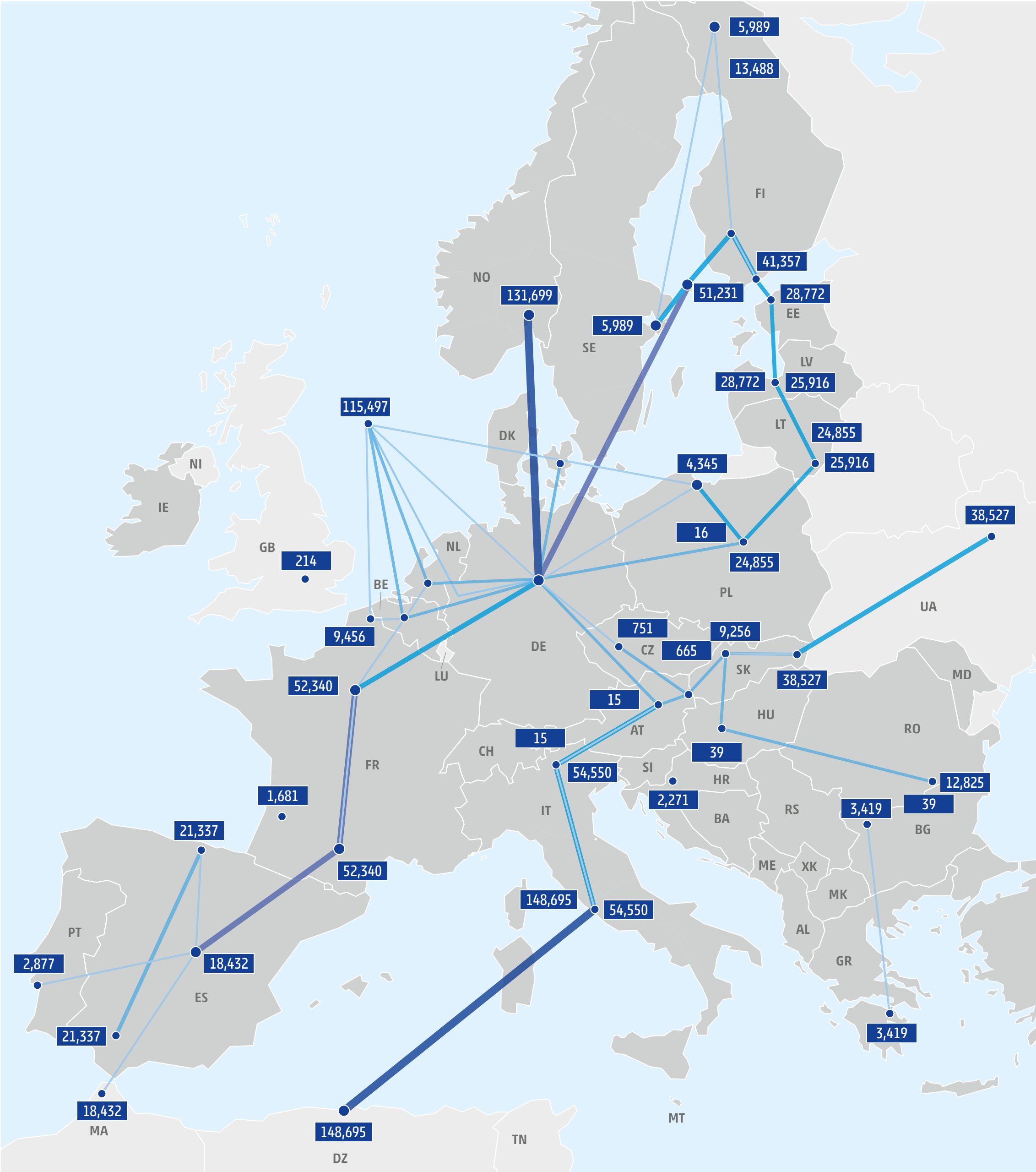

Figure 35: Grid flows* in the Advanced hydrogen infrastructure level in 2040 for stressful weather year (unit: GWh/y).

* Grid flows refer to simulations results and do not intend to represent how the European infrastructure is expected to evolve in the simulated years, being just outcomes of a modelling tool. The values are provided as a table in Annex II and as monthly values in Annex III).

When comparing Figure 32 with Figure 35, most European countries show the same behaviour in terms of being a net exporter, a net importer or a transit country for the stressful as for the reference weather year. As expected under stressful climatic conditions, corridors based mainly on electrolytic production will see their exporting role slightly reduced due to the lower availability of RES (i.e., Iberian and Nordic corridors).

Consequently, also the transit through countries along these routes is reduced (e.g., transit through Baltic countries). On the contrary, countries with access to import terminals will increase imports via ship for own consumption and transit. In addition, imports via pipeline from Ukrainian and North African corridors slightly increase their imports up to the maximum capability, determined by supply potentials and infrastructure bottlenecks.

4.1.2.1 IGI INDICATOR 1: HYDROGEN MARKET CLEARING PRICE SPREADS FOR REFERENCE WEATHER YEAR

Overview: Hydrogen market clearing prices per country

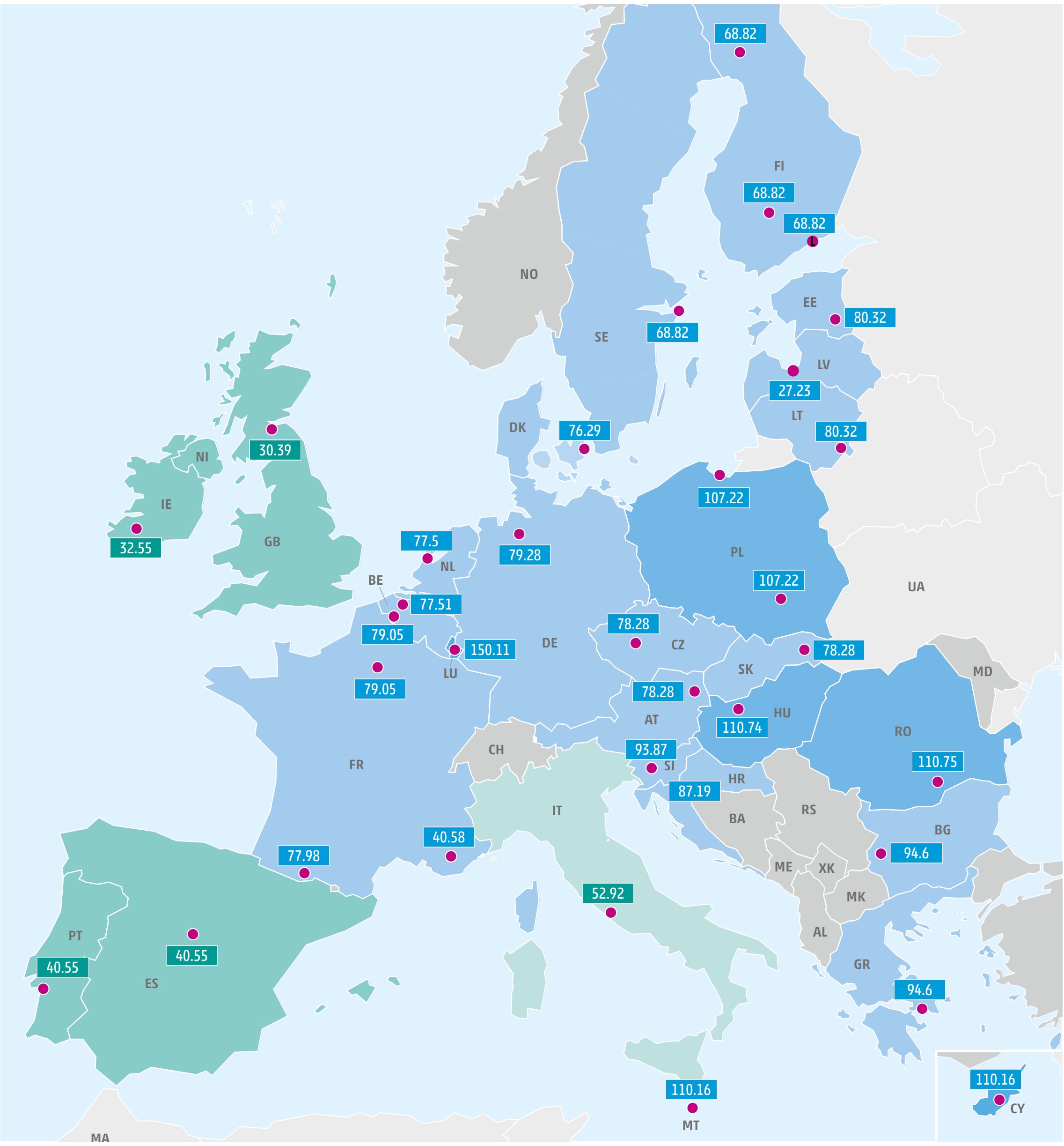

Figure 36: Average of the hourly hydrogen market clearing prices per country in the Advanced hydrogen infrastructure level in 2040 (unit: €/MWh).

The increase of hydrogen demand considered in the 2040 assessment leads to a general increase of average hydrogen market clearing prices in Europe when compared to the 2030 assessment, as represented in Figure 36. The fundamental reasons are explained in section 4.1.1.1 The Advanced hydrogen infrastructure level considers a significant increase of import terminal capacities (see Table 6 in section 1.1.2), increasing the overall availability of shipped hydrogen imports.

Despite having lower overall hydrogen demand curtailment in the Advanced hydrogen infrastructure level, hydrogen market clearing prices in most European countries are higher than in the PCI/PMI hydrogen infrastructure level for 2040 and lower in some countries like Poland. This relates to the improved connectivity that enables more countries to compete for the hydrogen supply options, maximising the overall socio-economic welfare that includes (among others) the surplus of all the hydrogen consumers as well as the surplus of the hydrogen producers.

The price formation in the DHEM is based on the merit order of hydrogen production (see section 1.2.1). Several price groups stand out, while a signification correlation is understood here as a correlation above 0.7:

1. **Portugal, Spain, France-South region:** Portugal and Spain are producers and net exporters of electrolytic hydrogen from RES to other countries. While the France-South region is sufficiently connected to the Iberian peninsula, price spreads appear with other groups of (regions of) countries due to an internal bottleneck in France. The prices in this group show no significant correlation with the prices in other groups.
2. **France-Southwest region:** The prices in this group show no significant correlation with the prices in other groups. The group exists due to bottlenecks within France.
3. **France-North region:** The prices in this group show significant correlations with prices in groups 4, 5, 6, 7, 11. The group exists due to bottlenecks within France.
4. **France, Belgium-Mons region:** The prices in this group show significant correlations with prices in groups 3, 5, 6, 7, 10, 11. The group exists due to bottlenecks within France and Belgium.
5. **Belgium, the Netherlands:** The prices in this group show significant correlations with prices in groups 3, 4, 6, 7, 10, 11. The group exists due to bottlenecks with France and Germany.
6. **Denmark:** The prices in this group show significant correlations with prices in groups 4, 5, 7, 10, 11. The group exists due to a bottleneck from Denmark to Germany.
7. **Germany, Czechia, Austria, Slovakia-East region, Slovakia-West region:** The group grew by Slovakia-East and Slovakia-West regions in comparison with the PCI/PMI hydrogen infrastructure level. The prices in this group show significant correlations with prices in groups 3, 4, 5, 6, 10, 11. The group exists due to bottlenecks from France to Germany, from Belgium to Germany, from Denmark to Germany, from Italy to Austria, from Slovakia to Hungary, from Germany to Finland and Sweden, and from Germany to Poland.
8. **Italy:** While being connected to Austria, the bottleneck between Italy and Austria is so dominant that Italy has no correlation with the prices in other groups.
9. **Poland-North region, Poland-South region:** This group grew by the Poland-South region in comparison with the PCI/PMI hydrogen infrastructure level.
10. **Sweden, Finland:** The prices in this group show significant correlations with prices in groups 3, 4, 5, 6, 7, 11. The group exists due to a bottleneck between Sweden/Finland and Germany and a bottleneck between Finland and Estonia.
11. **Estonia, Latvia, Lithuania:** The prices in this group show significant correlations with prices in groups 3, 4, 5, 6, 7, 10. The group exists due to a bottleneck between Finland and Estonia as well as bottlenecks from Lithuania to Poland and within Poland.
12. **Ireland, the United Kingdom:** Isolated countries without significant price correlations but with average prices below 100 €/MWh.
13. **Greece, Bulgaria:** Countries showing significant price correlation, jointly isolated from the other European countries.
14. **Croatia (only connected to Bosnia), Slovenia, Luxembourg, Cyprus, Malta:** Isolated countries without significant price correlations (except for Croatia and Slovenia due to a similar national hydrogen production constellation) and with average prices above 100 €/MWh.

The IGI indicator 1 in the 2040 assessment of the Advanced hydrogen infrastructure level reveals the same borders that were identified in the PCI/PMI hydrogen infrastructure level assessment for 2040.

Border	Threshold 1: Absolute average hourly hydrogen market clearing price spread above 4 €/MWh	Threshold 2: More than 40 days with hydrogen market clearing price spread above 20 €/MWh
DEh_2–DKh_2	24	155
DEh_2–FIh_2	18	114
DEh_2–ITh_2	31	206
DEh_2–PLh_2N	45	271
DEh_2–PLh_2S	45	271
DEh_2–SEh_2	18	114
FIh_2–EEh_2	15	97
FRh_2–FRh_2S	49	319
FRh_2–FRh_2SW	31	183
FRh_2–ITh_2	32	214
FRh_2S–FRh_2SW	57	265
HUh_2–ATh_2	44	271
HUh_2–HRh_2	31	207
HUh_2–SKh_2E	44	271
ITh_2–ATh_2	31	206
ITh_2-HRh_2	49	288
LTh_2-PLh_2N	42	263
NLh_2–UKh_2	58	309
PLh_2S–CZh_2	45	271
PLh_2S–SKh_2E	45	271
ROh_2–BGh_2	22	129
SIh_2–HRh_2	11	45
SKh_2E–PLh_2S	45	271
UKh_2–BEh_2	58	309
UKh_2–IEh_2	25	133

Table 34: List of borders in the advanced hydrogen infrastructure level that exceed (at least one of) the thresholds defined for IGI indicator 1 in 2040.

4.1.2.2 IGI INDICATOR 2.1: HYDROGEN DEMAND CURTAILMENT FOR REFERENCE WEATHER YEAR

As explained in section 1.2.2, this IGI indicator assesses infrastructure gaps by quantifying hydrogen demand curtailments at individual nodes during the reference weather year, assuming no disruptions of infrastructures or of supply sources. It involves a multi-step simulation process integrating DHEM and DGM[12] outputs to evaluate the combined curtailments across nodes. The assessment is performed for the advanced hydrogen infrastructure level in 2040, showing the effects of matured infrastructure in 2040.

Figure 34 and Table 35 show yearly average curtailment rates of hydrogen demand in the Zone 2 nodes of different European countries. For countries where the hydrogen market is divided into several sub-zones (i.e., nodes), the curtailment rate in the different sub-zones is presented. The yearly average hydrogen curtailment rates are thereby colour-coded in the map to indicate levels relative to the set threshold: blue signifies curtailment above the threshold, while green represents rates that are not above it.

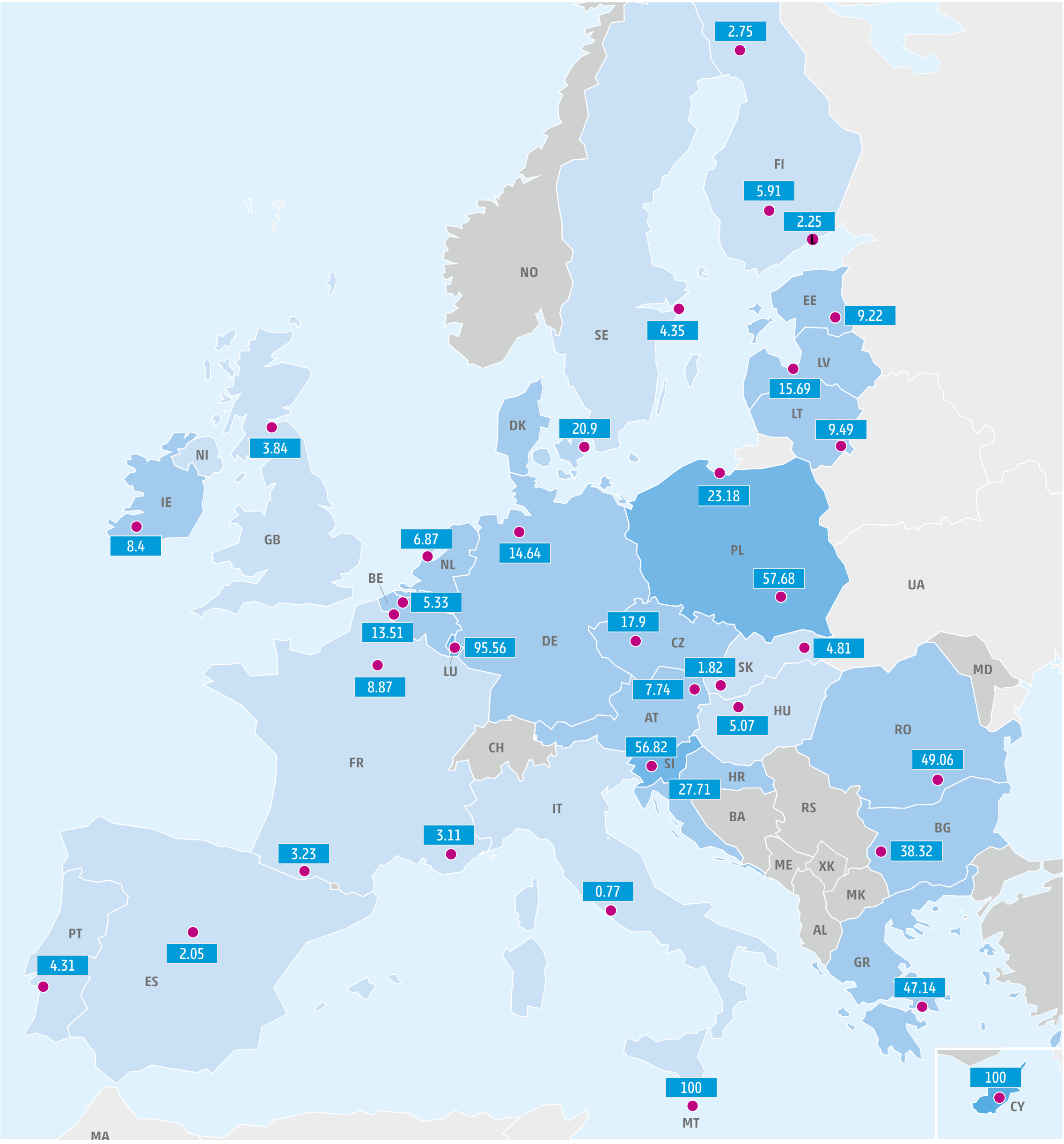

Figure 37: Yearly average hydrogen demand curtailment rate at country or node level in the advanced hydrogen infrastructure level in 2040 for reference year (unit: %).

12 This draft TYNDP 2024 IGI report only includes the simulation results of the DHEM.

Country/ Region	Demand Curtailment (%)	Threshold passed
ATh_2	7.74	YES
BEh_2	5.33	YES
BEH_2Mo	13.51	YES
BGh_2	38.32	YES
CYh_2	100	YES
CZh_2	17.9	YES
DEh_2	14.40	YES
DKh_2	20.9	YES
EEh_2	9.22	YES
ESh_2	2.05	YES
FIh_2	5.91	YES
FIh_2N	2.75	YES
FIh_2S	2.25	YES
FRh_2	8.87	YES
FRh_2S	3.11	YES
FRh_2SW	3.23	YES
GRh_2	47.14	YES
HRh_2	27.71	YES

Country/ Region	Demand Curtailment (%)	Threshold passed
HUh_2	5.07	YES
IEh_2	8.4	YES
ITh_2	0.77	YES
LTh_2	9.49	YES
LUh_2	95.56	YES
LVh_2	15.69	YES
MTh_2	100	YES
NLh_2	6.87	YES
PLh_2N	23.18	YES
PLh_2S	57.68	YES
PTh_2	4.31	YES
ROh_2	49.06	YES
SEh_2	4.35	YES
SIh_2	56.82	YES
SKh_2E	1.82	YES
SKh_2W	3.72	YES
UKh_2	3.84	YES

Table 35: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the Advanced hydrogen infrastructure level in 2040 for reference weather year and check of the threshold of IGI indicator 2.1 (unit: %).

All European countries and regions overshoot the threshold of 0 % for IGI indicator 2.1 under the Advanced hydrogen infrastructure level in 2040. However, differences in the hydrogen curtailment rates between nodes are related to the level of infrastructure development and supply availability. In comparison with IGI indicator 1, this IGI indicator focusses on the availability of supplies.

As detailed in Figure 37, (regions of) countries can be aggregated in different groups according to their average yearly hydrogen demand curtailment rates:

1. **Rates below 5 %:** Spain, Finland-North region, Finland-South region, France-South region, France-Southwest region, Italy, Portugal, Sweden, Slovakia-East, Slovakia-West, the United Kingdom.
2. **Rates between 5 % and 20 %:** Austria, Belgium, Belgium-Mons region, Czechia, Germany, Estonia, Finland, France, Hungary, Ireland, Lithuania, Latvia, the Netherlands.
3. **Rates between 20 % and 50 %:** Bulgaria, Denmark, Greece, Croatia, Poland-North, Romania.
4. **Rates between 50 % and 100 %:** Slovenia, Luxembourg, Poland-South.
5. **Full curtailment of 100 %:** Cyprus, Malta.

Without the infrastructure already considered in the hydrogen infrastructure level, the overall hydrogen demand curtailment would be higher.

While hydrogen demand curtailment rates decrease in newly connected countries and regions and the overall hydrogen demand curtailment in Europe decreases compared to the PCI/PMI hydrogen infrastructure level, the curtailment rates in several countries and regions increase slightly, as other, newly connected countries and regions are supplied instead.

Considering group 1, in comparison with the PCI/PMI hydrogen infrastructure level, improved infrastructure could especially enhance the curtailment situation of the France-Southwest region (11.5 % to 3 %).

Within group 2, especially Hungary could benefit from its new interconnection in the Advanced hydrogen infrastructure level (75 % to 5 %).

Countries and regions of group 3 see the most significant reduction in the Poland-North region (50 % to 23 %) due to additional capacities in the Advanced hydrogen infrastructure level as well as in Romania (90 % to 49 %) due to its new interconnection with Hungary. Here, Hungary is acting as a transit country for hydrogen it receives from Slovakia.

In group 4, advanced infrastructure projects mitigate curtailment in Poland-South.

Malta and Cyprus, representing group 5, remain fully curtailed due to their geographic isolation within the European hydrogen market and have no hydrogen production assets.

In the Poland-North Region, France and Czechia, on top of the curtailments observed in Zone 2 nodes as described in the paragraphs above, hydrogen demand curtailments can be observed in Zone 1 that increase during the winter months.

4.1.2.3 IGI INDICATOR 2.2: HYDROGEN DEMAND CURTAILMENT FOR STRESSFUL WEATHER YEAR

Threshold 1: Average yearly hydrogen demand curtailment rate above 3 %

The 2.2 IGI indicator shows the yearly average hydrogen demand curtailment rates in the Zone 2 nodes of various European countries for 2040, simulated under a stressful weather year. This weather scenario assumes adverse conditions, such as reduced wind and solar energy availability, which directly impacts hydrogen production. For countries with hydrogen markets divided into multiple sub-zones (i.e., nodes), curtailment rates are depicted individually for each sub-zone on the map. The yearly average hydrogen curtailment rates are thereby colour-coded to indicate levels relative to the set threshold 1: blue signifies curtailment above the threshold, while green represents rates that are not.

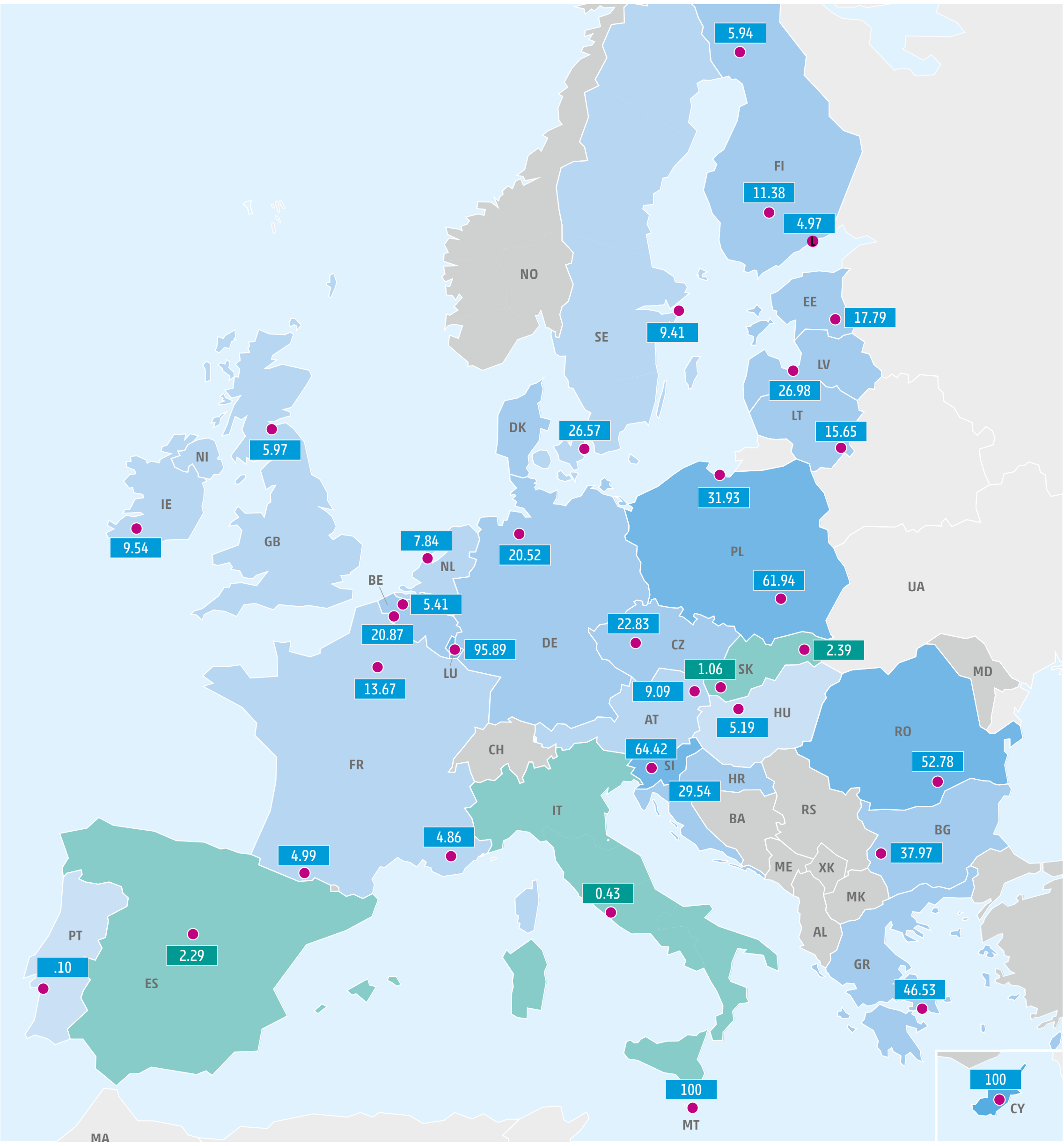

Figure 38: Yearly average hydrogen demand curtailment rate at country or node level in the Advanced hydrogen infrastructure level in 2040 for stressful weather year (unit: %).

Country node	Demand Curtailment (%)
ATh_2	9.09
BEh_2	5.41
BEH_2Mo	20.87
BGh_2	37.97
CYh_2	100.00
CZh_2	22.83
DEh_2	20.17
DKh_2	26.57
EEh_2	17.79
ESh_2	2.29
FIh_2	11.38
FIh_2N	5.94
FIh_2S	4.97
FRh_2	13.67
FRh_2S	4.86
FRh_2SW	4.99
GRh_2	46.53
HRh_2	29.54
HUh_2	5.19
IEh_2	9.54
ITh_2	0.43
LTh_2	15.65
LUh_2	95.89
LVh_2	26.98
MTh_2	100.00
NLh_2	7.84
PLh_2N	31.93
PLh_2S	61.94
PTh_2	6.10
ROh_2	52.78
SEh_2	9.41
SIh_2	64.42
SKh_2E	1.06
SKh_2W	2.39
UKh_2	5.97

Table 36: Yearly average hydrogen demand curtailment rate at country/sub-zone level in the advanced infrastructure level in 2040 for stressful weather year and check of threshold 1 of IGI indicator 2.2 (unit: %).

Countries and (regions of countries) can be aggregated in different groups according to their average yearly hydrogen demand curtailment rates:

Rates below 3 %: Slovakia-East, Slovakia-West, Spain, Italy.

Rates between 3 % and 20 %: Austria, Belgium, Estonia, Finland, Finland-North region, Finland-South region, France, France-South region, France-Southwest region, Hungary, Ireland, Lithuania, the Netherlands, Portugal, Sweden, the United Kingdom.

Rates between 20 % and 50 %: Belgium-Mons Region, Bulgaria, Czechia, Germany, Denmark, Greece, Croatia, Latvia, Poland-North region.

Rates between 50 % and 100 %: Luxembourg, Poland-South region, Romania, Slovenia.

Full curtailment of 100 %: Malta, Cyprus.

Compared with the PCI/PMI hydrogen infrastructure level, group 1 grows by the Slovakia-West region, reducing its hydrogen demand curtailment below the threshold of IGI indicator 2.2.

Threshold 2: hydrogen demand curtailment rate of more than 5 % for at least one month per year

All the countries and regions that exceed threshold 1 also exceeded threshold 2.

4.2 COMPARISON BETWEEN PCI/PMI HYDROGEN INFRASTRUCTURE LEVEL AND ADVANCED HYDROGEN INFRASTRUCTURE LEVEL

4.2.1 MAXIMUM UTILISATION OF INTERCONNECTORS

Table 37 displays the maximum utilisation rates of hydrogen interconnections for both hydrogen infrastructure levels in 2040 for the reference weather year. As stated in section 1.1, some countries are completely isolated from the hydrogen infrastructure:

- Countries and regions that are isolated in both hydrogen infrastructure levels: Slovenia, Ireland, the United Kingdom, Cyprus, Malta, France-Southwest region, Poland-South region, Luxembourg. Bulgaria and Greece are interconnected with each other but isolated from the main backbone.
- Countries that are only isolated in the PCI/PMI hydrogen infrastructure level: Hungary, Romania. Bosnia and Croatia are interconnected with each other in the Advanced hydrogen infrastructure level but isolated from the main backbone.

Interconnection	Stated direction		Reverse direction		Comments
	PCI/PMI IL	ADV IL	PCI/PMI IL	ADV IL	
ATh_2 → DEh_2	100	100	100	100	No bottleneck, as alternative route (e.g., through SK and CZ) still has free capacities.
ATh_2 → IB-ITh_2	100	45	100	100	Capacity from IT to AT is a bottleneck.
ATh_2 → IB-SKh_2W	100	100	94	87	
BAh_2 → HRh_2		0		0	The low utilisation is caused by low hydrogen supply to these jointly isolated countries, so BA and HR always need hydrogen supply themselves if the other country needs it.
BEh_2 → DEh_2	100	100	100	100	
BEh_2 → FRh_2	100	100	100	100	Capacity from FR to BE is a bottleneck.
BEh_2 → FRh_2N	0	0	100	100	Capacity from FR-North to BE is a bottleneck.
BEh_2 → NLh_2	100	100	100	100	No bottleneck, as alternative route (e.g., through DE) still has free capacities.
BEH_2Mo → FRh_2Va	0	0	39	36	The flow direction is from FR to BE.
BGh_2 → GRh_2	0	0	53	46	The flow direction is from GR to BG.
CZh_2 → DEh_2	50	50	49	40	
DEh_2 → DKh_2	59	87	100	100	Capacity from DK to DE is a bottleneck.
DEh_2 → FRh_2	100	100	100	100	Capacity from FR to DE is a bottleneck.
DEh_2 → NLh_2	100	100	92	99.9	
DEh_2 → PLh_2N		100		93	Capacity from DE to PL is a bottleneck.
DEh_2 → PL$h_2$nbc	100	100	100	100	Capacity from DE to PL is a bottleneck.
DE$h_2$ba → DEh_2		0			
DE$h_2$bp → DEh_2		100			Allows import through DEbp terminal in ADV IL.
DE$h_2$bp → DE$h_2$ba		0			
EEh_2 → FIh_2S	0	0	100	100	Capacity from FI to EE is a bottleneck (as alternative route via DE is also congested at the same time).

Interconnection	Stated direction		Reverse direction		Comments
	PCI/ PMI IL	ADV IL	PCI/ PMI IL	ADV IL	
EEh_2 → LVh_2	96	96	0	0	
ESh_2 → FRh_2S	100	100	80	44	Capacity from FR-South to other nodes in FR is the dominant bottleneck.
ESh_2 → PTh_2	61	24	0	0	The flow direction is from ES to PT.
FIh_2 → FIh_2AI	63	56	45	20	
FIh_2 → FIh_2N	1	0.3	2	1	Very high capacities set in the model as this arc is not representing a bottleneck.
FIh_2 → FIh_2S	2	1	3	3	Very high capacities set in the model as this arc is not representing a bottleneck.
FIh_2AI → DEh_2	100	100			Capacity from FI/SE to DE is a bottleneck (as alternative route via EE is also congested at the same time).
FIh_2AI → SEh_2	13	5	47	47	
FIh_2N → SEh_2	94	55	100	100	
FRh_2 → FRh_2S	91	54	100	100	Capacity from FR-South to FR is a bottleneck that limits supplies from ES.
FRh_2 → FRh_2Va	29	1	14	13	
HUh_2 → IB-SKh_2C		41		100	Capacity from SK to HU is a bottleneck.
HUh_2 → ROh_2		88		14	Utilisation rate from HU to RO is affected by bottleneck from SK to HU.
IB-ITh_2 → ITh_2	0	0	84	84	
IB-SKh_2C → SKh_2E	7	3	100	50	
IB-SKh_2C → SKh_2W	100	64	6	38	
IB-SKh_2E → SKh_2E	100	50	0	0	
IB-SKh_2W → CZh_2	100	100			
IB-SKh_2W → SKh_2W	20	45	100	64	
LTh_2 → LVh_2	5	5	100	92	
LTh_2 → PLh_2nbc	100	94	0	0	
PLh_2N → PLh_2S		30			
PLh_2nbc → PLh_2N	0	100			Capacity from PLnbc to PL-North is a bottleneck.
PLh_2S → PLh_2nbc	100	100			
DZh_2 → ITh_2	100	100			
LH_2_Tk_BE → BEh_2	100	100			
LH_2_Tk_DE → DEh_2	100	100			
LH_2_Tk_DEbp → DEh_2bp	0	100			Pipeline in ADV IL allows usage of import terminal.
LH_2_Tk_FRn → FRh_2N	100	100			
LH_2_Tk_NL → NLh_2	100	100			
LH_2_Tk_PLN → PLh_2N		100			New terminal in ADV IL.
MAh_2 → ESh_2	100	100			
UAh_2 → IB-SKh_2E	100	100			
Y-NOh_2 → DEh_2	100	100			

Table 37: Maximum utilisation rates of interconnections in the PCI/PMI hydrogen infrastructure level and in the Advanced hydrogen infrastructure level in 2040 for the reference weather year (unit: %).

Interconnection	Stated direction		Reverse direction		Comments on significant deviations from the maximum utilisation rates compared with the reference weather year
	PCI/ PMI IL	ADV IL	PCI/ PMI IL	ADV IL	
ATh$_2$ → DEh$_2$	100	100	100	100	Increase of max. utilisation from DE to AT.
ATh$_2$ → IB-ITh$_2$	31	44	100	100	
ATh$_2$ → IB-SKh$_2$W	78	100	100	94	Max. utilisation from AT to SK reaches 100 %.
BAh$_2$ → HRh$_2$		0		0	
BEh$_2$ → DEh$_2$	100	100	100		Max. utilisation from BE to DE reaches 100 %.
BEh$_2$ → FRh$_2$	92	100	100	100	Max. utilisation from BE to FR reaches 100 %.
BEh$_2$ → FRh$_2$N	0	0	100	100	
BEh$_2$ → NLh$_2$	99	100	100	100	
BEH$_2$Mo → FRh$_2$Va	0	0	37	37	
BGh$_2$ → GRh$_2$	0	0	55	55	
CZh$_2$ → DEh$_2$	50	50	48	36	
DEh$_2$ → DKh$_2$	87	87	100	100	
DEh$_2$ → FRh$_2$	100	100	100	100	
DEh$_2$ → NLh$_2$	100	100	100	100	Max. utilisation from NL to DE reaches 100 %.
DEh$_2$ → PLh$_2$N		100		100	
DEh$_2$ → PLh$_2$nbc	100	100	100	100	
DEh$_2$ba → DEh$_2$		0			
DEh$_2$bp → DEh$_2$		100			
DEh$_2$bp → DEh$_2$ba		0			
EEh$_2$ → FIh$_2$S	0	0	100	100	
EEh$_2$ → LVh$_2$	100	97	0	0	
ESh$_2$ → FRh$_2$S	100	100	79	80	Dependence of Iberian hydrogen production on RES and lower RES availability increase max. utilisation from FR to ES to decrease HCR in ES and PT.
ESh$_2$ → PTh$_2$	60	60	47	47	
FIh$_2$ → FIh$_2$Al	64	64	45	26	
FIh$_2$ → FIh$_2$N	2	1	1	2	
FIh$_2$ → FIh$_2$S	2	2	4	4	
FIh$_2$Al → DEh$_2$	100	100			
FIh$_2$Al → SEh$_2$	14	14	47	47	
FIh$_2$N → SEh$_2$	96	97	100	100	
FRh$_2$ → FRh$_2$S	90	91	100	100	
FRh$_2$ → FRh$_2$Va	31	31	13	14	
HUh$_2$ → IB-SKh$_2$C		41		100	
HUh$_2$ → ROh$_2$		88		14	
IB-ITh$_2$ → ITh$_2$	0	0	84	84	Max. utilisation reaches 100 %.
IB-SKh$_2$C → SKh$_2$E	7	3	100	50	
IB-SKh$_2$C → SKh$_2$W	100	64	7	38	
IB-SKh$_2$E → SKh$_2$E	100	50	0	0	
IB-SKh$_2$W → CZh$_2$	100	100			
IB-SKh$_2$W → SKh$_2$W	20	44	100	64	
LTh$_2$ → LVh$_2$	5	5	100	92	
LTh$_2$ → PLh$_2$nbc	100	100	0	0	

Interconnection	Stated direction		Reverse direction		Comments on significant deviations from the maximum utilisation rates compared with the reference weather year
	PCI/ PMI IL	ADV IL	PCI/ PMI IL	ADV IL	
$PLh_2N \rightarrow PLh_2S$		30			
$PLh_2nbc \rightarrow PLh_2N$	100	100			
$PLh_2S \rightarrow PLh_2nbc$	27	22			
$DZh_2 \rightarrow ITh_2$	100	100			
LH_2_Tk_BE → BEh_2	100	100			
LH_2_Tk_DE → DEh_2	100	100			
LH_2_Tk_DEbp → DEh_2bp	0	100			
LH_2_Tk_FRn → FRh_2N	100	100			
LH_2_Tk_NL → NLh_2	100	100			
LH_2_Tk_PLN → PLh_2N		100			
$MAh_2 \rightarrow ESh_2$	100	100			
UAh_2 → IB-SKh_2E	100	100			
Y-$NOh_2 \rightarrow DEh_2$	100	100			

Table 38: Maximum utilisation rates of interconnections in the PCI/PMI hydrogen infrastructure level and in the Advanced hydrogen infrastructure level in 2040 for the stressful weather year (unit: %).

Concerning pipelines connecting offshore electrolysers, the following observations are made:

- Offshore electrolyser node in the Netherlands: A share of the national electrolyser capacity of the Netherlands is allocated to an offshore node. Because it is connected only by capacity from a less-advanced project (HyONE) which is not taken in account in either of the ENTSOG infrastructure levels in this report, Offshore electrolyser node in the Netherlands: A share of the national electrolyser capacity of the Netherlands is allocated to an offshore node. Because it is connected only by capacity from a less-advanced project (HyONE) which is not taken in account in either of the ENTSOG infrastructure levels in this report, the offshore electrolysers are not used in the simulations. This leads to unused renewable hydrogen production offshore. The order of magnitude of this unused renewable hydrogen production offshore would have led to a maximum utilisation rate of 100 % when this less advanced project would be taken into account.
- Offshore electrolysis in Germany: The offshore electrolysis in Germany (namely in the Northern Sea) is connected to the mainland through the PCI project AquaDuctus. Therefore, the project capacity foreseen for national production is included in the PCI/PMI hydrogen infrastructure level, as well as in the Advanced hydrogen infrastructure level. Maximum utilisation rate will be calculated in the final IGI report as described in the TYNDP 2024 Annex D2 based on the enabled electrolyser capacity and infrastructure level.

4.2.2 ANALYSIS WITH HYPOTHETICAL INFRASTRUCTURE APPROACH

This section will be produced after the public consultation of the TYNDP 2024 Infrastructure Gaps Identification report in line with the methodology described by steps 2 to 3 in section 6 of the TYNDP 2024 Annex D2.

4.2.3 IDENTIFICATION OF PROJECTS THAT SOLVED OR MITIGATED INFRASTRUCTURE GAPS

Solved infrastructure gaps in Advanced hydrogen infrastructure level compared to PCI/PMI hydrogen infrastructure level

The additional projects of the advanced infrastructure level could solve the following indications of regional hydrogen infrastructure gaps:

- Borders as captured by IGI indicator 1: None.
- Countries and regions as captured by IGI indicator 2.1: None.
- Countries and regions as captured by IGI indicator 2.2: Slovakia-West.

Not all IGI indicators could be solved from a regional perspective even if the advanced hydrogen projects provide benefits.

Identification of advanced, non-PCI/PMI projects responsible for solving hydrogen infrastructure gaps by addressing hydrogen infrastructure bottlenecks

The following advanced, non-PCI/PMI projects contributed to mitigate the identified infrastructure gaps in the 2040 assessment:

- Pipeline imports: All pipeline imports available in both infrastructure levels.
  - Slovakia to Hungary (HU/SK hydrogen corridor and SK-HU H_2 corridor)
  - Netherlands to Germany (H_2Coastlink, IP Elten/Zevenaar – Cologne, Hyperlink and H_2ercules Network North-West)
  - Germany to Poland (Pomeranian Green Hydrogen Cluster)
  - Hungary to Romania (Giurgiu Nădlac hydrogen corridor and HU/RO hydrogen corridor)
  - Romania to Hungary (Giurgiu Nădlac hydrogen corridor and HU/RO hydrogen corridor)
- Import terminals
  - New Ammonia terminal in Gdansk and Hydrogen Highway – Northern Section
  - Increased terminal capacity in the Netherlands (Eemshaven H_2)
- Hydrogen storages
  - Hydrogen storage projects in Germany (RWE H_2 Storage Gronau-Epe, UST Hydrogen Storage Krummhörn, RWE H_2 Storage Xanten, EWE Hydrogen Storage Huntorf, EWE Hydrogen Storage Jemgum, RWE H_2 Storage Staßfurt
  - Hydrogen storage project in the France-Southwest region of France (HySoW storage)

Besides the projects listed above, the projects included in the PCI/PMI hydrogen infrastructure level also contribute to the solving and mitigation of infrastructure gaps.


Picture courtesy of GASCADE

5 CONCLUSIONS

This IGI report provides the following main insights:

- Observed hydrogen demand satisfaction and hydrogen price convergence in Europe are enabled by the projects that are included in the respective hydrogen infrastructure levels.
- Every simulation showed hydrogen demand curtailments in Europe, especially in winter.
- Supply and infrastructure in the two hydrogen infrastructure levels are not sufficient on European level. This is indicated by the IGI indicators.
- All European hydrogen corridors considered in the assessments are needed to satisfy hydrogen demand.
- Hydrogen pipelines and storages help to mitigate hydrogen demand curtailments.
- Hydrogen infrastructure bottlenecks exist and are explained in the report.
- Due to the effect of the weather on the demand/supply balance of hydrogen, the European hydrogen backbone benefits from flexibilities in the supply, storage, and transit infrastructure.
- Several countries, especially islands and countries in South-East Europe, are not connected to the European hydrogen backbone in one or both hydrogen infrastructure levels.
- Isolated countries benefit from new connections with the European hydrogen backbone.
- Many projects represent anticipatory investments. They are not fully utilised in 2030 but show high utilisation in 2040. This allows to unlock the significant economies of scale of hydrogen infrastructure projects.
- Even projects that are currently defined as less advanced, especially if increasing exports towards curtailed countries, will be needed.

Thereby, this IGI report is based on the TYNDP 2024 NT+ scenario and the projects submitted to the TYNDP 2024.

ANNEX I: NODE-SPECIFIC HYDROGEN PRODUCTION CAPACITIES

Node	Category	Year	Installed capacity13 [MWH_2]	Data sources besides TYNDP 2024 NT+ scenario14 with specifications of TYNDP 2024 Annex D115
AT Z1	SMR/ATR	2030	996	
AT Z1	SMR/ATR	2040	498	
AT00 Z1	Electrolyser Z1	2030	797	
AT00 Z1	Electrolyser Z1	2040	1,091	
AT00 Z2	Electrolyser Z2	2030	14	
AT00 Z2	Electrolyser Z2	2040	4,797	
BE Z1	SMR/ATR	2030	2,298	
BE Z1	SMR/ATR	2040	1,149	
BEh_2	Electrolyser Z2	2030	303	
BEh_2	Electrolyser Z2	2040	1,367	
BG Z1	SMR/ATR	2030	1,331	
BG Z1	SMR/ATR	2040	665	
BG00 Z2	Electrolyser Z2	2030	53	
BG00 Z2	Electrolyser Z2	2040	72	
CH00 Z2	Electrolyser Z2	2030	213	
CH00 Z2	Electrolyser Z2	2040	1,135	
CZ Z1	SMR/ATR	2030	988	
CZ Z1	SMR/ATR	2040	494	
CZ00 Z1	Electrolyser Z1	2040	574	
CZ00 Z2	Electrolyser Z2	2030	228	
CZ00 Z2	Electrolyser Z2	2040	1,494	
DE Z1	SMR/ATR	2030	9,748	

13 The electrolyser efficiency is 69% in 2030 and 71% in 2040 in terms of NCV. Therefore, from the perspective of the electricity system, the installed capacity of electrolysers is higher. Here, the installed capacities are stated from the perspective of the hydrogen system and in terms of GCV.

14 Each country's total electrolyser and SMR/ATR capacities are specified in the TYNDP 2024 NT+ scenario. In the scenario documentation, the NCV is used to align with EC scenarios. The TYNDP 2024 however uses the GCV as this is commonly used in the gas markets.

15 TYNDP 2024 Annex D1 explains i) that project promoters can split Zones into sub-Zones, ii) that a country's electrolyser capacity can undergo a redistribution methodology to allocate electrolyser capacities to (sub-)Zones, and iii) that SMR/ATR capacities for hydrogen production from natural gas are only connected to Zone 1.

Node	Category	Year	Installed capacity13 [MWH_2]	Data sources besides TYNDP 2024 NT+ scenario14 with specifications of TYNDP 2024 Annex D115
DE Z1	SMR/ATR	2040	4,874	
DE00 Z2	Electrolyser Z2	2030	10,378	
DE00 Z2	Electrolyser Z2	2040	32,555	
DK Z1	SMR/ATR	2030	0	
DK Z1	SMR/ATR	2040	0	
DKh_2	Electrolyser Z2	2030	2,596	
DKh_2	Electrolyser Z2	2040	3,553	
DKW1 Z2	Electrolyser Z2	2030	1,359	
DKW1 Z2	Electrolyser Z2	2040	11,709	
EE Z1	SMR/ATR	2030	167	
EE Z1	SMR/ATR	2040	83	
ES Z1	SMR/ATR	2030	2,891	
ES Z1	SMR/ATR	2040	1,446	
ES00 Z2	Electrolyser Z2	2030	7,822	
ES00 Z2	Electrolyser Z2	2040	14,298	
ES00_DRES ES	DRES	2030	12,009	
ES00_DRES ES	DRES	2040	21,584	
ESh_2Z1a Z1	Electrolyser Z1	2030	1,007	
ESh_2Z1a Z1	Electrolyser Z1	2040	1,378	
FI00 Z1	Electrolyser Z1	2030	1,567	Project promoter specifications
FI00 Z1	Electrolyser Z1	2040	2,623	Project promoter specifications
FIh_2N	Electrolyser Z2	2030	2,863	Project promoter specifications
FIh_2N	Electrolyser Z2	2040	3,919	Project promoter specifications
FIh_2S	Electrolyser Z2	2030	2,652	Project promoter specifications
FIh_2S	Electrolyser Z2	2040	20,207	Project promoter specifications
FIS Z1	SMR/ATR	2030	785	Project promoter specifications

Node	Category	Year	Installed capacity13 [MWH$_2$]	Data sources besides TYNDP 2024 NT+ scenario14 with specifications of TYNDP 2024 Annex D115
FIS Z1	SMR/ATR	2040	393	Project promoter specifications
FR Z1	SMR/ATR	2030	2,635	Project promoter specifications
FR Z1	SMR/ATR	2040	1,317	Project promoter specifications
FRh$_2$	Electrolyser Z2	2030	3,010	Project promoter specifications
FRh$_2$	Electrolyser Z2	2040	12,981	Project promoter specifications
FRh$_2$SW	Electrolyser Z2	2030	167	Project promoter specifications
FRh$_2$SW	Electrolyser Z2	2040	754	Project promoter specifications
FRh$_2$Va	Electrolyser Z2	2030	212	Project promoter specifications
FRh$_2$Va	Electrolyser Z2	2040	412	Project promoter specifications
GR Z1	SMR/ATR	2030	785	
GR Z1	SMR/ATR	2040	393	
GR00 Z2	Electrolyser Z2	2030	974	
GR00 Z2	Electrolyser Z2	2040	6,513	
HR Z1	SMR/ATR	2030	917	
HR Z1	SMR/ATR	2040	459	
HR00 Z1	Electrolyser Z1	2030	990	
HR00 Z1	Electrolyser Z1	2040	1,355	
HR00 Z2	Electrolyser Z2	2030	43	
HR00 Z2	Electrolyser Z2	2040	2,914	
HU Z1	SMR/ATR	2030	1,264	
HU Z1	SMR/ATR	2040	632	
HU00 Z2	Electrolyser Z2	2030	195	
HU00 Z2	Electrolyser Z2	2040	686	
IE Z1	SMR/ATR	2030	0	
IE Z1	SMR/ATR	2040	0	
IE00 Z1	Electrolyser Z1	2030	266	
IE00 Z1	Electrolyser Z1	2040	364	
IE00 Z2	Electrolyser Z2	2030	625	
IE00 Z2	Electrolyser Z2	2040	3,122	
IT Z1	SMR/ATR	2030	3,158	
IT Z1	SMR/ATR	2040	1,579	
ITCA Z2	Electrolyser Z2	2030	1,311	

Node	Category	Year	Installed capacity13 [MWH_2]	Data sources besides TYNDP 2024 NT+ scenario14 with specifications of TYNDP 2024 Annex D115
ITCA Z2	Electrolyser Z2	2040	1,794	
ITCN Z2	Electrolyser Z2	2040	1,453	
ITCS Z2	Electrolyser Z2	2040	747	
ITN1 Z2	Electrolyser Z2	2040	1,560	
ITS1 Z2	Electrolyser Z2	2030	2,323	
ITS1 Z2	Electrolyser Z2	2040	3,179	
ITSI Z2	Electrolyser Z2	2030	424	
ITSI Z2	Electrolyser Z2	2040	991	
LT Z1	SMR/ATR	2030	1,469	
LT Z1	SMR/ATR	2040	734	
LT00 Z2	Electrolyser Z2	2030	243	
LT00 Z2	Electrolyser Z2	2040	1,963	
LU Z1	SMR/ATR	2030	0	
LU Z1	SMR/ATR	2040	0	
LUG1 Z1	Electrolyser Z1	2040	46	
LUG1 Z2	Electrolyser Z2	2030	41	
LUG1 Z2	Electrolyser Z2	2040	56	
LV Z1	SMR/ATR	2030	0	
LV Z1	SMR/ATR	2040	0	
NL Z1	SMR/ATR	2030	6,736	
NL Z1	SMR/ATR	2040	3,368	
NL00 Offshore	Electrolyser Offshore	2040	9,737	Project promoter specifications
NL00 Z2	Electrolyser Z2	2030	3,246	
NL00 Z2	Electrolyser Z2	2040	16,385	
PLh_2N	Electrolyser Z2	2040	158	Project promoter specifications
PLh_2nZ1a Z1	Electrolyser Z1	2040	694	Project promoter specifications
PLh_2S	Electrolyser Z2	2030	1,623	Project promoter specifications
PLh_2S	Electrolyser Z2	2040	3,038	Project promoter specifications
PLN Z1	SMR/ATR	2030	2,255	Project promoter specifications
PLN Z1	SMR/ATR	2040	1,127	Project promoter specifications
PLS Z1	SMR/ATR	2030	2,255	Project promoter specifications
PLS Z1	SMR/ATR	2040	1,127	Project promoter specifications

Node	Category	Year	Installed capacity13 [MWH_2]	Data sources besides TYNDP 2024 NT+ scenario14 with specifications of TYNDP 2024 Annex D115
PT Z1	SMR/ATR	2030	542	
PT Z1	SMR/ATR	2040	271	
PT00 Z1	Electrolyser Z1	2040	82	
PT00 Z2	Electrolyser Z2	2030	1,014	
PT00 Z2	Electrolyser Z2	2040	1,538	
RO Z1	SMR/ATR	2030	1,834	
RO Z1	SMR/ATR	2040	917	
RO00 Z2	Electrolyser Z2	2030	406	
RO00 Z2	Electrolyser Z2	2040	567	
SE Z1	SMR/ATR	2030	664	
SE Z1	SMR/ATR	2040	332	
SE01 Z1	Electrolyser Z1	2030	74	
SE01 Z1	Electrolyser Z1	2040	101	
SE01 Z2	Electrolyser Z2	2030	1,201	
SE01 Z2	Electrolyser Z2	2040	1,644	
SE02 Z1	Electrolyser Z1	2030	474	
SE02 Z1	Electrolyser Z1	2040	2,035	
SE02 Z2	Electrolyser Z2	2030	1,163	
SE02 Z2	Electrolyser Z2	2040	1,592	
SE03 Z2	Electrolyser Z2	2040	8,936	
SE04 Z1	Electrolyser Z1	2030	109	
SE04 Z1	Electrolyser Z1	2040	149	
SE04 Z2	Electrolyser Z2	2030	2,388	
SE04 Z2	Electrolyser Z2	2040	3,268	
SI Z1	SMR/ATR	2030	0	
SI Z1	SMR/ATR	2040	0	
SI00 Z1	Electrolyser Z1	2030	45	
SI00 Z1	Electrolyser Z1	2040	142	
SI00 Z2	Electrolyser Z2	2030	186	
SI00 Z2	Electrolyser Z2	2040	1,772	
SKE Z1	SMR/ATR	2030	311	Project promoter specifications
SKE Z1	SMR/ATR	2040	155	Project promoter specifications

Node	Category	Year	Installed capacity13 [MWH$_2$]	Data sources besides TYNDP 2024 NT+ scenario14 with specifications of TYNDP 2024 Annex D115
SKW Z1	SMR/ATR	2030	621	Project promoter specifications
SKW Z1	SMR/ATR	2040	311	Project promoter specifications
UK Z1	SMR/ATR	2030	3,528	
UK Z1	SMR/ATR	2040	1,764	
UK00 Z1	Electrolyser Z1	2030	1,919	
UK00 Z1	Electrolyser Z1	2040	7,280	
UK00 Z2	Electrolyser Z2	2030	1,900	
UK00 Z2	Electrolyser Z2	2040	12,038	
UKNI	Electrolyser Z2	2030	2,405	
UKNI	Electrolyser Z2	2040	3,292	
UKNI Z1	Electrolyser Z1	2030	282	
UKNI Z1	Electrolyser Z1	2040	386	

Picture courtesy of DESFA

ANNEX II: YEARLY ENERGY FLOWS

(IN EU-27 AND UK) FOR REFERENCE WEATHER YEAR AND STRESSFUL WEATHER YEAR IN 2030 AND 2040 ASSESSMENT CASES.

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/y								
AT	**35,673**	**35,232**	**37,815**	**35,256**	**3,544**	**31,584**	**3,867**	**31,351**
ATh$_2$ → CZh$_2$	0	0	0	0	0	0	0	0
ATh$_2$ → DEh$_2$	25,165	15,271	29,050	16,328	3,241	22,275	3,612	22,735
ATh$_2$ → HUh$_2$	0	0	0	0	0	0	0	0
ATh$_2$ → IB-ITh$_2$	1	92	0	15	303	822	255	670
ATh$_2$ → IB-SKh$_2$W	10,508	19,869	8,766	18,914	0	8,487	0	7,946
ATh$_2$ → SIh$_2$	0	0	0	0	0	0	0	0
BE	**312**	**13,421**	**317**	**14,051**	**3,947**	**13,106**	**4,993**	**13,708**
BEh$_2$ → BEH$_2$Mo	0	0	0	0	0	0	0	0
BEh$_2$ → DEh$_2$	312	8,880	317	10,019	3,947	7,058	4,993	7,921
BEh$_2$ → FRh$_2$	0	1,987	0	2,166	0	1,798	0	2,138
BEh$_2$ → FRh$_2$N	0	0	0	0	0	0	0	0
BEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
BEh$_2$ → NLh$_2$	0	2,554	0	1,866	0	4,250	0	3,648
BEh$_2$ → UKh$_2$/INT	0	0	0	0	0	0	0	0
BEH$_2$Mo → BEh$_2$	0	0	0	0	0	0	0	0
BEH$_2$Mo → FRh$_2$Va	0	0	0	0	0	0	0	0
BG	**1,278**	**0**	**1,277**	**0**	**1,273**	**0**	**1,274**	**0**
BGh$_2$ → GRh$_2$	1,278	0	1,277	0	1,273	0	1,274	0
BGh$_2$ → MKh$_2$	0	0	0	0	0	0	0	0
BGh$_2$ → ROh$_2$	0	0	0	0	0	0	0	0
CZ	**0**	**1,158**	**0**	**751**	**0**	**5,301**	**0**	**5,669**
CZh$_2$ → ATh$_2$	0	0	0	0	0	0	0	0
CZh$_2$ → DEh$_2$	0	1,158	0	751	0	5,301	0	5,669
CZh$_2$ → IB-SKh$_2$W	0	0	0	0	0	0	0	0
CZh$_2$ → PLh$_2$S	0	0	0	0	0	0	0	0

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/y								
DE	**48,606**	**53,038**	**42,181**	**51,138**	**41,550**	**42,774**	**33,850**	**42,722**
DEh_2 → ATh_2	206	2,016	61	1,861	2,924	2,021	2,474	1,959
DEh_2 → BEh_2	6,192	4,416	3,666	4,092	4,990	6,722	3,177	6,142
DEh_2 → CHh_2	0	0	0	0	0	0	0	0
DEh_2 → CZh_2	4,020	11,744	3,418	9,495	3,553	5,197	2,831	4,410
DEh_2 → DKh_2	3,816	2,942	3,584	2,747	1,981	3,098	1,576	2,777
DEh_2 → FRh_2	4,937	5,807	5,650	6,357	2,773	6,404	3,292	6,877
DEh_2 → LUh_2	0	0	0	0	0	0	0	0
DEh_2 → NLh_2	3,147	5,384	1,722	4,049	2,510	7,374	1,443	5,953
DEh_2 → PLh_2N	6,339	5,020	5,745	4,636	0	0	0	0
DEh_2 → PLh_2nbc	9,008	13,214	10,472	15,132	13,337	11,957	13,040	14,605
DEh_2 → Y-NOh_2	0	0	0	0	0	0	0	0
DEh_2ba → DEh_2	0	0	0	0	0	0	0	0
DEh_2bp → DEh_2	1,508	2,495	2,215	2,770	0	0	0	0
DEh_2bp → DEh_2ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	9,434		5,648		9,482		6,017	
DK	**8,442**	**20,685**	**6,714**	**18,553**	**8,848**	**20,477**	**6,945**	**18,421**
DKh_2 → DEh_2	8,442	20,685	6,714	18,553	8,848	20,477	6,945	18,421
DKh_2 → PLh_2N	0	0	0	0	0	0	0	0
DKh_2 → SEh_2	0	0	0	0	0	0	0	0
EE	**2,394**	**37,945**	**4,446**	**28,772**	**1,815**	**33,886**	**2,965**	**24,365**
EEh_2 → FIh_2S	794	0	3,299	0	536	0	2,160	0
EEh_2 → LVh_2	1,600	37,945	1,147	28,772	1,278	33,886	805	24,365
ES	**47.013**	**61,841**	**40,809**	**59,256**	**46,779**	**62,483**	**40,963**	**59,633**
ESh_2 → FRh_2S	46.286	58,855	39,998	56,379	46,127	59,498	40,246	56,742
ESh_2 → FRh_2SW	0	0	0	0	0	0	0	0
ESh_2 → ITh_2	0	0	0	0	0	0	0	0
ESh_2 → PTh_2	728	2,986	811	2,877	652	2,984	717	2,891

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/y							
FI	**78,985**	**231,122**	**61,409**	**190,718**	**80,089**	**232,698**	**61,304**	**192,150**
FIh_2 → FIh_2AI	18,041	48,761	14,256	39,689	18,483	50,891	14,375	41,988
FIh_2 → FIh_2N	24	129	101	300	0	189	0	359
FIh_2 → FIh_2S	754	1,928	653	2,577	768	1,009	596	1,480
FIh_2AI → DEh_2	34,093	66,965	24,089	51,231	34,800	70,052	25,022	54,682
FIh_2AI → FIh_2	1,451	3,700	1,397	4,516	1,480	2,384	1,427	3,135
FIh_2AI → PLh_2N	0	0	0	0	0	0	0	0
FIh_2AI → SEh_2	98	235	570	518	0	282	0	545
FIh_2N → FIh_2	15,221	16,549	11,604	13,489	15,405	16,880	11,874	14,039
FIh_2N → SEh_2	135	4,027	459	5,989	113	4,204	472	5,950
FIh_2S → EEh_2	1,991	40,453	1,455	31,051	1,663	36,361	1,108	26,631
FIh_2S → FIh_2	7,176	48,374	6,825	41,358	7,378	50,445	6,429	43,341
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**85,000**	**105,452**	**75,534**	**101,399**	**86,468**	**106,326**	**75,248**	**101,990**
FRh_2 → BEh_2	0	4,919	0	4,108	0	5,944	0	4,842
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	34,570	27,552	29,608	25,187	36,164	27,051	30,315	25,034
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	2,196	3,628	2,644	3,814	1,873	3,784	2,236	3,955
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	379	0	396	4	188	0	178	5
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	8,027	0	9,456	0	7,429	0	8,815
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	2,169	3,324	2,529	3,559	1,788	3,540	2,030	3,636
FRh_2S → FRh_2	44,301	54,800	39,121	52,340	45,208	55,391	39,454	52,761
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	1,129	2,326	1,018	2,131	971	2,323	810	2,145
FRh_2Va → FRh_2	258	876	218	802	276	865	225	797
GR	**5**	**3,140**	**4**	**3,149**	**5**	**3,188**	**4**	**3,221**
GRh_2 → BGh_2	5	3,140	4	3,149	5	3,188	4	3,221
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/y							
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**6,214**	**14,100**	**5,138**	**12,941**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	97	0	116	0	0	0	0
$HUh_2 \rightarrow ROh_2$	6,214	14,003	5,138	12,826	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**60,745**	**170,730**	**59,505**	**170,965**	**5,827**	**158,006**	**6,265**	**160,574**
IB-$ITh_2 \rightarrow ATh_2$	41,520	54,669	43,805	54,550	5,524	51,696	6,010	51,588
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	1	92	0	15	303	822	255	670
IB-$SKh_2C \rightarrow HUh_2$	8,032	30,202	6,311	29,208	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	685	676	623	665	0	895	0	847
IB-$SKh_2C \rightarrow SKh_2W$	0	15,554	0	16,634	0	32,650	0	33,822
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	38,184	0	38,527	0	34,591	0	35,843
IB-$SKh_2W \rightarrow ATh_2$	0	1,807	0	2,187	0	2,679	0	2,829
IB-$SKh_2W \rightarrow CZh_2$	418	17,583	566	17,513	0	31,962	0	32,425
IB-$SKh_2W \rightarrow SKh_2W$	10,090	11,963	8,199	11,666	0	2,711	0	2,549
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**41,520**	**54,669**	**43,805**	**54,550**	**5,524**	**51,696**	**6,010**	**51,588**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	41,520	54,669	43,805	54,550	5,524	51,696	6,010	51,588
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**900**	**33,538**	**3,597**	**24,953**	**636**	**29,674**	**2,432**	**20,683**
$LTh_2 \rightarrow LVh_2$	900	61	3,597	98	632	129	2,427	198
$LTh_2 \rightarrow PLh_2nbc$	0	33,477	0	24,855	4	29,545	5	20,485

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/y								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**1,582**	**34,593**	**3,913**	**25,916**	**1,109**	**30,629**	**2,559**	**21,618**
$LVh_2 \rightarrow EEh_2$	825	0	3,387	0	564	0	2,239	0
$LVh_2 \rightarrow LTh_2$	758	34,593	526	25,916	545	30,629	320	21,618
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**10,007**	**34,883**	**14,583**	**32,610**	**13,548**	**27,988**	**17,082**	**26,116**
$NLh_2 \rightarrow BEh_2$	2,309	16,018	2,472	14,282	2,286	17,353	2,201	14,677
$NLh_2 \rightarrow DEh_2$	7,698	18,866	12,111	18,327	11,262	10,635	14,881	11,438
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**9,008**	**50,337**	**10,473**	**43,353**	**13,341**	**41,653**	**13,045**	**35,163**
$PLh_2N \rightarrow DEh_2$	0	168	1	137	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	3,353	0	3,197	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	4,866	0	3,487	1	12,335	2	8,507
$PLh_2nbc \rightarrow LTh_2$	1,191	0	4,154	0	852	0	2,862	0
$PLh_2nbc \rightarrow PLh_2N$	7,818	41,887	6,319	36,517	12,489	29,242	10,181	26,619
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	62	0	16	0	75	0	37
PT	**3,777**	**0**	**3,417**	**6**	**3,823**	**0**	**3,428**	**6**
$PTh_2 \rightarrow ESh_2$	3,777	0	3,417	6	3,823	0	3,428	6
RO	**0**	**21**	**0**	**39**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	21	0	39	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**17,749**	**23,157**	**11,959**	**18,192**	**17,947**	**22,524**	**12,278**	**17,485**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	17,601	22,139	11,801	16,576	17,797	21,827	12,074	16,374
$SEh_2 \rightarrow FIh_2N$	148	1,018	158	1,615	150	697	204	1,111

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/y								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**8,717**	**57,819**	**6,934**	**58,843**	**0**	**62,410**	**0**	**64,527**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	35,971	0	36,283	0	32,650	0	33,822
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	8,717	10,363	6,934	10,108	0	895	0	847
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	11,484	0	12,452	0	28,865	0	29,858
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0

ANNEX III: MONTHLY ENERGY FLOWS

(IN EU-27 AND UK) FOR REFERENCE WEATHER YEAR AND STRESSFUL WEATHER YEARS IN 2030 AND 2040 ASSESSMENT CASES

JANUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
AT	**3,098**	**1,888**	**3,456**	**1,080**	**402**	**1,778**	**98**	**1,146**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	1,813	1,068	2,933	911	402	1,503	98	1,127
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-SKh_2W	1,285	820	523	169	0	276	0	19
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BE	**29**	**1,230**	**46**	**2,095**	**307**	**1,179**	**772**	**2,217**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	29	1,013	46	1,362	307	910	772	1,375
BEh_2 → FRh_2	0	139	0	222	0	140	0	224
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	78	0	511	0	129	0	618
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**98**	**0**	**97**	**0**	**98**	**0**	**97**	**0**
BGh_2 → GRh_2	98	0	97	0	98	0	97	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0

JANUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
CZ	**0**	**37**	**0**	**336**	**0**	**164**	**0**	**460**
CZh$_2$ → ATh$_2$	0	0	0	0	0	0	0	0
CZh$_2$ → DEh$_2$	0	37	0	336	0	164	0	460
CZh$_2$ → IB-SKh$_2$W	0	0	0	0	0	0	0	0
CZh$_2$ → PLh$_2$S	0	0	0	0	0	0	0	0
DE	**3,564**	**2,486**	**1,299**	**1,313**	**2,997**	**1,224**	**680**	**865**
DEh$_2$ → ATh$_2$	29	150	2	82	185	108	58	125
DEh$_2$ → BEh$_2$	475	38	22	1	330	105	13	7
DEh$_2$ → CHh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → CZh$_2$	447	1,024	135	290	397	423	119	96
DEh$_2$ → DKh$_2$	187	50	184	32	94	50	56	34
DEh$_2$ → FRh$_2$	46	23	135	17	21	37	81	24
DEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → NLh$_2$	117	27	12	90	63	38	0	195
DEh$_2$ → PLh$_2$N	556	334	246	160	0	0	0	0
DEh$_2$ → PLh$_2$nbc	730	536	208	248	1,157	464	338	384
DEh$_2$ → Y-NOh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ba → DEh$_2$	0	0	0	0	0	0	0	0
DEh$_2$bp → DEh$_2$	103	303	352	392	0	0	0	0
DEh$_2$bp → DEh$_2$ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	875		3		749		16	
DK	**883**	**2,148**	**277**	**990**	**919**	**2,147**	**260**	**1,041**
DKh$_2$ → DEh$_2$	883	2,148	277	990	919	2,147	260	1,041
DKh$_2$ → PLh$_2$N	0	0	0	0	0	0	0	0
DKh$_2$ → SEh$_2$	0	0	0	0	0	0	0	0
EE	**149**	**4,196**	**110**	**2,516**	**114**	**3,970**	**52**	**2,619**
EEh$_2$ → FIh$_2$S	2	0	44	0	2	0	18	0
EEh$_2$ → LVh$_2$	147	4,196	66	2,516	112	3,970	35	2,619

JANUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
ES	**5,191**	**6,292**	**3,206**	**4,918**	**5,231**	**6,348**	**3,165**	**4,955**
$ESh_2 \rightarrow FRh_2S$	5,148	6,049	3,160	4,738	5,187	6,109	3,114	4,770
$ESh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow PTh_2$	43	242	46	180	44	240	52	185
FI	**8,254**	**25,075**	**6,734**	**22,076**	**8,314**	**25,270**	**6,716**	**22,321**
$FIh_2 \rightarrow FIh_2AI$	1,953	5,666	1,744	5,466	2,002	5,807	1,804	5,548
$FIh_2 \rightarrow FIh_2N$	0	0	3	25	0	0	0	11
$FIh_2 \rightarrow FIh_2S$	50	14	7	5	46	0	3	0
$FIh_2AI \rightarrow DEh_2$	3,618	7,343	2,698	6,161	3,622	7,523	2,632	6,272
$FIh_2AI \rightarrow FIh_2$	89	66	34	16	84	19	27	8
$FIh_2AI \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$FIh_2AI \rightarrow SEh_2$	0	0	9	28	0	0	0	45
$FIh_2N \rightarrow FIh_2$	1,664	1,943	1,433	1,439	1,669	1,995	1,441	1,483
$FIh_2N \rightarrow SEh_2$	8	307	27	790	12	295	22	690
$FIh_2S \rightarrow EEh_2$	186	4,426	98	2,707	151	4,199	66	2,807
$FIh_2S \rightarrow FIh_2$	687	5,309	682	5,437	729	5,432	721	5,458
$FIh_2S \rightarrow FIh_2SZ1$	0	0	0	0	0	0	0	0
$FIh_2SZ1 \rightarrow FIh_2S$	0	0	0	0	0	0	0	0
FR	**9,682**	**9,568**	**5,409**	**8,341**	**9,797**	**9,731**	**5,343**	**8,642**
$FRh_2 \rightarrow BEh_2$	0	189	0	92	0	340	0	117
$FRh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow DEh_2$	4,377	2,668	2,153	2,354	4,496	2,661	2,180	2,571
$FRh_2 \rightarrow FRh_2N$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2S$	26	14	33	1	15	27	26	3
$FRh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2Va$	24	0	32	0	10	0	12	0
$FRh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$FRh_2N \rightarrow BEh_2$	0	875	0	1,422	0	770	0	1,380
$FRh_2N \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2S \rightarrow ESh_2$	23	13	37	0	13	26	30	1
$FRh_2S \rightarrow FRh_2$	5,099	5,543	3,101	4,347	5,141	5,647	3,063	4,443
$FRh_2S \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2S$	0	0	0	0	0	0	0	0
$FRh_2Va \rightarrow BEH_2Mo$	103	211	48	98	90	205	28	100
$FRh_2Va \rightarrow FRh_2$	30	55	4	26	32	54	4	27

JANUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
GR	**0**	**203**	**0**	**170**	**0**	**204**	**0**	**162**
$GRh_2 \rightarrow BGh_2$	0	203	0	170	0	204	0	162
$GRh_2 \rightarrow CYh_2$	0	0	0	0	0	0	0	0
$GRh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**674**	**720**	**190**	**217**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow IB\text{-}SKh_2C$	0	0	0	60	0	0	0	0
$HUh_2 \rightarrow ROh_2$	674	720	190	157	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**5,936**	**14,190**	**4,799**	**14,372**	**685**	**14,775**	**376**	**15,797**
$IB\text{-}ITh_2 \rightarrow ATh_2$	3,578	3,945	3,953	3,561	685	3,946	376	3,575
$IB\text{-}ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$IB\text{-}ITh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
$IB\text{-}SKh_2C \rightarrow HUh_2$	992	2,546	278	1,758	0	0	0	0
$IB\text{-}SKh_2C \rightarrow SKh_2E$	81	5	45	1	0	26	0	3
$IB\text{-}SKh_2C \rightarrow SKh_2W$	0	1,563	0	2,477	0	3,590	0	4,141
$IB\text{-}SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$IB\text{-}SKh_2E \rightarrow SKh_2E$	0	4,277	0	4,427	0	3,847	0	4,391
$IB\text{-}SKh_2W \rightarrow ATh_2$	0	121	0	684	0	170	0	818
$IB\text{-}SKh_2W \rightarrow CZh_2$	49	1,595	103	1,447	0	3,116	0	2,861
$IB\text{-}SKh_2W \rightarrow SKh_2W$	1,236	139	420	18	0	80	0	9
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,578**	**3,945**	**3,953**	**3,561**	**685**	**3,946**	**376**	**3,575**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow IB\text{-}ITh_2$	3,578	3,945	3,953	3,561	685	3,946	376	3,575
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0

JANUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LT	**4**	**3,718**	**48**	**2,163**	**6**	**3,507**	**23**	**2,305**
LTh_2 → LVh_2	4	1	48	1	5	1	22	1
LTh_2 → PLh_2nbc	0	3,718	0	2,162	2	3,506	2	2,304
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
LUh_2 → BEh_2	0	0	0	0	0	0	0	0
LUh_2 → DEh_2	0	0	0	0	0	0	0	0
LUh_2 → FRh_2	0	0	0	0	0	0	0	0
LV	**72**	**3,886**	**73**	**2,300**	**51**	**3,661**	**35**	**2,406**
LVh_2 → EEh_2	3	0	45	0	3	0	19	0
LVh_2 → LTh_2	69	3,886	28	2,300	48	3,661	16	2,406
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
MTh_2 → ITh_2	0	0	0	0	0	0	0	0
NL	**819**	**4,332**	**2,140**	**3,076**	**1,192**	**3,351**	**2,224**	**2,483**
NLh_2 → BEh_2	221	798	55	260	230	1,437	44	368
NLh_2 → DEh_2	598	3,534	2,085	2,816	962	1,914	2,179	2,115
NLh_2 → UKh_2	0	0	0	0	0	0	0	0
PL	**730**	**4,311**	**209**	**2,471**	**1,159**	**3,970**	**339**	**2,693**
PLh_2N → DEh_2	0	7	1	45	0	0	0	0
PLh_2N → DKh_2	0	0	0	0	0	0	0	0
PLh_2N → FIh_2AI	0	0	0	0	0	0	0	0
PLh_2N → PLh_2S	0	50	0	12	0	0	0	0
PLh_2nbc → DEh_2	0	623	0	686	1	1,472	2	1,219
PLh_2nbc → LTh_2	15	0	63	0	14	0	34	0
PLh_2nbc → PLh_2N	715	3,631	145	1,726	1,144	2,497	303	1,471
PLh_2nbc → PLh_2S	0	0	0	0	0	0	0	0
PLh_2S → CZh_2	0	0	0	0	0	0	0	0
PLh_2S → $IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
PLh_2S → PLh_2N	0	0	0	0	0	0	0	0
PLh_2S → PLh_2nbc	0	0	0	2	0	0	0	2
PT	**390**	**0**	**230**	**0**	**391**	**0**	**215**	**0**
PTh_2 → ESh_2	390	0	230	0	391	0	215	0
RO	**0**	**0**	**0**	**19**	**0**	**0**	**0**	**0**
ROh_2 → BGh_2	0	0	0	0	0	0	0	0
ROh_2 → HUh_2	0	0	0	19	0	0	0	0
ROh_2 → MDh_2	0	0	0	0	0	0	0	0
ROh_2 → RSh_2	0	0	0	0	0	0	0	0

JANUARY

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
SE	1,763	1,758	1,002	742	1,711	1,738	861	779
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	1,754	1,743	997	740	1,704	1,735	856	776
$SEh_2 \rightarrow FIh_2N$	9	14	5	2	7	2	5	3
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**1,073**	**5,147**	**323**	**6,155**	**0**	**6,706**	**0**	**7,812**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	4,000	0	4,161	0	3,590	0	4,141
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	1,073	114	323	14	0	26	0	3
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	1,033	0	1,979	0	3,090	0	3,668
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow UKh_2$	0	0	0	0	0	0	0	0

FEBRUARY

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
AT	**2,649**	**2,116**	**3,437**	**1,703**	**326**	**1,978**	**617**	**1,647**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	1,402	1,119	2,877	1,432	326	1,463	617	1,587
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	0	61	0	2	0	66	0	6
ATh_2 → IB-SKh_2W	1,246	937	561	270	0	449	0	54
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BE	**5**	**1,062**	**47**	**1,722**	**86**	**931**	**611**	**1,776**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	5	729	47	1,138	86	522	611	1,030
BEh_2 → FRh_2	0	238	0	205	0	228	0	213
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	95	0	379	0	181	0	533
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**86**	**0**	**84**	**0**	**85**	**0**	**84**	**0**
BGh_2 → GRh_2	86	0	84	0	85	0	84	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0
CZ	**0**	**48**	**0**	**226**	**0**	**162**	**0**	**539**
CZh_2 → ATh_2	0	0	0	0	0	0	0	0
CZh_2 → DEh_2	0	48	0	226	0	162	0	539
CZh_2 → IB-SKh_2W	0	0	0	0	0	0	0	0
CZh_2 → PLh_2S	0	0	0	0	0	0	0	0

FEBRUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
DE	**3,530**	**4,078**	**1,507**	**1,749**	**3,226**	**2,712**	**852**	**1,362**
$DEh_2 \rightarrow ATh_2$	51	508	1	42	233	438	38	121
$DEh_2 \rightarrow BEh_2$	462	65	47	3	322	253	24	45
$DEh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow CZh_2$	446	1,509	157	334	439	523	130	33
$DEh_2 \rightarrow DKh_2$	100	3	217	72	85	7	108	111
$DEh_2 \rightarrow FRh_2$	284	660	184	328	165	745	97	372
$DEh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow NLh_2$	149	81	10	114	93	247	2	248
$DEh_2 \rightarrow PLh_2N$	536	433	261	149	0	0	0	0
$DEh_2 \rightarrow PLh_2nbc$	881	578	289	349	1,385	500	411	432
$DEh_2 \rightarrow Y\text{-}NOh_2$	0	0	0	0	0	0	0	0
$DEh_2ba \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$DEh_2bp \rightarrow DEh_2$	14	241	301	358	0	0	0	0
$DEh_2bp \rightarrow DEh_2ba$	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	606		39		504		43	
DK	**1,172**	**2,415**	**308**	**722**	**1,176**	**2,415**	**274**	**734**
$DKh_2 \rightarrow DEh_2$	1,172	2,415	308	722	1,176	2,415	274	734
$DKh_2 \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$DKh_2 \rightarrow SEh_2$	0	0	0	0	0	0	0	0
EE	**200**	**4,014**	**144**	**1,565**	**175**	**3,813**	**112**	**1,617**
$EEh_2 \rightarrow FIh_2S$	73	0	75	0	55	0	76	0
$EEh_2 \rightarrow LVh_2$	127	4,014	69	1,565	120	3,813	36	1,617
ES	**3,934**	**5,032**	**3,204**	**4,485**	**4,062**	**5,083**	**3,181**	**4,754**
$ESh_2 \rightarrow FRh_2S$	3,880	4,785	3,134	4,267	4,014	4,833	3,115	4,568
$ESh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow PTh_2$	54	247	70	218	48	250	66	187

FEBRUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
FI	**6,991**	**21,001**	**4,304**	**16,088**	**7,013**	**21,094**	**4,262**	**16,463**
FIh_2 → FIh_2AI	1,619	4,264	1,113	4,025	1,635	4,359	1,130	4,166
FIh_2 → FIh_2N	3	0	2	6	0	0	0	11
FIh_2 → FIh_2S	54	47	33	61	45	23	17	51
FIh_2AI → DEh_2	3,058	6,495	1,577	4,432	3,092	6,649	1,576	4,572
FIh_2AI → FIh_2	98	154	57	91	85	87	34	96
FIh_2AI → PLh_2N	0	0	0	0	0	0	0	0
FIh_2AI → SEh_2	14	0	17	12	0	0	0	12
FIh_2N → FIh_2	1,372	1,627	923	993	1,392	1,607	912	1,076
FIh_2N → SEh_2	7	151	25	664	10	150	47	598
FIh_2S → EEh_2	163	4,234	93	1,711	156	4,032	59	1,761
FIh_2S → FIh_2	603	4,030	465	4,093	600	4,188	488	4,121
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**7,835**	**8,662**	**5,188**	**7,657**	**8,025**	**8,480**	**5,171**	**7,975**
FRh_2 → BEh_2	0	187	0	47	0	366	0	101
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	3,414	2,251	1,953	2,042	3,676	2,018	2,012	2,122
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	233	450	8	61	128	489	3	61
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	12	0	44	0	10	0	22	2
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	529	0	1,302	0	380	0	1,241
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	251	431	16	52	143	469	8	52
FRh_2S → FRh_2	3,795	4,540	3,110	4,014	3,940	4,486	3,089	4,255
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	98	211	54	110	96	211	35	113
FRh_2Va → FRh_2	32	62	3	28	33	61	3	28
GR	**0**	**226**	**0**	**309**	**0**	**227**	**0**	**310**
GRh_2 → BGh_2	0	226	0	309	0	227	0	310
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

FEBRUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**716**	**938**	**238**	**265**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	31	0	35	0	0	0	0
$HUh_2 \rightarrow ROh_2$	716	907	238	230	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**5,398**	**12,476**	**4,843**	**13,304**	**547**	**12,778**	**911**	**14,856**
IB-$ITh_2 \rightarrow ATh_2$	3,060	3,184	3,894	3,614	547	3,175	911	3,612
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	61	0	2	0	66	0	6
IB-$SKh_2C \rightarrow HUh_2$	1,018	2,527	343	1,739	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	74	8	45	0	0	32	0	0
IB-$SKh_2C \rightarrow SKh_2W$	0	1,205	0	2,067	0	3,091	0	3,801
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	3,822	0	4,018	0	3,310	0	4,028
IB-$SKh_2W \rightarrow ATh_2$	0	65	0	411	0	126	0	422
IB-$SKh_2W \rightarrow CZh_2$	8	1,442	79	1,453	0	2,878	0	2,987
IB-$SKh_2W \rightarrow SKh_2W$	1,238	162	482	0	0	101	0	0
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,060**	**3,184**	**3,894**	**3,614**	**547**	**3,175**	**911**	**3,612**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,060	3,184	3,894	3,614	547	3,175	911	3,612
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**82**	**3,705**	**82**	**1,293**	**66**	**3,476**	**85**	**1,345**
$LTh_2 \rightarrow LVh_2$	82	0	82	2	66	0	85	2
$LTh_2 \rightarrow PLh_2nbc$	0	3,705	0	1,291	0	3,475	0	1,343

FEBRUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**132**	**3,723**	**111**	**1,411**	**110**	**3,522**	**94**	**1,468**
$LVh_2 \rightarrow EEh_2$	76	0	78	0	59	0	79	0
$LVh_2 \rightarrow LTh_2$	56	3,723	33	1,411	51	3,522	15	1,468
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**571**	**4,341**	**1,693**	**1,954**	**815**	**3,421**	**1,751**	**1,343**
$NLh_2 \rightarrow BEh_2$	339	1,011	90	205	387	1,610	62	274
$NLh_2 \rightarrow DEh_2$	232	3,330	1,603	1,749	428	1,811	1,689	1,069
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**881**	**4,328**	**289**	**1,728**	**1,385**	**3,975**	**411**	**1,842**
$PLh_2N \rightarrow DEh_2$	0	0	0	49	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	45	0	11	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	556	0	240	0	1,431	0	648
$PLh_2nbc \rightarrow LTh_2$	96	0	89	0	79	0	91	0
$PLh_2nbc \rightarrow PLh_2N$	785	3,727	200	1,413	1,306	2,544	320	1,161
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	0	0	14	0	0	0	34
PT	**334**	**0**	**245**	**6**	**337**	**0**	**248**	**6**
$PTh_2 \rightarrow ESh_2$	334	0	245	6	337	0	248	6
RO	**0**	**14**	**0**	**14**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	14	0	14	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**1,560**	**2,411**	**543**	**543**	**1,551**	**2,388**	**484**	**525**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	1,551	2,386	538	510	1,542	2,377	480	513
$SEh_2 \rightarrow FIh_2N$	9	25	5	33	9	10	4	11

FEBRUARY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**1,091**	**4,442**	**388**	**5,365**	**0**	**5,779**	**0**	**7,156**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	3,578	0	3,771	0	3,091	0	3,801
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	1,091	131	388	0	0	32	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	733	0	1,594	0	2,656	0	3,355
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow UKh_2$	0	0	0	0	0	0	0	0

MARCH	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
AT	**3,317**	**3,460**	**3,895**	**3,236**	**606**	**3,137**	**789**	**3,172**
ATh$_2$ → CZh$_2$	0	0	0	0	0	0	0	0
ATh$_2$ → DEh$_2$	2,118	1,594	3,062	2,173	606	1,975	789	2,658
ATh$_2$ → HUh$_2$	0	0	0	0	0	0	0	0
ATh$_2$ → IB-ITh$_2$	0	0	0	0	0	0	0	0
ATh$_2$ → IB-SKh$_2$W	1,199	1,866	834	1,063	0	1,162	0	514
ATh$_2$ → SIh$_2$	0	0	0	0	0	0	0	0
BE	**11**	**554**	**30**	**1,389**	**127**	**506**	**486**	**1,275**
BEh$_2$ → BEH$_2$Mo	0	0	0	0	0	0	0	0
BEh$_2$ → DEh$_2$	11	348	30	1,084	127	307	486	841
BEh$_2$ → FRh$_2$	0	149	0	199	0	107	0	188
BEh$_2$ → FRh$_2$N	0	0	0	0	0	0	0	0
BEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
BEh$_2$ → NLh$_2$	0	57	0	106	0	92	0	246
BEh$_2$ → UKh$_2$/INT	0	0	0	0	0	0	0	0
BEH$_2$Mo → BEh$_2$	0	0	0	0	0	0	0	0
BEH$_2$Mo → FRh$_2$Va	0	0	0	0	0	0	0	0
BG	**99**	**0**	**99**	**0**	**98**	**0**	**99**	**0**
BGh$_2$ → GRh$_2$	99	0	99	0	98	0	99	0
BGh$_2$ → MKh$_2$	0	0	0	0	0	0	0	0
BGh$_2$ → ROh$_2$	0	0	0	0	0	0	0	0
CH	0	0	0	0	0	0	0	0
CHh$_2$ → DEh$_2$	0	0	0	0	0	0	0	0
CHh$_2$ → FRh$_2$	0	0	0	0	0	0	0	0
CHh$_2$ → IB-ITh$_2$	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh$_2$ → GRh$_2$	0	0	0	0	0	0	0	0
CZ	0	0	0	0	0	274	0	599
CZh$_2$ → ATh$_2$	0	0	0	0	0	0	0	0
CZh$_2$ → DEh$_2$	0	0	0	0	0	274	0	599
CZh$_2$ → IB-SKh$_2$W	0	0	0	0	0	0	0	0
CZh$_2$ → PLh$_2$S	0	0	0	0	0	0	0	0

MARCH	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
DE	**4,292**	**4,929**	**2,900**	**3,083**	**3,958**	**3,562**	**1,956**	**2,367**
$DEh_2 \rightarrow ATh_2$	31	110	2	15	200	195	50	5
$DEh_2 \rightarrow BEh_2$	655	447	142	44	495	638	142	178
$DEh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow CZh_2$	414	1,471	282	452	416	527	238	50
$DEh_2 \rightarrow DKh_2$	166	165	372	178	143	152	131	190
$DEh_2 \rightarrow FRh_2$	283	721	205	295	240	656	67	366
$DEh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow NLh_2$	281	200	46	65	152	431	47	240
$DEh_2 \rightarrow PLh_2N$	588	554	451	349	0	0	0	0
$DEh_2 \rightarrow PLh_2nbc$	942	1,164	999	1,370	1,531	964	1,134	1,338
$DEh_2 \rightarrow Y\text{-}NOh_2$	0	0	0	0	0	0	0	0
$DEh_2ba \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$DEh_2bp \rightarrow DEh_2$	18	98	243	316	0	0	0	0
$DEh_2bp \rightarrow DEh_2ba$	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	915		159		782		147	
DK	**1,106**	**2,532**	**370**	**1,429**	**1,146**	**2,505**	**396**	**1,387**
$DKh_2 \rightarrow DEh_2$	1,106	2,532	370	1,429	1,146	2,505	396	1,387
$DKh_2 \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$DKh_2 \rightarrow SEh_2$	0	0	0	0	0	0	0	0
EE	**224**	**4,224**	**581**	**1,965**	**196**	**3,764**	**348**	**1,635**
$EEh_2 \rightarrow FIh_2S$	63	0	507	0	50	0	305	0
$EEh_2 \rightarrow LVh_2$	161	4,224	74	1,965	146	3,764	43	1,635
ES	**4,733**	**5,320**	**3,692**	**5,208**	**4,795**	**5,606**	**3,683**	**5,134**
$ESh_2 \rightarrow FRh_2S$	4,696	5,076	3,653	4,992	4,760	5,348	3,648	4,914
$ESh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow PTh_2$	37	244	39	216	35	258	36	221

MARCH	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
FI	**7,188**	**22,555**	**4,363**	**14,974**	**7,011**	**22,594**	**4,247**	**15,471**
$FIh_2 \rightarrow FIh_2Al$	1,591	4,612	1,049	2,960	1,565	4,751	1,007	3,259
$FIh_2 \rightarrow FIh_2N$	3	11	14	83	0	6	0	90
$FIh_2 \rightarrow FIh_2S$	74	105	37	124	94	55	20	105
$FIh_2Al \rightarrow DEh_2$	3,193	6,816	1,379	3,824	3,060	7,116	1,609	4,121
$FIh_2Al \rightarrow FIh_2$	133	243	72	242	166	166	61	244
$FIh_2Al \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$FIh_2Al \rightarrow SEh_2$	12	7	146	125	0	12	0	113
$FIh_2N \rightarrow FIh_2$	1,362	1,734	767	839	1,344	1,748	848	951
$FIh_2N \rightarrow SEh_2$	8	173	154	999	9	198	141	946
$FIh_2S \rightarrow EEh_2$	200	4,465	98	2,163	183	4,006	66	1,836
$FIh_2S \rightarrow FIh_2$	613	4,389	647	3,615	589	4,537	494	3,806
$FIh_2S \rightarrow FIh_2SZ1$	0	0	0	0	0	0	0	0
$FIh_2SZ1 \rightarrow FIh_2S$	0	0	0	0	0	0	0	0
FR	**8,740**	**8,780**	**6,488**	**8,298**	**8,863**	**8,932**	**6,424**	**8,112**
$FRh_2 \rightarrow BEh_2$	0	640	0	171	0	715	0	300
$FRh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow DEh_2$	3,651	2,001	2,720	1,951	3,767	2,056	2,714	1,844
$FRh_2 \rightarrow FRh_2N$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2S$	223	463	42	180	195	390	26	188
$FRh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2Va$	26	0	29	0	23	0	19	0
$FRh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$FRh_2N \rightarrow BEh_2$	0	271	0	986	0	241	0	900
$FRh_2N \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2S \rightarrow ESh_2$	217	409	41	155	188	351	24	155
$FRh_2S \rightarrow FRh_2$	4,487	4,689	3,565	4,619	4,552	4,872	3,561	4,491
$FRh_2S \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2S$	0	0	0	0	0	0	0	0
$FRh_2Va \rightarrow BEH_2Mo$	108	229	75	181	107	229	64	179
$FRh_2Va \rightarrow FRh_2$	29	78	17	54	31	78	17	55
GR	**2**	**406**	**0**	**360**	**3**	**411**	**0**	**361**
$GRh_2 \rightarrow BGh_2$	2	406	0	360	3	411	0	361
$GRh_2 \rightarrow CYh_2$	0	0	0	0	0	0	0	0
$GRh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0

MARCH	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**716**	**1,468**	**423**	**847**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	716	1,468	423	847	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**6,040**	**14,351**	**5,863**	**15,363**	**910**	**12,754**	**1,150**	**16,201**
IB-$ITh_2 \rightarrow ATh_2$	3,799	4,691	4,408	4,793	910	4,603	1,150	4,775
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
IB-$SKh_2C \rightarrow HUh_2$	971	2,976	559	2,409	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	71	47	62	8	0	96	0	22
IB-$SKh_2C \rightarrow SKh_2W$	0	891	0	1,693	0	2,351	0	3,710
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	3,368	0	4,191	0	2,518	0	3,952
IB-$SKh_2W \rightarrow ATh_2$	0	10	0	85	0	59	0	142
IB-$SKh_2W \rightarrow CZh_2$	15	1,459	87	1,971	0	2,832	0	3,533
IB-$SKh_2W \rightarrow SKh_2W$	1,183	910	747	213	0	296	0	66
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,799**	**4,691**	**4,408**	**4,793**	**910**	**4,603**	**1,150**	**4,775**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,799	4,691	4,408	4,793	910	4,603	1,150	4,775
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**71**	**3,679**	**543**	**1,556**	**62**	**3,218**	**340**	**1,197**
$LTh_2 \rightarrow LVh_2$	71	0	543	3	62	1	339	4
$LTh_2 \rightarrow PLh_2nbc$	0	3,679	0	1,552	0	3,218	0	1,194

MARCH	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**147**	**3,884**	**548**	**1,746**	**124**	**3,426**	**335**	**1,409**
$LVh_2 \rightarrow EEh_2$	65	0	519	0	53	0	316	0
$LVh_2 \rightarrow LTh_2$	82	3,884	29	1,746	71	3,426	18	1,409
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**515**	**3,720**	**1,612**	**3,293**	**751**	**3,388**	**1,682**	**2,511**
$NLh_2 \rightarrow BEh_2$	334	2,410	198	671	318	2,587	185	1,040
$NLh_2 \rightarrow DEh_2$	181	1,310	1,414	2,622	433	801	1,498	1,470
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**942**	**4,982**	**999**	**2,978**	**1,531**	**4,182**	**1,134**	**2,532**
$PLh_2N \rightarrow DEh_2$	0	0	0	1	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	139	0	54	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	418	0	197	0	1,217	0	437
$PLh_2nbc \rightarrow LTh_2$	88	0	609	0	80	0	393	0
$PLh_2nbc \rightarrow PLh_2N$	854	4,425	390	2,725	1,451	2,965	741	2,094
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	0	0	0	0	0	0	0
PT	**436**	**0**	**384**	**0**	**441**	**0**	**388**	**0**
$PTh_2 \rightarrow ESh_2$	436	0	384	0	441	0	388	0
RO	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**1,759**	**2,498**	**557**	**1,318**	**1,676**	**2,581**	**673**	**1,285**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	1,747	2,454	548	1,230	1,661	2,542	663	1,220
$SEh_2 \rightarrow FIh_2N$	12	44	9	87	15	38	10	65

MARCH	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SIh_2 → ATh_2	0	0	0	0	0	0	0	0
SIh_2 → HRh_2	0	0	0	0	0	0	0	0
SIh_2 → HUh_2	0	0	0	0	0	0	0	0
SIh_2 → ITh_2	0	0	0	0	0	0	0	0
SK	**1,042**	**4,426**	**621**	**5,316**	**0**	**4,471**	**0**	**6,960**
SKh_2E → IB-SKh_2C	0	3,151	0	3,936	0	2,351	0	3,710
SKh_2E → IB-SKh_2E	0	0	0	0	0	0	0	0
SKh_2W → IB-SKh_2C	1,042	763	621	174	0	96	0	22
SKh_2W → IB-SKh_2W	0	511	0	1,206	0	2,024	0	3,228
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
UKh_2 → BEh_2	0	0	0	0	0	0	0	0
UKh_2 → IEh_2	0	0	0	0	0	0	0	0
UKh_2 → NLh_2	0	0	0	0	0	0	0	0
UKh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
UKh_2/INT → BEh_2	0	0	0	0	0	0	0	0
UKh_2/INT → UKh_2	0	0	0	0	0	0	0	0

APRIL	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
AT	**3,033**	**4,116**	**3,293**	**3,550**	**303**	**3,805**	**473**	**3,255**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	2,186	1,680	2,555	1,677	280	2,498	467	2,361
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	0	0	0	0	23	9	6	38
ATh_2 → IB-SKh_2W	847	2,436	739	1,874	0	1,298	0	856
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BE	**13**	**663**	**28**	**801**	**139**	**617**	**286**	**726**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	13	456	28	595	139	265	286	287
BEh_2 → FRh_2	0	165	0	134	0	144	0	139
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	42	0	72	0	208	0	299
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**109**	**0**	**110**	**0**	**109**	**0**	**110**	**0**
BGh_2 → GRh_2	109	0	110	0	109	0	110	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0
CZ	**0**	**1**	**0**	**7**	**0**	**438**	**0**	**687**
CZh_2 → ATh_2	0	0	0	0	0	0	0	0
CZh_2 → DEh_2	0	1	0	7	0	438	0	687
CZh_2 → IB-SKh_2W	0	0	0	0	0	0	0	0
CZh_2 → PLh_2S	0	0	0	0	0	0	0	0

APRIL	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
DE	**5,063**	**4,953**	**4,550**	**4,517**	**4,577**	**3,932**	**3,528**	**3,674**
$DEh_2 \rightarrow ATh_2$	2	33	1	58	242	8	166	37
$DEh_2 \rightarrow BEh_2$	878	585	513	370	655	906	417	616
$DEh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow CZh_2$	335	1,014	312	658	315	317	246	180
$DEh_2 \rightarrow DKh_2$	276	172	330	509	194	228	174	486
$DEh_2 \rightarrow FRh_2$	291	678	474	188	193	651	150	194
$DEh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow NLh_2$	533	510	271	543	384	669	201	708
$DEh_2 \rightarrow PLh_2N$	568	491	559	429	0	0	0	0
$DEh_2 \rightarrow PLh_2nbc$	935	1,338	1,103	1,574	1,414	1,153	1,376	1,452
$DEh_2 \rightarrow Y\text{-}NOh_2$	0	0	0	0	0	0	0	0
$DEh_2ba \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$DEh_2bp \rightarrow DEh_2$	34	133	128	189	0	0	0	0
$DEh_2bp \rightarrow DEh_2ba$	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	1,212		860		1,180		798	
DK	**877**	**1,995**	**580**	**1,373**	**937**	**1,911**	**614**	**1,363**
$DKh_2 \rightarrow DEh_2$	877	1,995	580	1,373	937	1,911	614	1,363
$DKh_2 \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$DKh_2 \rightarrow SEh_2$	0	0	0	0	0	0	0	0
EE	**195**	**3,297**	**475**	**2,094**	**169**	**2,818**	**356**	**1,662**
$EEh_2 \rightarrow FIh_2S$	76	0	352	0	60	0	264	0
$EEh_2 \rightarrow LVh_2$	120	3,297	123	2,094	109	2,818	91	1,662
ES	**3,908**	**4,660**	**3,555**	**5,241**	**4,060**	**4,876**	**3,691**	**5,348**
$ESh_2 \rightarrow FRh_2S$	3,855	4,366	3,490	4,976	4,010	4,583	3,641	5,076
$ESh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow PTh_2$	53	295	65	265	49	293	50	272

APRIL	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
FI	**6,384**	**19,154**	**5,255**	**14,531**	**6,592**	**19,177**	**5,379**	**14,782**
$FIh_2 \rightarrow FIh_2Al$	1,397	3,868	1,185	2,921	1,448	4,076	1,224	3,177
$FIh_2 \rightarrow FIh_2N$	2	57	11	78	0	69	0	89
$FIh_2 \rightarrow FIh_2S$	114	152	49	131	118	89	41	52
$FIh_2Al \rightarrow DEh_2$	2,771	5,663	2,101	3,651	2,891	5,847	2,267	3,966
$FIh_2Al \rightarrow FIh_2$	199	288	107	246	193	199	108	159
$FIh_2Al \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$FIh_2Al \rightarrow SEh_2$	6	16	53	95	0	5	0	100
$FIh_2N \rightarrow FIh_2$	1,178	1,255	970	1,006	1,220	1,410	1,023	1,059
$FIh_2N \rightarrow SEh_2$	5	301	39	796	4	312	40	809
$FIh_2S \rightarrow EEh_2$	153	3,512	150	2,282	142	3,034	118	1,854
$FIh_2S \rightarrow FIh_2$	561	4,042	592	3,325	577	4,137	558	3,516
$FIh_2S \rightarrow FIh_2SZ1$	0	0	0	0	0	0	0	0
$FIh_2SZ1 \rightarrow FIh_2S$	0	0	0	0	0	0	0	0
FR	**7,121**	**7,861**	**6,305**	**8,009**	**7,555**	**8,167**	**6,496**	**8,211**
$FRh_2 \rightarrow BEh_2$	0	546	0	489	0	653	0	583
$FRh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow DEh_2$	2,909	1,730	2,611	1,943	3,176	1,709	2,770	1,905
$FRh_2 \rightarrow FRh_2N$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2S$	143	442	80	106	151	440	39	120
$FRh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2Va$	25	0	39	0	17	0	21	0
$FRh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$FRh_2N \rightarrow BEh_2$	0	410	0	623	0	378	0	557
$FRh_2N \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2S \rightarrow ESh_2$	155	409	82	93	159	416	32	111
$FRh_2S \rightarrow FRh_2$	3,761	4,039	3,376	4,497	3,926	4,282	3,537	4,674
$FRh_2S \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2S$	0	0	0	0	0	0	0	0
$FRh_2Va \rightarrow BEH_2Mo$	103	204	98	184	97	206	78	188
$FRh_2Va \rightarrow FRh_2$	25	82	19	73	29	82	21	73
GR	**0**	**297**	**0**	**288**	**0**	**312**	**0**	**291**
$GRh_2 \rightarrow BGh_2$	0	297	0	288	0	312	0	291
$GRh_2 \rightarrow CYh_2$	0	0	0	0	0	0	0	0
$GRh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0

APRIL	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**562**	**1,561**	**499**	**1,401**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	562	1,561	499	1,401	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**5,118**	**13,818**	**5,149**	**14,215**	**543**	**11,402**	**718**	**13,096**
IB-$ITh_2 \rightarrow ATh_2$	3,528	4,984	3,791	4,843	520	4,723	712	4,656
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	0	0	0	23	9	6	38
IB-$SKh_2C \rightarrow HUh_2$	694	2,687	570	2,535	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	49	104	49	73	0	121	0	84
IB-$SKh_2C \rightarrow SKh_2W$	0	830	0	1,163	0	1,783	0	2,535
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	2,166	0	2,861	0	1,888	0	2,678
IB-$SKh_2W \rightarrow ATh_2$	0	1	0	4	0	18	0	24
IB-$SKh_2W \rightarrow CZh_2$	5	1,234	20	1,516	0	2,489	0	2,830
IB-$SKh_2W \rightarrow SKh_2W$	842	1,812	719	1,221	0	371	0	252
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,528**	**4,984**	**3,791**	**4,843**	**520**	**4,723**	**712**	**4,656**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,528	4,984	3,791	4,843	520	4,723	712	4,656
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**88**	**3,020**	**383**	**1,780**	**73**	**2,549**	**293**	**1,346**
$LTh_2 \rightarrow LVh_2$	88	7	383	13	73	15	293	19
$LTh_2 \rightarrow PLh_2nbc$	0	3,013	0	1,767	0	2,535	1	1,327

APRIL	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**127**	**2,997**	**425**	**1,864**	**105**	**2,527**	**314**	**1,435**
$LVh_2 \rightarrow EEh_2$	79	0	361	0	64	0	273	0
$LVh_2 \rightarrow LTh_2$	47	2,997	64	1,864	41	2,527	41	1,435
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**346**	**2,659**	**709**	**2,123**	**602**	**2,144**	**1,017**	**1,749**
$NLh_2 \rightarrow BEh_2$	181	1,827	170	1,296	204	1,710	177	1,349
$NLh_2 \rightarrow DEh_2$	165	832	539	827	399	434	840	399
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**935**	**4,786**	**1,103**	**3,648**	**1,414**	**3,688**	**1,377**	**2,779**
$PLh_2N \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	435	0	307	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	293	0	159	0	905	0	487
$PLh_2nbc \rightarrow LTh_2$	111	0	433	0	89	0	334	0
$PLh_2nbc \rightarrow PLh_2N$	824	4,058	669	3,182	1,325	2,783	1,043	2,291
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	0	0	0	0	0	0	0
PT	**365**	**0**	**296**	**0**	**377**	**0**	**313**	**0**
$PTh_2 \rightarrow ESh_2$	365	0	296	0	377	0	313	0
RO	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**1,597**	**2,202**	**1,087**	**1,224**	**1,654**	**2,057**	**1,173**	**1,140**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	1,579	2,099	1,075	1,071	1,636	1,976	1,150	1,048
$SEh_2 \rightarrow FIh_2N$	18	103	12	153	18	81	22	92

APRIL	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SIh_2 → ATh_2	0	0	0	0	0	0	0	0
SIh_2 → HRh_2	0	0	0	0	0	0	0	0
SIh_2 → HUh_2	0	0	0	0	0	0	0	0
SIh_2 → ITh_2	0	0	0	0	0	0	0	0
SK	**743**	**4,232**	**620**	**4,638**	**0**	**3,484**	**0**	**4,869**
SKh_2E → IB-SKh_2C	0	2,043	0	2,707	0	1,783	0	2,535
SKh_2E → IB-SKh_2E	0	0	0	0	0	0	0	0
SKh_2W → IB-SKh_2C	743	1,577	620	1,064	0	121	0	84
SKh_2W → IB-SKh_2W	0	611	0	867	0	1,579	0	2,250
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
UKh_2 → BEh_2	0	0	0	0	0	0	0	0
UKh_2 → IEh_2	0	0	0	0	0	0	0	0
UKh_2 → NLh_2	0	0	0	0	0	0	0	0
UKh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
UKh_2/INT → BEh_2	0	0	0	0	0	0	0	0
UKh_2/INT → UKh_2	0	0	0	0	0	0	0	0

MAY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
AT	**3,136**	**3,818**	**2,924**	**4,700**	**293**	**3,321**	**232**	**3,850**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	2,283	1,579	2,116	1,566	259	2,283	200	2,101
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	0	2	0	0	34	69	32	91
ATh_2 → IB-SKh_2W	853	2,236	807	3,134	0	968	0	1,659
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BE	**21**	**955**	**6**	**537**	**231**	**917**	**165**	**426**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	21	659	6	304	231	468	165	100
BEh_2 → FRh_2	0	171	0	173	0	112	0	133
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	125	0	60	0	336	0	193
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**115**	**0**	**119**	**0**	**116**	**0**	**119**	**0**
BGh_2 → GRh_2	115	0	119	0	116	0	119	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0
CZ	**0**	**0**	**0**	**1**	**0**	**503**	**0**	**298**
CZh_2 → ATh_2	0	0	0	0	0	0	0	0
CZh_2 → DEh_2	0	0	0	1	0	503	0	298
CZh_2 → IB-SKh_2W	0	0	0	0	0	0	0	0
CZh_2 → PLh_2S	0	0	0	0	0	0	0	0

MAY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
DE	**5,093**	**5,380**	**5,295**	**6,216**	**4,825**	**4,364**	**4,965**	**4,918**
DEh$_2$ → ATh$_2$	8	129	13	84	288	83	318	88
DEh$_2$ → BEh$_2$	800	415	692	623	652	697	657	919
DEh$_2$ → CHh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → CZh$_2$	371	965	353	1,484	358	361	321	594
DEh$_2$ → DKh$_2$	343	473	212	293	255	501	93	300
DEh$_2$ → FRh$_2$	266	665	483	926	158	583	291	932
DEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → NLh$_2$	456	484	385	333	337	590	377	459
DEh$_2$ → PLh$_2$N	590	488	583	571	0	0	0	0
DEh$_2$ → PLh$_2$nbc	927	1,574	1,127	1,808	1,474	1,550	1,526	1,627
DEh$_2$ → Y-NOh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ba → DEh$_2$	0	0	0	0	0	0	0	0
DEh$_2$bp → DEh$_2$	60	187	69	94	0	0	0	0
DEh$_2$bp → DEh$_2$ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	1,272		1,377		1,305		1,382	
DK	**727**	**1,640**	**953**	**2,246**	**797**	**1,572**	**966**	**2,223**
DKh$_2$ → DEh$_2$	727	1,640	953	2,246	797	1,572	966	2,223
DKh$_2$ → PLh$_2$N	0	0	0	0	0	0	0	0
DKh$_2$ → SEh$_2$	0	0	0	0	0	0	0	0
EE	**241**	**2,746**	**360**	**3,102**	**198**	**1,970**	**275**	**2,477**
EEh$_2$ → FIh$_2$S	99	0	242	0	67	0	174	0
EEh$_2$ → LVh$_2$	143	2,746	117	3,102	131	1,970	101	2,477
ES	**4,472**	**5,021**	**3,506**	**5,152**	**4,676**	**5,106**	**3,479**	**5,059**
ESh$_2$ → FRh$_2$S	4,422	4,741	3,451	4,873	4,635	4,835	3,420	4,758
ESh$_2$ → FRh$_2$SW	0	0	0	0	0	0	0	0
ESh$_2$ → ITh$_2$	0	0	0	0	0	0	0	0
ESh$_2$ → PTh$_2$	51	280	55	279	41	271	59	301

MAY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
FI	**6,131**	**14,306**	**5,634**	**17,086**	**6,280**	**13,782**	**5,603**	**17,337**
FIh_2 → FIh_2AI	1,261	2,282	1,245	3,299	1,290	2,502	1,250	3,610
FIh_2 → FIh_2N	4	1	8	29	0	16	0	32
FIh_2 → FIh_2S	69	485	52	188	84	200	50	93
FIh_2AI → DEh_2	2,832	4,246	2,376	4,825	2,925	4,484	2,407	5,231
FIh_2AI → FIh_2	137	812	121	312	157	492	135	182
FIh_2AI → PLh_2N	0	0	0	0	0	0	0	0
FIh_2AI → SEh_2	13	0	32	28	0	10	0	42
FIh_2N → FIh_2	1,053	1,108	1,030	1,342	1,076	1,030	1,053	1,281
FIh_2N → SEh_2	4	82	30	343	4	183	30	375
FIh_2S → EEh_2	174	2,950	145	3,323	164	2,172	128	2,692
FIh_2S → FIh_2	583	2,340	593	3,397	581	2,692	551	3,800
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**8,175**	**8,818**	**6,730**	**8,996**	**8,685**	**8,654**	**6,617**	**8,630**
FRh_2 → BEh_2	0	496	0	628	0	562	0	686
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	3,451	2,106	2,709	1,977	3,727	2,031	2,696	1,834
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	116	451	308	662	123	324	275	593
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	29	0	12	0	20	0	6	0
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	656	0	292	0	625	0	241
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	108	389	272	631	118	292	237	556
FRh_2S → FRh_2	4,339	4,407	3,297	4,498	4,568	4,506	3,275	4,414
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	106	222	99	218	102	222	95	218
FRh_2Va → FRh_2	26	92	34	90	27	91	34	89
GR	**3**	**430**	**0**	**306**	**3**	**455**	**0**	**324**
GRh_2 → BGh_2	3	430	0	306	3	455	0	324
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

MAY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**561**	**1,539**	**506**	**1,815**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	561	1,539	506	1,815	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**5,241**	**14,502**	**4,927**	**13,823**	**533**	**12,686**	**398**	**10,055**
IB-$ITh_2 \rightarrow ATh_2$	3,646	5,133	3,426	5,148	499	4,703	365	4,406
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	2	0	0	34	69	32	91
IB-$SKh_2C \rightarrow HUh_2$	690	2,755	642	2,975	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	52	91	52	149	0	103	0	163
IB-$SKh_2C \rightarrow SKh_2W$	0	977	0	498	0	2,325	0	1,269
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	2,602	0	1,581	0	2,458	0	1,342
IB-$SKh_2W \rightarrow ATh_2$	0	0	0	0	0	30	0	27
IB-$SKh_2W \rightarrow CZh_2$	7	1,376	9	1,032	0	2,688	0	2,266
IB-$SKh_2W \rightarrow SKh_2W$	846	1,566	798	2,441	0	311	0	491
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,646**	**5,133**	**3,426**	**5,148**	**499**	**4,703**	**365**	**4,406**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,646	5,133	3,426	5,148	499	4,703	365	4,406
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**112**	**2,414**	**267**	**2,745**	**76**	**1,647**	**199**	**2,125**
$LTh_2 \rightarrow LVh_2$	112	10	267	8	76	23	198	18
$LTh_2 \rightarrow PLh_2nbc$	0	2,404	0	2,737	0	1,625	0	2,108

MAY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**169**	**2,466**	**301**	**2,793**	**127**	**1,701**	**220**	**2,186**
$LVh_2 \rightarrow EEh_2$	103	0	249	0	70	0	181	0
$LVh_2 \rightarrow LTh_2$	66	2,466	52	2,793	57	1,701	39	2,186
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**309**	**2,386**	**766**	**3,290**	**775**	**1,901**	**890**	**2,627**
$NLh_2 \rightarrow BEh_2$	158	1,487	311	2,400	158	1,429	287	2,219
$NLh_2 \rightarrow DEh_2$	151	899	455	890	617	472	603	409
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**927**	**4,399**	**1,127**	**4,994**	**1,474**	**3,175**	**1,527**	**3,734**
$PLh_2N \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	421	0	448	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	224	0	316	0	596	0	798
$PLh_2nbc \rightarrow LTh_2$	150	0	313	0	106	0	240	0
$PLh_2nbc \rightarrow PLh_2N$	777	3,754	815	4,230	1,367	2,579	1,287	2,937
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	0	0	0	0	0	0	0
PT	**373**	**0**	**344**	**0**	**401**	**0**	**337**	**0**
$PTh_2 \rightarrow ESh_2$	373	0	344	0	401	0	337	0
RO	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**1,739**	**3,001**	**1,299**	**2,064**	**1,808**	**2,622**	**1,314**	**1,995**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	1,721	2,776	1,284	1,867	1,792	2,483	1,292	1,846
$SEh_2 \rightarrow FIh_2N$	18	225	15	197	16	139	22	149

MAY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**742**	**4,528**	**694**	**3,961**	**0**	**4,488**	**0**	**2,557**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	2,457	0	1,493	0	2,325	0	1,269
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	742	1,366	694	2,129	0	103	0	163
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	706	0	339	0	2,061	0	1,125
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow UKh_2$	0	0	0	0	0	0	0	0

JUNE	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
AT	**2,521**	**3,801**	**2,968**	**4,155**	**127**	**3,147**	**260**	**3,690**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	1,701	1,411	2,282	1,758	82	1,904	243	2,319
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	0	0	0	9	45	200	17	85
ATh_2 → IB-SKh_2W	820	2,390	686	2,388	0	1,044	0	1,285
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BE	**22**	**713**	**28**	**596**	**248**	**669**	**290**	**611**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	22	547	28	433	248	385	290	178
BEh_2 → FRh_2	0	127	0	149	0	90	0	184
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	39	0	14	0	194	0	249
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**111**	**0**	**114**	**0**	**110**	**0**	**113**	**0**
BGh_2 → GRh_2	111	0	114	0	110	0	113	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0
CZ	**0**	**0**	**0**	**3**	**0**	**345**	**0**	**451**
CZh_2 → ATh_2	0	0	0	0	0	0	0	0
CZh_2 → DEh_2	0	0	0	3	0	345	0	451
CZh_2 → IB-SKh_2W	0	0	0	0	0	0	0	0
CZh_2 → PLh_2S	0	0	0	0	0	0	0	0

JUNE	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
DE	**5,033**	**5,608**	**4,559**	**6,281**	**4,717**	**4,873**	**3,737**	**5,627**
DEh$_2$ → ATh$_2$	8	57	3	83	399	197	253	84
DEh$_2$ → BEh$_2$	748	532	518	749	609	766	357	1,067
DEh$_2$ → CHh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → CZh$_2$	370	1,085	328	957	335	534	273	364
DEh$_2$ → DKh$_2$	304	386	200	307	206	401	72	320
DEh$_2$ → FRh$_2$	506	668	777	985	285	692	568	1,081
DEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → NLh$_2$	442	553	254	696	362	705	147	893
DEh$_2$ → PLh$_2$N	571	498	529	489	0	0	0	0
DEh$_2$ → PLh$_2$nbc	833	1,686	1,182	1,891	1,268	1,580	1,361	1,818
DEh$_2$ → Y-NOh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ba → DEh$_2$	0	0	0	0	0	0	0	0
DEh$_2$bp → DEh$_2$	70	143	103	124	0	0	0	0
DEh$_2$bp → DEh$_2$ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	1,181		666		1,252		706	
DK	**785**	**1,610**	**764**	**1,909**	**807**	**1,567**	**822**	**1,864**
DKh$_2$ → DEh$_2$	785	1,610	764	1,909	807	1,567	822	1,864
DKh$_2$ → PLh$_2$N	0	0	0	0	0	0	0	0
DKh$_2$ → SEh$_2$	0	0	0	0	0	0	0	0
EE	**173**	**2,626**	**501**	**2,339**	**148**	**1,975**	**333**	**1,562**
EEh$_2$ → FIh$_2$S	17	0	418	0	11	0	260	0
EEh$_2$ → LVh$_2$	156	2,626	83	2,339	138	1,975	73	1,562
ES	**3,853**	**5,182**	**3,135**	**4,517**	**4,047**	**5,215**	**3,117**	**4,667**
ESh$_2$ → FRh$_2$S	3,794	4,907	3,054	4,254	3,994	4,941	3,045	4,409
ESh$_2$ → FRh$_2$SW	0	0	0	0	0	0	0	0
ESh$_2$ → ITh$_2$	0	0	0	0	0	0	0	0
ESh$_2$ → PTh$_2$	59	276	81	263	53	274	72	258

JUNE	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
FI	**6,134**	**14,037**	**4,373**	**12,052**	**6,305**	**13,859**	**4,422**	**12,114**
$FIh_2 \rightarrow FIh_2AI$	1,214	2,270	911	1,997	1,265	2,498	908	2,293
$FIh_2 \rightarrow FIh_2N$	0	5	12	17	0	0	0	20
$FIh_2 \rightarrow FIh_2S$	95	528	73	282	70	315	77	135
$FIh_2AI \rightarrow DEh_2$	2,901	4,054	1,758	3,221	3,039	4,504	1,907	3,709
$FIh_2AI \rightarrow FIh_2$	182	915	177	495	149	562	186	299
$FIh_2AI \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$FIh_2AI \rightarrow SEh_2$	0	11	62	30	0	19	0	45
$FIh_2N \rightarrow FIh_2$	1,021	1,000	731	1,039	1,049	1,035	764	1,126
$FIh_2N \rightarrow SEh_2$	1	118	31	265	1	106	31	295
$FIh_2S \rightarrow EEh_2$	188	2,827	105	2,535	170	2,178	94	1,757
$FIh_2S \rightarrow FIh_2$	531	2,308	513	2,171	562	2,643	455	2,435
$FIh_2S \rightarrow FIh_2SZ1$	0	0	0	0	0	0	0	0
$FIh_2SZ1 \rightarrow FIh_2S$	0	0	0	0	0	0	0	0
FR	**7,365**	**8,751**	**5,928**	**7,842**	**7,537**	**8,881**	**5,849**	**8,200**
$FRh_2 \rightarrow BEh_2$	0	523	0	460	0	582	0	540
$FRh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow DEh_2$	2,940	2,138	2,142	1,817	3,155	2,123	2,184	1,749
$FRh_2 \rightarrow FRh_2N$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2S$	290	438	346	473	195	434	314	619
$FRh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2Va$	28	0	40	0	17	0	17	0
$FRh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$FRh_2N \rightarrow BEh_2$	0	452	0	412	0	437	0	395
$FRh_2N \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2S \rightarrow ESh_2$	292	416	328	410	189	421	283	547
$FRh_2S \rightarrow FRh_2$	3,686	4,486	2,958	3,984	3,860	4,586	2,956	4,066
$FRh_2S \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2S$	0	0	0	0	0	0	0	0
$FRh_2Va \rightarrow BEH_2Mo$	103	209	96	203	94	209	76	203
$FRh_2Va \rightarrow FRh_2$	25	90	19	82	28	88	19	81
GR	**0**	**193**	**0**	**291**	**0**	**195**	**0**	**299**
$GRh_2 \rightarrow BGh_2$	0	193	0	291	0	195	0	299
$GRh_2 \rightarrow CYh_2$	0	0	0	0	0	0	0	0
$GRh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0

JUNE	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
HRh_2 → ALh_2	0	0	0	0	0	0	0	0
HRh_2 → BAh_2	0	0	0	0	0	0	0	0
HRh_2 → HUh_2	0	0	0	0	0	0	0	0
HRh_2 → RSh_2	0	0	0	0	0	0	0	0
HRh_2 → SIh_2	0	0	0	0	0	0	0	0
HU	**534**	**1,563**	**465**	**1,560**	**0**	**0**	**0**	**0**
HUh_2 → ATh_2	0	0	0	0	0	0	0	0
HUh_2 → HRh_2	0	0	0	0	0	0	0	0
HUh_2 → IB-SKh_2C	0	0	0	0	0	0	0	0
HUh_2 → ROh_2	534	1,563	465	1,560	0	0	0	0
HUh_2 → RSh_2	0	0	0	0	0	0	0	0
HUh_2 → SIh_2	0	0	0	0	0	0	0	0
IB	**4,545**	**13,879**	**4,731**	**14,105**	**219**	**11,334**	**418**	**11,864**
IB-ITh_2 → ATh_2	3,015	4,926	3,467	4,950	175	4,243	401	4,594
IB-ITh_2 → CHh_2	0	0	0	0	0	0	0	0
IB-ITh_2 → ITh_2	0	0	0	9	45	200	17	85
IB-SKh_2C → HUh_2	661	2,702	528	2,698	0	0	0	0
IB-SKh_2C → SKh_2E	49	89	49	92	0	115	0	115
IB-SKh_2C → SKh_2W	0	838	0	881	0	1,948	0	1,965
IB-SKh_2E → PLh_2S	0	0	0	0	0	0	0	0
IB-SKh_2E → SKh_2E	0	2,331	0	2,451	0	2,060	0	2,078
IB-SKh_2W → ATh_2	0	0	0	0	0	41	0	35
IB-SKh_2W → CZh_2	11	1,337	11	1,459	0	2,381	0	2,646
IB-SKh_2W → SKh_2W	809	1,656	676	1,566	0	346	0	345
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
IEh_2 → UKh_2	0	0	0	0	0	0	0	0
IT	**3,015**	**4,926**	**3,467**	**4,950**	**175**	**4,243**	**401**	**4,594**
ITh_2 → ESh_2	0	0	0	0	0	0	0	0
ITh_2 → GRh_2	0	0	0	0	0	0	0	0
ITh_2 → IB-ITh_2	3,015	4,926	3,467	4,950	175	4,243	401	4,594
ITh_2 → MTh_2	0	0	0	0	0	0	0	0
ITh_2 → SIh_2	0	0	0	0	0	0	0	0
LT	**22**	**2,264**	**457**	**2,030**	**14**	**1,596**	**291**	**1,290**
LTh_2 → LVh_2	22	7	457	17	14	20	291	37
LTh_2 → PLh_2nbc	0	2,256	0	2,012	0	1,575	0	1,253

JUNE	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**94**	**2,347**	**464**	**2,069**	**73**	**1,709**	**295**	**1,313**
$LVh_2 \rightarrow EEh_2$	18	0	429	0	11	0	268	0
$LVh_2 \rightarrow LTh_2$	76	2,347	34	2,069	62	1,709	26	1,313
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**461**	**2,395**	**697**	**2,061**	**892**	**2,070**	**1,061**	**1,738**
$NLh_2 \rightarrow BEh_2$	173	1,624	227	1,578	172	1,641	234	1,557
$NLh_2 \rightarrow DEh_2$	288	771	470	483	720	429	827	181
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**833**	**4,403**	**1,182**	**4,357**	**1,268**	**3,155**	**1,361**	**3,071**
$PLh_2N \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	460	0	453	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	227	0	169	0	612	0	466
$PLh_2nbc \rightarrow LTh_2$	71	0	515	0	45	0	335	0
$PLh_2nbc \rightarrow PLh_2N$	762	3,716	667	3,734	1,223	2,543	1,026	2,606
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	0	0	0	0	0	0	0
PT	**309**	**0**	**267**	**0**	**310**	**0**	**254**	**0**
$PTh_2 \rightarrow ESh_2$	309	0	267	0	310	0	254	0
RO	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**1,887**	**2,945**	**1,110**	**2,076**	**1,940**	**2,794**	**1,212**	**1,942**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	1,869	2,710	1,087	1,749	1,923	2,587	1,184	1,760
$SEh_2 \rightarrow FIh_2N$	18	235	23	327	17	207	28	182

JUNE	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SIh_2 → ATh_2	0	0	0	0	0	0	0	0
SIh_2 → HRh_2	0	0	0	0	0	0	0	0
SIh_2 → HUh_2	0	0	0	0	0	0	0	0
SIh_2 → ITh_2	0	0	0	0	0	0	0	0
SK	**710**	**4,232**	**577**	**4,307**	**0**	**3,788**	**0**	**3,821**
SKh_2E → IB-SKh_2C	0	2,193	0	2,315	0	1,948	0	1,965
SKh_2E → IB-SKh_2E	0	0	0	0	0	0	0	0
SKh_2W → IB-SKh_2C	710	1,436	577	1,356	0	115	0	115
SKh_2W → IB-SKh_2W	0	603	0	636	0	1,724	0	1,741
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
UKh_2 → BEh_2	0	0	0	0	0	0	0	0
UKh_2 → IEh_2	0	0	0	0	0	0	0	0
UKh_2 → NLh_2	0	0	0	0	0	0	0	0
UKh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
UKh_2/INT → BEh_2	0	0	0	0	0	0	0	0
UKh_2/INT → UKh_2	0	0	0	0	0	0	0	0

JULY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
AT	**2,608**	**3,297**	**2,714**	**4,231**	**115**	**2,621**	**106**	**3,607**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	1,918	1,059	2,043	1,601	49	1,786	81	2,228
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	0	0	0	0	66	179	25	118
ATh_2 → IB-SKh_2W	689	2,239	671	2,630	0	656	0	1,261
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BE	**51**	**743**	**8**	**590**	**385**	**661**	**229**	**590**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	51	538	8	405	385	293	229	311
BEh_2 → FRh_2	0	195	0	182	0	193	0	204
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	9	0	3	0	176	0	74
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**113**	**0**	**116**	**0**	**113**	**0**	**116**	**0**
BGh_2 → GRh_2	113	0	116	0	113	0	116	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0
CZ	**0**	**0**	**0**	**3**	**0**	**546**	**0**	**441**
CZh_2 → ATh_2	0	0	0	0	0	0	0	0
CZh_2 → DEh_2	0	0	0	3	0	546	0	441
CZh_2 → IB-SKh_2W	0	0	0	0	0	0	0	0
CZh_2 → PLh_2S	0	0	0	0	0	0	0	0

JULY

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
DE	**4,646**	**6,370**	**4,576**	**6,916**	**3,642**	**5,968**	**4,045**	**5,888**
DEh$_2$ → ATh$_2$	15	200	7	102	336	241	352	122
DEh$_2$ → BEh$_2$	483	744	436	702	456	1,116	393	893
DEh$_2$ → CHh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → CZh$_2$	326	906	327	1,189	221	646	290	537
DEh$_2$ → DKh$_2$	397	485	193	399	119	467	56	390
DEh$_2$ → FRh$_2$	817	824	660	1,107	311	1,047	410	1,148
DEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → NLh$_2$	233	1,074	148	569	265	1,210	115	717
DEh$_2$ → PLh$_2$N	570	509	560	524	0	0	0	0
DEh$_2$ → PLh$_2$nbc	768	1,475	1,489	2,213	984	1,241	1,694	2,081
DEh$_2$ → Y-NOh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ba → DEh$_2$	0	0	0	0	0	0	0	0
DEh$_2$bp → DEh$_2$	178	153	99	111	0	0	0	0
DEh$_2$bp → DEh$_2$ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	858		658		951		734	
DK	**661**	**1,598**	**750**	**1,730**	**693**	**1,578**	**782**	**1,706**
DKh$_2$ → DEh$_2$	661	1,598	750	1,730	693	1,578	782	1,706
DKh$_2$ → PLh$_2$N	0	0	0	0	0	0	0	0
DKh$_2$ → SEh$_2$	0	0	0	0	0	0	0	0
EE	**252**	**3,060**	**667**	**2,011**	**181**	**2,603**	**452**	**1,202**
EEh$_2$ → FIh$_2$S	111	0	597	0	85	0	398	0
EEh$_2$ → LVh$_2$	141	3,060	70	2,011	97	2,603	54	1,202
ES	**2,941**	**4,695**	**3,211**	**4,360**	**2,933**	**4,673**	**3,211**	**4,313**
ESh$_2$ → FRh$_2$S	2,847	4,397	3,124	4,094	2,852	4,384	3,147	4,043
ESh$_2$ → FRh$_2$SW	0	0	0	0	0	0	0	0
ESh$_2$ → ITh$_2$	0	0	0	0	0	0	0	0
ESh$_2$ → PTh$_2$	95	299	87	266	80	289	64	271

JULY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
FI	**6,328**	**17,465**	**3,169**	**10,428**	**6,232**	**17,683**	**2,965**	**9,888**
FIh_2 → FIh_2AI	1,391	3,392	582	1,332	1,385	3,584	522	1,536
FIh_2 → FIh_2N	3	0	20	5	0	15	0	2
FIh_2 → FIh_2S	50	138	124	745	64	47	122	431
FIh_2AI → DEh_2	2,807	5,315	1,087	2,423	2,762	5,758	1,140	2,866
FIh_2AI → FIh_2	123	314	243	1,150	147	166	279	828
FIh_2AI → PLh_2N	0	0	0	0	0	0	0	0
FIh_2AI → SEh_2	13	33	83	8	0	29	0	15
FIh_2N → FIh_2	1,173	1,189	431	839	1,145	1,406	448	810
FIh_2N → SEh_2	12	263	38	201	12	271	44	253
FIh_2S → EEh_2	171	3,282	87	2,208	124	2,822	71	1,399
FIh_2S → FIh_2	585	3,539	474	1,517	593	3,584	340	1,748
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**5,224**	**8,070**	**6,382**	**7,850**	**5,135**	**8,162**	**6,336**	**7,781**
FRh_2 → BEh_2	0	511	0	563	0	612	0	588
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	1,984	1,797	2,452	1,555	2,018	1,755	2,519	1,517
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	128	481	378	698	87	554	328	676
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	46	0	19	0	13	0	9	0
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	503	0	360	0	412	0	361
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	143	439	375	642	85	504	299	612
FRh_2S → FRh_2	2,812	4,035	3,033	3,742	2,851	4,023	3,067	3,735
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	95	211	95	202	65	210	86	203
FRh_2Va → FRh_2	15	93	29	89	16	92	29	89
GR	**0**	**333**	**0**	**348**	**0**	**334**	**0**	**362**
GRh_2 → BGh_2	0	333	0	348	0	334	0	362
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

JULY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**477**	**1,547**	**479**	**1,655**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow IB\text{-}SKh_2C$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	477	1,547	479	1,655	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0

JULY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
IB	**4,382**	**14,745**	**4,465**	**14,032**	**166**	**12,403**	**179**	**11,020**
IB-ITh$_2$ → ATh$_2$	3,114	5,102	3,224	5,118	100	4,425	154	4,592
IB-ITh$_2$ → CHh$_2$	0	0	0	0	0	0	0	0
IB-ITh$_2$ → ITh$_2$	0	0	0	0	66	179	25	118
IB-SKh$_2$C → HUh$_2$	532	2,783	524	2,858	0	0	0	0
IB-SKh$_2$C → SKh$_2$E	47	84	46	115	0	96	0	134
IB-SKh$_2$C → SKh$_2$W	0	1,011	0	731	0	2,393	0	1,670
IB-SKh$_2$E → PLh$_2$S	0	0	0	0	0	0	0	0
IB-SKh$_2$E → SKh$_2$E	0	2,801	0	2,055	0	2,526	0	1,765
IB-SKh$_2$W → ATh$_2$	0	0	0	0	0	17	0	9
IB-SKh$_2$W → CZh$_2$	17	1,571	8	1,141	0	2,479	0	2,330
IB-SKh$_2$W → SKh$_2$W	672	1,393	663	2,015	0	289	0	402
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
IEh$_2$ → UKh$_2$	0	0	0	0	0	0	0	0
IT	**3,114**	**5,102**	**3,224**	**5,118**	**100**	**4,425**	**154**	**4,592**
ITh$_2$ → ESh$_2$	0	0	0	0	0	0	0	0
ITh$_2$ → GRh$_2$	0	0	0	0	0	0	0	0
ITh$_2$ → IB-ITh$_2$	3,114	5,102	3,224	5,118	100	4,425	154	4,592
ITh$_2$ → MTh$_2$	0	0	0	0	0	0	0	0
ITh$_2$ → SIh$_2$	0	0	0	0	0	0	0	0
LT	**123**	**2,745**	**651**	**1,693**	**99**	**2,297**	**447**	**891**
LTh$_2$ → LVh$_2$	123	10	651	13	98	22	447	45
LTh$_2$ → PLh$_2$nbc	0	2,735	0	1,680	1	2,275	1	846
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
LUh$_2$ → BEh$_2$	0	0	0	0	0	0	0	0
LUh$_2$ → DEh$_2$	0	0	0	0	0	0	0	0
LUh$_2$ → FRh$_2$	0	0	0	0	0	0	0	0
LV	**184**	**2,754**	**643**	**1,749**	**125**	**2,309**	**433**	**974**
LVh$_2$ → EEh$_2$	114	0	613	0	88	0	412	0
LVh$_2$ → LTh$_2$	70	2,754	30	1,749	37	2,309	21	974
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
MTh$_2$ → ITh$_2$	0	0	0	0	0	0	0	0
NL	**861**	**2,415**	**862**	**2,964**	**1,218**	**1,841**	**1,035**	**2,503**
NLh$_2$ → BEh$_2$	160	1,475	278	1,963	140	1,408	265	1,886
NLh$_2$ → DEh$_2$	700	940	585	1,001	1,078	433	770	617
NLh$_2$ → UKh$_2$	0	0	0	0	0	0	0	0

JULY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
PL	**768**	**4,751**	**1,489**	**4,417**	**985**	**3,516**	**1,694**	**2,927**
$PLh_2N \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	541	0	523	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	262	0	111	0	805	0	285
$PLh_2nbc \rightarrow LTh_2$	146	0	754	0	116	0	529	0
$PLh_2nbc \rightarrow PLh_2N$	622	3,948	735	3,782	869	2,711	1,165	2,642
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	0	0	0	0	0	0	0
PT	**223**	**0**	**263**	**0**	**216**	**0**	**282**	**0**
$PTh_2 \rightarrow ESh_2$	223	0	263	0	216	0	282	0
RO	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**1,566**	**2,346**	**857**	**2,605**	**1,541**	**2,413**	**934**	**2,392**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	1,552	2,269	831	2,250	1,524	2,369	897	2,173
$SEh_2 \rightarrow FIh_2N$	14	77	26	354	17	44	37	219
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**579**	**4,603**	**570**	**4,229**	**0**	**4,617**	**0**	**3,285**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	2,657	0	1,941	0	2,393	0	1,670
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	579	1,222	570	1,762	0	96	0	134
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	725	0	526	0	2,128	0	1,481

JULY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow UKh_2$	0	0	0	0	0	0	0	0

AUGUST	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
AT	**2,541**	**3,531**	**2,782**	**3,445**	**161**	**2,765**	**143**	**2,928**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	1,785	1,135	2,132	1,126	69	1,897	94	2,159
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	1	0	0	0	92	240	48	95
ATh_2 → IB-SKh_2W	755	2,396	651	2,319	0	628	0	673
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BE	**28**	**918**	**21**	**832**	**328**	**885**	**374**	**763**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	28	739	21	565	328	501	374	384
BEh_2 → FRh_2	0	153	0	238	0	113	0	177
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	27	0	29	0	271	0	202
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**119**	**0**	**117**	**0**	**117**	**0**	**116**	**0**
BGh_2 → GRh_2	119	0	117	0	117	0	116	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0
CZ	**0**	**3**	**0**	**3**	**0**	**519**	**0**	**635**
CZh_2 → ATh_2	0	0	0	0	0	0	0	0
CZh_2 → DEh_2	0	3	0	3	0	519	0	635
CZh_2 → IB-SKh_2W	0	0	0	0	0	0	0	0
CZh_2 → PLh_2S	0	0	0	0	0	0	0	0

AUGUST	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
DE	**4,988**	**5,284**	**4,379**	**6,457**	**4,238**	**4,740**	**3,543**	**5,880**
DEh_2 → ATh_2	42	187	2	148	357	318	317	207
DEh_2 → BEh_2	622	500	380	581	600	644	358	832
DEh_2 → CHh_2	0	0	0	0	0	0	0	0
DEh_2 → CZh_2	292	1,032	308	866	225	798	232	541
DEh_2 → DKh_2	442	549	294	443	166	556	74	427
DEh_2 → FRh_2	575	298	836	984	194	501	381	1,049
DEh_2 → LUh_2	0	0	0	0	0	0	0	0
DEh_2 → NLh_2	353	438	146	746	362	500	148	922
DEh_2 → PLh_2N	570	503	551	513	0	0	0	0
DEh_2 → PLh_2nbc	868	1,602	1,083	2,022	1,071	1,422	1,268	1,902
DEh_2 → Y-NOh_2	0	0	0	0	0	0	0	0
DEh_2ba → DEh_2	0	0	0	0	0	0	0	0
DEh_2bp → DEh_2	156	176	162	154	0	0	0	0
DEh_2bp → DEh_2ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	1,069		617		1,264		766	
DK	**597**	**1,758**	**702**	**1,739**	**630**	**1,745**	**746**	**1,718**
DKh_2 → DEh_2	597	1,758	702	1,739	630	1,745	746	1,718
DKh_2 → PLh_2N	0	0	0	0	0	0	0	0
DKh_2 → SEh_2	0	0	0	0	0	0	0	0
EE	**275**	**2,927**	**455**	**2,181**	**173**	**2,385**	**296**	**1,513**
EEh_2 → FIh_2S	130	0	366	0	66	0	233	0
EEh_2 → LVh_2	145	2,927	89	2,181	107	2,385	63	1,513
ES	**3,364**	**5,245**	**2,700**	**4,375**	**3,356**	**5,165**	**2,758**	**4,366**
ESh_2 → FRh_2S	3,295	4,968	2,595	4,100	3,296	4,884	2,675	4,074
ESh_2 → FRh_2SW	0	0	0	0	0	0	0	0
ESh_2 → ITh_2	0	0	0	0	0	0	0	0
ESh_2 → PTh_2	68	277	104	276	61	281	82	292

AUGUST	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
FI	**6,132**	**17,165**	**4,130**	**11,617**	**6,377**	**17,374**	**4,108**	**11,289**
$FIh_2 \rightarrow FIh_2Al$	1,359	3,501	814	1,772	1,417	3,806	822	2,005
$FIh_2 \rightarrow FIh_2N$	3	6	12	10	0	12	0	9
$FIh_2 \rightarrow FIh_2S$	106	265	99	510	111	153	91	296
$FIh_2Al \rightarrow DEh_2$	2,567	4,762	1,717	3,028	2,746	5,104	1,793	3,322
$FIh_2Al \rightarrow FIh_2$	208	507	203	992	218	378	223	657
$FIh_2Al \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$FIh_2Al \rightarrow SEh_2$	14	24	48	12	0	22	0	12
$FIh_2N \rightarrow FIh_2$	1,154	1,243	643	898	1,187	1,296	668	993
$FIh_2N \rightarrow SEh_2$	2	257	5	174	0	273	3	223
$FIh_2S \rightarrow EEh_2$	173	3,132	110	2,367	135	2,589	83	1,693
$FIh_2S \rightarrow FIh_2$	546	3,467	480	1,856	562	3,742	425	2,080
$FIh_2S \rightarrow FIh_2SZ1$	0	0	0	0	0	0	0	0
$FIh_2SZ1 \rightarrow FIh_2S$	0	0	0	0	0	0	0	0
FR	**5,870**	**8,547**	**5,135**	**8,040**	**5,904**	**8,634**	**5,162**	**7,940**
$FRh_2 \rightarrow BEh_2$	0	499	0	485	0	560	0	527
$FRh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow DEh_2$	2,263	2,229	1,834	1,631	2,362	2,058	1,942	1,617
$FRh_2 \rightarrow FRh_2N$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2S$	100	130	310	643	68	270	226	599
$FRh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2 \rightarrow FRh_2Va$	44	0	34	0	12	0	8	0
$FRh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$FRh_2N \rightarrow BEh_2$	0	620	0	522	0	616	0	468
$FRh_2N \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2S \rightarrow ESh_2$	106	112	312	628	69	250	224	570
$FRh_2S \rightarrow FRh_2$	3,240	4,649	2,535	3,837	3,302	4,575	2,673	3,863
$FRh_2S \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$FRh_2SW \rightarrow FRh_2S$	0	0	0	0	0	0	0	0
$FRh_2Va \rightarrow BEH_2Mo$	98	212	92	203	71	212	68	208
$FRh_2Va \rightarrow FRh_2$	19	96	19	90	20	92	20	88

AUGUST	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
GR	**0**	**302**	**0**	**314**	**0**	**285**	**0**	**325**
$GRh_2 \rightarrow BGh_2$	0	302	0	314	0	285	0	325
$GRh_2 \rightarrow CYh_2$	0	0	0	0	0	0	0	0
$GRh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**481**	**1,546**	**462**	**1,576**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	481	1,546	462	1,576	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**4,396**	**14,406**	**4,495**	**14,699**	**229**	**11,928**	**221**	**12,875**
IB-$ITh_2 \rightarrow ATh_2$	3,019	5,039	3,300	5,099	137	4,242	172	4,641
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	1	0	0	0	92	240	48	95
IB-$SKh_2C \rightarrow HUh_2$	574	2,756	498	2,840	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	47	92	47	86	0	103	0	91
IB-$SKh_2C \rightarrow SKh_2W$	0	947	0	937	0	2,280	0	2,504
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	2,478	0	2,760	0	2,406	0	2,641
IB-$SKh_2W \rightarrow ATh_2$	0	0	0	0	0	38	0	11
IB-$SKh_2W \rightarrow CZh_2$	41	1,433	13	1,553	0	2,311	0	2,618
IB-$SKh_2W \rightarrow SKh_2W$	715	1,661	638	1,424	0	309	0	274
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,019**	**5,039**	**3,300**	**5,099**	**137**	**4,242**	**172**	**4,641**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,019	5,039	3,300	5,099	137	4,242	172	4,641
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0

AUGUST	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
LT	**145**	**2,456**	**399**	**1,921**	**76**	**1,919**	**263**	**1,274**
$LTh_2 \rightarrow LVh_2$	145	8	399	25	76	19	263	41
$LTh_2 \rightarrow PLh_2nbc$	0	2,448	0	1,896	0	1,900	0	1,233
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**211**	**2,640**	**413**	**1,939**	**111**	**2,111**	**264**	**1,291**
$LVh_2 \rightarrow EEh_2$	134	0	376	0	69	0	241	0
$LVh_2 \rightarrow LTh_2$	77	2,640	37	1,939	42	2,111	22	1,291
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**817**	**2,403**	**1,030**	**2,589**	**1,058**	**1,882**	**1,363**	**2,032**
$NLh_2 \rightarrow BEh_2$	130	1,488	202	1,630	136	1,419	173	1,509
$NLh_2 \rightarrow DEh_2$	686	915	828	959	922	464	1,190	523
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**868**	**4,546**	**1,083**	**4,388**	**1,071**	**3,323**	**1,268**	**3,135**
$PLh_2N \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	496	0	470	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	217	0	194	0	653	0	478
$PLh_2nbc \rightarrow LTh_2$	190	0	476	0	109	0	321	0
$PLh_2nbc \rightarrow PLh_2N$	678	3,833	607	3,724	962	2,670	947	2,657
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	0	0	0	0	0	0	0
PT	**282**	**0**	**202**	**0**	**289**	**0**	**217**	**0**
$PTh_2 \rightarrow ESh_2$	282	0	202	0	289	0	217	0
RO	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0

AUGUST

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SE	**1,449**	**1,900**	**1,174**	**2,473**	**1,567**	**1,762**	**1,226**	**2,164**
SEh_2 → DKh_2	0	0	0	0	0	0	0	0
SEh_2 → FIh_2AI	1,429	1,792	1,153	2,260	1,547	1,698	1,194	1,986
SEh_2 → FIh_2N	20	108	21	214	20	64	32	178
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SIh_2 → ATh_2	0	0	0	0	0	0	0	0
SIh_2 → HRh_2	0	0	0	0	0	0	0	0
SIh_2 → HUh_2	0	0	0	0	0	0	0	0
SIh_2 → ITh_2	0	0	0	0	0	0	0	0
SK	**621**	**4,493**	**544**	**4,521**	**0**	**4,412**	**0**	**4,825**
SKh_2E → IB-SKh_2C	0	2,342	0	2,617	0	2,280	0	2,504
SKh_2E → IB-SKh_2E	0	0	0	0	0	0	0	0
SKh_2W → IB-SKh_2C	621	1,453	544	1,247	0	103	0	91
SKh_2W → IB-SKh_2W	0	698	0	658	0	2,029	0	2,230
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
UKh_2 → BEh_2	0	0	0	0	0	0	0	0
UKh_2 → IEh_2	0	0	0	0	0	0	0	0
UKh_2 → NLh_2	0	0	0	0	0	0	0	0
UKh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
UKh_2/INT → BEh_2	0	0	0	0	0	0	0	0
UKh_2/INT → UKh_2	0	0	0	0	0	0	0	0

SEPTEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
AT	**2,741**	**3,364**	**2,560**	**3,022**	**209**	**2,923**	**195**	**2,462**
$ATh_2 \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$ATh_2 \rightarrow DEh_2$	2,003	1,187	1,850	792	178	1,927	76	1,585
$ATh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ATh_2 \rightarrow$ IB-ITh_2	0	0	0	0	30	16	119	204
$ATh_2 \rightarrow$ IB-SKh_2W	738	2,177	709	2,229	0	980	0	674
$ATh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
BE	**23**	**776**	**26**	**565**	**267**	**750**	**259**	**508**
$BEh_2 \rightarrow BEH_2Mo$	0	0	0	0	0	0	0	0
$BEh_2 \rightarrow DEh_2$	23	661	26	433	267	496	259	248
$BEh_2 \rightarrow FRh_2$	0	115	0	101	0	132	0	100
$BEh_2 \rightarrow FRh_2N$	0	0	0	0	0	0	0	0
$BEh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$BEh_2 \rightarrow NLh_2$	0	0	0	31	0	122	0	160
$BEh_2 \rightarrow UKh_2$/INT	0	0	0	0	0	0	0	0
$BEH_2Mo \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$BEH_2Mo \rightarrow FRh_2Va$	0	0	0	0	0	0	0	0
BG	**117**	**0**	**113**	**0**	**116**	**0**	**113**	**0**
$BGh_2 \rightarrow GRh_2$	117	0	113	0	116	0	113	0
$BGh_2 \rightarrow MKh_2$	0	0	0	0	0	0	0	0
$BGh_2 \rightarrow ROh_2$	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$CHh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$CHh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$CHh_2 \rightarrow$ IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$CYh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
CZ	**0**	**3**	**0**	**0**	**0**	**496**	**0**	**432**
$CZh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$CZh_2 \rightarrow DEh_2$	0	3	0	0	0	496	0	432
$CZh_2 \rightarrow$ IB-SKh_2W	0	0	0	0	0	0	0	0
$CZh_2 \rightarrow PLh_2S$	0	0	0	0	0	0	0	0

SEPTEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
DE	**4,758**	**6,045**	**4,530**	**4,944**	**4,261**	**4,985**	**4,063**	**4,716**
DEh$_2$ → ATh$_2$	3	170	16	196	318	40	454	285
DEh$_2$ → BEh$_2$	652	635	470	641	503	798	421	943
DEh$_2$ → CHh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → CZh$_2$	328	957	336	984	280	457	262	725
DEh$_2$ → DKh$_2$	313	411	259	93	197	422	116	87
DEh$_2$ → FRh$_2$	704	555	837	759	571	652	553	878
DEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → NLh$_2$	390	940	276	526	312	986	276	780
DEh$_2$ → PLh$_2$N	558	488	565	485	0	0	0	0
DEh$_2$ → PLh$_2$nbc	824	1,749	890	1,126	1,208	1,629	1,165	1,017
DEh$_2$ → Y-NOh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ba → DEh$_2$	0	0	0	0	0	0	0	0
DEh$_2$bp → DEh$_2$	89	140	104	133	0	0	0	0
DEh$_2$bp → DEh$_2$ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	896		777		872		816	
DK	**668**	**1,543**	**826**	**2,166**	**729**	**1,525**	**865**	**2,135**
DKh$_2$ → DEh$_2$	668	1,543	826	2,166	729	1,525	865	2,135
DKh$_2$ → PLh$_2$N	0	0	0	0	0	0	0	0
DKh$_2$ → SEh$_2$	0	0	0	0	0	0	0	0
EE	**199**	**2,362**	**272**	**3,771**	**165**	**1,785**	**188**	**3,381**
EEh$_2$ → FIh$_2$S	60	0	133	0	42	0	78	0
EEh$_2$ → LVh$_2$	139	2,362	140	3,771	123	1,785	110	3,381
ES	**3,549**	**5,116**	**2,775**	**4,685**	**3,621**	**5,018**	**2,810**	**4,599**
ESh$_2$ → FRh$_2$S	3,482	4,876	2,668	4,427	3,561	4,771	2,719	4,340
ESh$_2$ → FRh$_2$SW	0	0	0	0	0	0	0	0
ESh$_2$ → ITh$_2$	0	0	0	0	0	0	0	0
ESh$_2$ → PTh$_2$	67	240	107	259	60	246	91	258

SEPTEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
FI	**6,415**	**13,405**	**7,153**	**20,130**	**6,441**	**13,925**	**7,364**	**20,037**
FIh_2 → FIh_2Al	1,366	2,505	1,651	4,172	1,377	2,851	1,705	4,281
FIh_2 → FIh_2N	2	9	3	11	0	13	0	16
FIh_2 → FIh_2S	111	161	54	194	98	121	57	98
FIh_2Al → DEh_2	2,856	3,736	3,118	5,463	2,913	4,125	3,270	5,715
FIh_2Al → FIh_2	194	316	96	318	187	277	104	169
FIh_2Al → PLh_2N	0	0	0	0	0	0	0	0
FIh_2Al → SEh_2	7	39	19	63	0	50	0	57
FIh_2N → FIh_2	1,152	1,048	1,394	1,505	1,161	979	1,431	1,493
FIh_2N → SEh_2	1	369	6	354	1	445	6	374
FIh_2S → EEh_2	168	2,547	169	3,987	152	1,971	140	3,594
FIh_2S → FIh_2	557	2,676	642	4,063	552	3,093	650	4,240
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**6,779**	**8,709**	**5,699**	**7,922**	**7,088**	**8,551**	**5,695**	**7,942**
FRh_2 → BEh_2	0	518	0	512	0	568	0	578
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	2,505	2,204	2,039	1,659	2,631	2,042	2,139	1,627
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	407	362	440	475	505	419	403	529
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	37	0	33	0	17	0	9	0
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	499	0	408	0	456	0	366
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	383	332	429	448	458	388	364	474
FRh_2S → FRh_2	3,326	4,500	2,636	4,146	3,364	4,385	2,681	4,097
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	100	207	99	197	90	207	76	195
FRh_2Va → FRh_2	21	88	22	77	25	86	24	76
GR	**0**	**240**	**0**	**249**	**0**	**243**	**0**	**263**
GRh_2 → BGh_2	0	240	0	249	0	243	0	263
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

SEPTEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**502**	**1,473**	**496**	**1,461**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	502	1,473	496	1,461	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**4,615**	**14,166**	**4,361**	**14,153**	**336**	**12,173**	**263**	**11,763**
IB-$ITh_2 \rightarrow ATh_2$	3,240	5,016	3,046	4,892	306	4,773	144	4,309
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	0	0	0	30	16	119	204
IB-$SKh_2C \rightarrow HUh_2$	590	2,645	560	2,712	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	47	83	46	82	0	102	0	99
IB-$SKh_2C \rightarrow SKh_2W$	0	960	0	935	0	2,141	0	2,200
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	2,582	0	2,636	0	2,261	0	2,325
IB-$SKh_2W \rightarrow ATh_2$	0	0	0	22	0	9	0	65
IB-$SKh_2W \rightarrow CZh_2$	8	1,446	11	1,463	0	2,564	0	2,265
IB-$SKh_2W \rightarrow SKh_2W$	730	1,435	698	1,411	0	306	0	296
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,240**	**5,016**	**3,046**	**4,892**	**306**	**4,773**	**144**	**4,309**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,240	5,016	3,046	4,892	306	4,773	144	4,309
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**70**	**2,004**	**145**	**3,349**	**48**	**1,420**	**88**	**2,968**
$LTh_2 \rightarrow LVh_2$	70	9	145	2	48	18	88	6
$LTh_2 \rightarrow PLh_2nbc$	0	1,995	0	3,347	0	1,402	0	2,962

SEPTEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
LUh_2 → BEh_2	0	0	0	0	0	0	0	0
LUh_2 → DEh_2	0	0	0	0	0	0	0	0
LUh_2 → FRh_2	0	0	0	0	0	0	0	0
LV	**132**	**2,105**	**204**	**3,471**	**98**	**1,539**	**123**	**3,087**
LVh_2 → EEh_2	63	0	136	0	43	0	81	0
LVh_2 → LTh_2	69	2,105	68	3,471	55	1,539	43	3,087
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
MTh_2 → ITh_2	0	0	0	0	0	0	0	0
NL	**563**	**2,494**	**763**	**2,313**	**1,019**	**2,035**	**1,123**	**1,985**
NLh_2 → BEh_2	193	1,536	296	1,628	204	1,465	296	1,582
NLh_2 → DEh_2	370	958	467	685	815	570	827	403
NLh_2 → UKh_2	0	0	0	0	0	0	0	0
PL	**824**	**4,197**	**890**	**4,995**	**1,208**	**3,031**	**1,165**	**3,979**
PLh_2N → DEh_2	0	0	0	0	0	0	0	0
PLh_2N → DKh_2	0	0	0	0	0	0	0	0
PLh_2N → FIh_2AI	0	0	0	0	0	0	0	0
PLh_2N → PLh_2S	0	453	0	522	0	0	0	0
PLh_2nbc → DEh_2	0	180	0	480	0	501	0	1,234
PLh_2nbc → LTh_2	104	0	180	0	73	0	116	0
PLh_2nbc → PLh_2N	720	3,564	709	3,994	1,136	2,530	1,049	2,745
PLh_2nbc → PLh_2S	0	0	0	0	0	0	0	0
PLh_2S → CZh_2	0	0	0	0	0	0	0	0
PLh_2S → $IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
PLh_2S → PLh_2N	0	0	0	0	0	0	0	0
PLh_2S → PLh_2nbc	0	0	0	0	0	0	0	0
PT	**289**	**0**	**189**	**0**	**303**	**0**	**188**	**0**
PTh_2 → ESh_2	289	0	189	0	303	0	188	0
RO	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ROh_2 → BGh_2	0	0	0	0	0	0	0	0
ROh_2 → HUh_2	0	0	0	0	0	0	0	0
ROh_2 → MDh_2	0	0	0	0	0	0	0	0
ROh_2 → RSh_2	0	0	0	0	0	0	0	0
SE	**1,709**	**1,729**	**1,590**	**1,786**	**1,741**	**1,692**	**1,680**	**1,771**
SEh_2 → DKh_2	0	0	0	0	0	0	0	0
SEh_2 → FIh_2AI	1,691	1,586	1,582	1,673	1,723	1,602	1,669	1,660
SEh_2 → FIh_2N	18	144	8	113	18	90	10	111

SEPTEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**637**	**4,392**	**606**	**4,396**	**0**	**4,142**	**0**	**4,251**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	2,442	0	2,496	0	2,141	0	2,200
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	637	1,245	606	1,234	0	102	0	99
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	705	0	666	0	1,899	0	1,952
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow UKh_2$	0	0	0	0	0	0	0	0

OCTOBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
AT	**3,039**	**2,114**	**3,284**	**2,512**	**144**	**1,878**	**338**	**2,316**
$ATh_2 \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$ATh_2 \rightarrow DEh_2$	2,220	901	2,525	1,345	132	1,385	330	1,951
$ATh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$ATh_2 \rightarrow$ IB-ITh_2	0	29	0	1	12	41	8	28
$ATh_2 \rightarrow$ IB-SKh_2W	819	1,184	758	1,166	0	452	0	337
$ATh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
BE	**23**	**1,237**	**13**	**1,731**	**409**	**1,179**	**477**	**1,718**
$BEh_2 \rightarrow BEH_2Mo$	0	0	0	0	0	0	0	0
$BEh_2 \rightarrow DEh_2$	23	729	13	1,211	409	614	477	1,057
$BEh_2 \rightarrow FRh_2$	0	234	0	295	0	214	0	306
$BEh_2 \rightarrow FRh_2N$	0	0	0	0	0	0	0	0
$BEh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$BEh_2 \rightarrow NLh_2$	0	274	0	225	0	351	0	355
$BEh_2 \rightarrow UKh_2$/INT	0	0	0	0	0	0	0	0
$BEH_2Mo \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$BEH_2Mo \rightarrow FRh_2Va$	0	0	0	0	0	0	0	0
BG	**110**	**0**	**106**	**0**	**110**	**0**	**105**	**0**
$BGh_2 \rightarrow GRh_2$	110	0	106	0	110	0	105	0
$BGh_2 \rightarrow MKh_2$	0	0	0	0	0	0	0	0
$BGh_2 \rightarrow ROh_2$	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$CHh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$CHh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
$CHh_2 \rightarrow$ IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$CYh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
CZ	**0**	**126**	**0**	**13**	**0**	**381**	**0**	**470**
$CZh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$CZh_2 \rightarrow DEh_2$	0	126	0	13	0	381	0	470
$CZh_2 \rightarrow$ IB-SKh_2W	0	0	0	0	0	0	0	0
$CZh_2 \rightarrow PLh_2S$	0	0	0	0	0	0	0	0

OCTOBER

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
DE	**3,443**	**3,879**	**3,226**	**3,236**	**2,722**	**3,210**	**2,229**	**2,748**
$DEh_2 \rightarrow ATh_2$	11	397	4	118	253	252	163	137
$DEh_2 \rightarrow BEh_2$	283	268	194	145	251	542	138	299
$DEh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow CZh_2$	324	1,003	295	536	272	451	228	235
$DEh_2 \rightarrow DKh_2$	273	51	367	181	76	62	164	179
$DEh_2 \rightarrow FRh_2$	747	507	521	410	387	602	256	492
$DEh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow NLh_2$	143	337	99	165	140	645	64	408
$DEh_2 \rightarrow PLh_2N$	515	366	477	343	0	0	0	0
$DEh_2 \rightarrow PLh_2nbc$	605	712	827	1,024	946	656	978	1,000
$DEh_2 \rightarrow Y\text{-}NOh_2$	0	0	0	0	0	0	0	0
$DEh_2ba \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$DEh_2bp \rightarrow DEh_2$	179	238	222	313	0	0	0	0
$DEh_2bp \rightarrow DEh_2ba$	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	364		222		396		237	
DK	**670**	**1,904**	**428**	**1,545**	**692**	**1,927**	**446**	**1,573**
$DKh_2 \rightarrow DEh_2$	670	1,904	428	1,545	692	1,927	446	1,573
$DKh_2 \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$DKh_2 \rightarrow SEh_2$	0	0	0	0	0	0	0	0
EE	**157**	**3,909**	**374**	**2,269**	**122**	**3,699**	**207**	**2,038**
$EEh_2 \rightarrow FIh_2S$	24	0	278	0	21	0	151	0
$EEh_2 \rightarrow LVh_2$	133	3,909	97	2,269	100	3,699	56	2,038
ES	**2,758**	**4,469**	**3,240**	**4,840**	**2,770**	**4,403**	**3,255**	**4,805**
$ESh_2 \rightarrow FRh_2S$	2,673	4,259	3,177	4,630	2,700	4,188	3,199	4,597
$ESh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow PTh_2$	85	210	62	210	70	215	56	208

OCTOBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
FI	**8,175**	**22,583**	**5,290**	**14,055**	**8,254**	**22,881**	**5,082**	**14,017**
FIh_2 → FIh_2Al	1,920	5,052	1,205	2,897	1,952	5,202	1,186	2,938
FIh_2 → FIh_2N	1	24	7	3	0	24	0	23
FIh_2 → FIh_2S	28	28	60	178	35	4	58	103
FIh_2Al → DEh_2	3,670	6,360	2,065	3,686	3,708	6,582	2,030	3,915
FIh_2Al → FIh_2	63	67	139	369	68	31	133	282
FIh_2Al → PLh_2N	0	0	0	0	0	0	0	0
FIh_2Al → SEh_2	2	14	60	35	0	33	0	29
FIh_2N → FIh_2	1,627	1,801	969	1,084	1,627	1,721	964	1,135
FIh_2N → SEh_2	0	369	73	371	0	397	68	377
FIh_2S → EEh_2	168	4,125	124	2,451	135	3,914	83	2,218
FIh_2S → FIh_2	697	4,742	589	2,981	728	4,972	561	2,999
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**5,650**	**8,161**	**6,400**	**8,449**	**5,457**	**8,066**	**6,342**	**8,561**
FRh_2 → BEh_2	0	358	0	184	0	442	0	243
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	2,167	2,035	2,638	2,208	2,193	1,914	2,681	2,227
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	372	378	214	245	269	416	168	301
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	23	0	28	3	10	0	10	3
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	778	0	1,061	0	712	0	988
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	348	354	209	237	245	405	159	296
FRh_2S → FRh_2	2,637	4,019	3,215	4,279	2,649	3,935	3,245	4,265
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	82	175	78	171	69	176	62	178
FRh_2Va → FRh_2	20	64	18	61	20	64	18	61
GR	**0**	**237**	**4**	**219**	**0**	**242**	**4**	**222**
GRh_2 → BGh_2	0	237	4	219	0	242	4	222
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

OCTOBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**450**	**971**	**411**	**799**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	17	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	450	954	411	799	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**4,998**	**14,431**	**5,142**	**14,971**	**261**	**14,351**	**523**	**15,316**
IB-$ITh_2 \rightarrow ATh_2$	3,545	4,323	3,798	4,525	248	4,218	515	4,398
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	29	0	1	12	41	8	28
IB-$SKh_2C \rightarrow HUh_2$	574	2,491	529	2,364	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	59	34	56	23	0	51	0	33
IB-$SKh_2C \rightarrow SKh_2W$	0	1,527	0	1,690	0	3,259	0	3,578
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	3,726	0	3,960	0	3,448	0	3,797
IB-$SKh_2W \rightarrow ATh_2$	0	149	0	152	0	348	0	253
IB-$SKh_2W \rightarrow CZh_2$	66	1,548	56	1,850	0	2,832	0	3,128
IB-$SKh_2W \rightarrow SKh_2W$	753	606	702	407	0	154	0	100
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,545**	**4,323**	**3,798**	**4,525**	**248**	**4,218**	**515**	**4,398**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,545	4,323	3,798	4,525	248	4,218	515	4,398
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**28**	**3,516**	**304**	**1,944**	**26**	**3,302**	**173**	**1,715**
$LTh_2 \rightarrow LVh_2$	28	1	304	7	25	2	173	10
$LTh_2 \rightarrow PLh_2nbc$	0	3,515	0	1,938	1	3,300	0	1,705

OCTOBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
LUh_2 → BEh_2	0	0	0	0	0	0	0	0
LUh_2 → DEh_2	0	0	0	0	0	0	0	0
LUh_2 → FRh_2	0	0	0	0	0	0	0	0
LV	**80**	**3,612**	**326**	**2,054**	**64**	**3,401**	**179**	**1,821**
LVh_2 → EEh_2	25	0	286	0	22	0	157	0
LVh_2 → LTh_2	55	3,612	40	2,054	42	3,401	21	1,821
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
MTh_2 → ITh_2	0	0	0	0	0	0	0	0
NL	**1,261**	**3,068**	**1,525**	**3,252**	**1,478**	**2,344**	**1,696**	**2,671**
NLh_2 → BEh_2	249	1,326	220	777	216	1,456	183	928
NLh_2 → DEh_2	1,013	1,742	1,305	2,475	1,262	888	1,513	1,743
NLh_2 → UKh_2	0	0	0	0	0	0	0	0
PL	**605**	**4,439**	**827**	**3,099**	**947**	**3,957**	**978**	**2,705**
PLh_2N → DEh_2	0	14	0	6	0	0	0	0
PLh_2N → DKh_2	0	0	0	0	0	0	0	0
PLh_2N → FIh_2AI	0	0	0	0	0	0	0	0
PLh_2N → PLh_2S	0	197	0	131	0	0	0	0
PLh_2nbc → DEh_2	0	493	0	284	0	1,365	0	715
PLh_2nbc → LTh_2	37	0	359	0	34	0	212	0
PLh_2nbc → PLh_2N	568	3,734	468	2,678	913	2,591	766	1,991
PLh_2nbc → PLh_2S	0	0	0	0	0	0	0	0
PLh_2S → CZh_2	0	0	0	0	0	0	0	0
PLh_2S → $IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
PLh_2S → PLh_2N	0	0	0	0	0	0	0	0
PLh_2S → PLh_2nbc	0	0	0	0	0	0	0	0
PT	**211**	**0**	**250**	**0**	**208**	**0**	**240**	**0**
PTh_2 → ESh_2	211	0	250	0	208	0	240	0
RO	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**
ROh_2 → BGh_2	0	0	0	0	0	0	0	0
ROh_2 → HUh_2	0	6	0	0	0	0	0	0
ROh_2 → MDh_2	0	0	0	0	0	0	0	0
ROh_2 → RSh_2	0	0	0	0	0	0	0	0
SE	**1,821**	**1,423**	**1,075**	**1,272**	**1,832**	**1,459**	**993**	**1,328**
SEh_2 → DKh_2	0	0	0	0	0	0	0	0
SEh_2 → FIh_2AI	1,814	1,389	1,059	1,193	1,824	1,445	977	1,288
SEh_2 → FIh_2N	7	34	17	79	8	13	16	40

OCTOBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
SIh_2 → ATh_2	0	0	0	0	0	0	0	0
SIh_2 → HRh_2	0	0	0	0	0	0	0	0
SIh_2 → HUh_2	0	0	0	0	0	0	0	0
SIh_2 → ITh_2	0	0	0	0	0	0	0	0
SK	**633**	**5,152**	**586**	**5,320**	**0**	**6,191**	**0**	**6,756**
SKh_2E → IB-SKh_2C	0	3,513	0	3,729	0	3,259	0	3,578
SKh_2E → IB-SKh_2E	0	0	0	0	0	0	0	0
SKh_2W → IB-SKh_2C	633	522	586	347	0	51	0	33
SKh_2W → IB-SKh_2W	0	1,118	0	1,243	0	2,881	0	3,145
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
UKh_2 → BEh_2	0	0	0	0	0	0	0	0
UKh_2 → IEh_2	0	0	0	0	0	0	0	0
UKh_2 → NLh_2	0	0	0	0	0	0	0	0
UKh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
UKh_2/INT → BEh_2	0	0	0	0	0	0	0	0
UKh_2/INT → UKh_2	0	0	0	0	0	0	0	0

NOVEMBER

	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
AT	**3,446**	**2,306**	**2,834**	**2,024**	**466**	**2,323**	**144**	**1,668**
ATh$_2$ → CZh$_2$	0	0	0	0	0	0	0	0
ATh$_2$ → DEh$_2$	2,732	1,369	1,854	827	466	1,855	144	1,196
ATh$_2$ → HUh$_2$	0	0	0	0	0	0	0	0
ATh$_2$ → IB-ITh$_2$	0	0	0	4	0	2	0	5
ATh$_2$ → IB-SKh$_2$W	715	937	980	1,193	0	466	0	467
ATh$_2$ → SIh$_2$	0	0	0	0	0	0	0	0
BE	**52**	**1,902**	**32**	**1,167**	**616**	**1,957**	**373**	**1,161**
BEh$_2$ → BEH$_2$Mo	0	0	0	0	0	0	0	0
BEh$_2$ → DEh$_2$	52	1,332	32	973	616	1,172	373	774
BEh$_2$ → FRh$_2$	0	136	0	92	0	147	0	106
BEh$_2$ → FRh$_2$N	0	0	0	0	0	0	0	0
BEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
BEh$_2$ → NLh$_2$	0	434	0	102	0	638	0	282
BEh$_2$ → UKh$_2$/INT	0	0	0	0	0	0	0	0
BEH$_2$Mo → BEh$_2$	0	0	0	0	0	0	0	0
BEH$_2$Mo → FRh$_2$Va	0	0	0	0	0	0	0	0
BG	**102**	**0**	**101**	**0**	**102**	**0**	**101**	**0**
BGh$_2$ → GRh$_2$	102	0	101	0	102	0	101	0
BGh$_2$ → MKh$_2$	0	0	0	0	0	0	0	0
BGh$_2$ → ROh$_2$	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh$_2$ → DEh$_2$	0	0	0	0	0	0	0	0
CHh$_2$ → FRh$_2$	0	0	0	0	0	0	0	0
CHh$_2$ → IB-ITh$_2$	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh$_2$ → GRh$_2$	0	0	0	0	0	0	0	0
CZ	**0**	**191**	**0**	**11**	**0**	**667**	**0**	**178**
CZh$_2$ → ATh$_2$	0	0	0	0	0	0	0	0
CZh$_2$ → DEh$_2$	0	191	0	11	0	667	0	178
CZh$_2$ → IB-SKh$_2$W	0	0	0	0	0	0	0	0
CZh$_2$ → PLh$_2$S	0	0	0	0	0	0	0	0

NOVEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
DE	**2,666**	**2,541**	**3,328**	**4,588**	**1,727**	**1,771**	**3,074**	**3,624**
$DEh_2 \rightarrow ATh_2$	5	66	10	896	83	123	244	704
$DEh_2 \rightarrow BEh_2$	114	154	171	210	100	205	231	302
$DEh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow CZh_2$	249	575	360	1,350	198	152	308	1,043
$DEh_2 \rightarrow DKh_2$	520	130	442	91	258	145	278	97
$DEh_2 \rightarrow FRh_2$	411	181	434	357	248	200	374	331
$DEh_2 \rightarrow LUh_2$	0	0	0	0	0	0	0	0
$DEh_2 \rightarrow NLh_2$	48	223	38	121	38	339	48	219
$DEh_2 \rightarrow PLh_2N$	430	249	543	378	0	0	0	0
$DEh_2 \rightarrow PLh_2nbc$	443	664	912	981	611	607	1,221	928
$DEh_2 \rightarrow Y\text{-}NOh_2$	0	0	0	0	0	0	0	0
$DEh_2ba \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$DEh_2bp \rightarrow DEh_2$	273	300	147	204	0	0	0	0
$DEh_2bp \rightarrow DEh_2ba$	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	172		271		190		371	
DK	**256**	**947**	**656**	**1,922**	**266**	**965**	**661**	**1,898**
$DKh_2 \rightarrow DEh_2$	256	947	656	1,922	266	965	661	1,898
$DKh_2 \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$DKh_2 \rightarrow SEh_2$	0	0	0	0	0	0	0	0
EE	**188**	**2,783**	**365**	**2,681**	**105**	**2,627**	**242**	**2,457**
$EEh_2 \rightarrow FIh_2S$	67	0	259	0	33	0	162	0
$EEh_2 \rightarrow LVh_2$	120	2,783	107	2,681	72	2,627	80	2,457
ES	**3,185**	**5,400**	**4,203**	**5,747**	**3,205**	**5,469**	**4,192**	**5,862**
$ESh_2 \rightarrow FRh_2S$	3,100	5,200	4,139	5,514	3,122	5,278	4,130	5,631
$ESh_2 \rightarrow FRh_2SW$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
$ESh_2 \rightarrow PTh_2$	86	200	63	233	82	191	62	231

NOVEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
FI	**6,146**	**23,618**	**5,040**	**17,676**	**6,380**	**24,021**	**5,075**	**17,911**
FIh_2 → FIh_2Al	1,683	5,941	1,225	3,925	1,777	6,120	1,231	4,091
FIh_2 → FIh_2N	2	15	8	7	0	29	0	7
FIh_2 → FIh_2S	0	0	46	159	0	0	47	117
FIh_2Al → DEh_2	2,169	6,249	1,883	5,022	2,301	6,406	1,989	5,277
FIh_2Al → FIh_2	3	0	101	277	5	0	102	206
FIh_2Al → PLh_2N	0	0	0	0	0	0	0	0
FIh_2Al → SEh_2	10	83	42	36	0	91	0	24
FIh_2N → FIh_2	1,425	1,301	1,018	1,285	1,463	1,286	1,032	1,369
FIh_2N → SEh_2	63	923	23	227	46	970	33	190
FIh_2S → EEh_2	151	2,986	133	2,864	102	2,824	106	2,641
FIh_2S → FIh_2	641	6,119	561	3,875	686	6,294	535	3,988
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**5,700**	**9,305**	**8,102**	**10,045**	**5,708**	**9,529**	**7,979**	**10,105**
FRh_2 → BEh_2	0	222	0	380	0	278	0	434
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	2,217	2,901	3,164	2,983	2,267	3,038	3,171	2,977
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	157	19	464	270	137	20	419	266
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	36	0	33	0	23	0	20	0
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	1,040	0	720	0	1,013	0	680
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	144	18	408	261	120	16	363	262
FRh_2S → FRh_2	3,067	4,917	3,906	5,144	3,093	4,973	3,892	5,202
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	70	139	101	206	57	142	87	205
FRh_2Va → FRh_2	10	49	27	81	11	49	27	80
GR	**0**	**155**	**0**	**157**	**0**	**163**	**0**	**157**
GRh_2 → BGh_2	0	155	0	157	0	163	0	157
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

NOVEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**358**	**539**	**582**	**865**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	5	0	0	0	0	0	0
$HUh_2 \rightarrow ROh_2$	358	534	582	864	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**5,185**	**14,586**	**5,120**	**13,423**	**725**	**14,971**	**315**	**11,979**
IB-$ITh_2 \rightarrow ATh_2$	3,931	4,469	3,323	4,216	725	4,511	315	4,176
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	0	0	4	0	2	0	5
IB-$SKh_2C \rightarrow HUh_2$	482	1,993	755	2,427	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	57	33	63	30	0	41	0	90
IB-$SKh_2C \rightarrow SKh_2W$	0	1,920	0	1,295	0	3,376	0	2,464
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	3,708	0	3,311	0	3,564	0	2,620
IB-$SKh_2W \rightarrow ATh_2$	0	498	0	213	0	580	0	357
IB-$SKh_2W \rightarrow CZh_2$	60	1,447	36	1,123	0	2,775	0	1,994
IB-$SKh_2W \rightarrow SKh_2W$	655	516	944	804	0	123	0	274
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**3,931**	**4,469**	**3,323**	**4,216**	**725**	**4,511**	**315**	**4,176**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	3,931	4,469	3,323	4,216	725	4,511	315	4,176
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**75**	**2,348**	**283**	**2,457**	**40**	**2,250**	**182**	**2,234**
$LTh_2 \rightarrow LVh_2$	75	3	283	5	40	3	182	13
$LTh_2 \rightarrow PLh_2nbc$	0	2,345	0	2,452	1	2,246	0	2,221

NOVEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
LUh_2 → BEh_2	0	0	0	0	0	0	0	0
LUh_2 → DEh_2	0	0	0	0	0	0	0	0
LUh_2 → FRh_2	0	0	0	0	0	0	0	0
LV	**129**	**2,524**	**318**	**2,444**	**68**	**2,374**	**198**	**2,220**
LVh_2 → EEh_2	70	0	266	0	35	0	168	0
LVh_2 → LTh_2	60	2,524	52	2,444	33	2,374	29	2,220
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
MTh_2 → ITh_2	0	0	0	0	0	0	0	0
NL	**1,617**	**2,712**	**1,131**	**3,098**	**1,781**	**2,106**	**1,368**	**2,706**
NLh_2 → BEh_2	141	742	307	1,540	103	842	216	1,614
NLh_2 → DEh_2	1,476	1,971	824	1,558	1,678	1,264	1,152	1,092
NLh_2 → UKh_2	0	0	0	0	0	0	0	0
PL	**443**	**3,142**	**912**	**3,652**	**612**	**2,855**	**1,221**	**3,149**
PLh_2N → DEh_2	0	33	0	18	0	0	0	0
PLh_2N → DKh_2	0	0	0	0	0	0	0	0
PLh_2N → FIh_2AI	0	0	0	0	0	0	0	0
PLh_2N → PLh_2S	0	99	0	202	0	0	0	0
PLh_2nbc → DEh_2	0	440	0	322	0	928	0	868
PLh_2nbc → LTh_2	91	0	316	0	50	0	204	0
PLh_2nbc → PLh_2N	353	2,569	596	3,110	562	1,926	1,017	2,281
PLh_2nbc → PLh_2S	0	0	0	0	0	0	0	0
PLh_2S → CZh_2	0	0	0	0	0	0	0	0
PLh_2S → $IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
PLh_2S → PLh_2N	0	0	0	0	0	0	0	0
PLh_2S → PLh_2nbc	0	1	0	0	0	1	0	0
PT	**195**	**0**	**335**	**0**	**185**	**0**	**334**	**0**
PTh_2 → ESh_2	195	0	335	0	185	0	334	0
RO	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
ROh_2 → BGh_2	0	0	0	0	0	0	0	0
ROh_2 → HUh_2	0	0	0	0	0	0	0	0
ROh_2 → MDh_2	0	0	0	0	0	0	0	0
ROh_2 → RSh_2	0	0	0	0	0	0	0	0
SE	**500**	**391**	**813**	**1,464**	**531**	**376**	**875**	**1,474**
SEh_2 → DKh_2	0	0	0	0	0	0	0	0
SEh_2 → FIh_2AI	500	391	801	1,410	530	376	860	1,416
SEh_2 → FIh_2N	1	0	12	53	1	0	15	58

NOVEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**540**	**5,466**	**818**	**4,699**	**0**	**6,428**	**0**	**4,712**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	3,498	0	3,094	0	3,376	0	2,464
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	540	444	818	658	0	41	0	90
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	1,525	0	947	0	3,011	0	2,158
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0
UKh_2/INT => UKh_2	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

DECEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
AT	**3,546**	**1,420**	**3,669**	**1,597**	**392**	**1,906**	**472**	**1,610**
ATh_2 → CZh_2	0	0	0	0	0	0	0	0
ATh_2 → DEh_2	3,005	1,170	2,823	1,119	392	1,800	472	1,463
ATh_2 → HUh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
ATh_2 → IB-SKh_2W	541	250	846	478	0	106	0	147
ATh_2 → SIh_2	0	0	0	0	0	0	0	0
BA	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
BAh_2 → HRh_2	0	0	0	0	0	0	0	0
BE	**34**	**2,669**	**31**	**2,025**	**804**	**2,853**	**672**	**1,938**
BEh_2 → BEH_2Mo	0	0	0	0	0	0	0	0
BEh_2 → DEh_2	34	1,130	31	1,515	804	1,124	672	1,335
BEh_2 → FRh_2	0	166	0	176	0	179	0	166
BEh_2 → FRh_2N	0	0	0	0	0	0	0	0
BEh_2 → LUh_2	0	0	0	0	0	0	0	0
BEh_2 → NLh_2	0	1,374	0	334	0	1,550	0	437
BEh_2 → UKh_2/INT	0	0	0	0	0	0	0	0
BEH_2Mo → BEh_2	0	0	0	0	0	0	0	0
BEH_2Mo → FRh_2Va	0	0	0	0	0	0	0	0
BG	**100**	**0**	**100**	**0**	**100**	**0**	**100**	**0**
BGh_2 → GRh_2	100	0	100	0	100	0	100	0
BGh_2 → MKh_2	0	0	0	0	0	0	0	0
BGh_2 → ROh_2	0	0	0	0	0	0	0	0
CH	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CHh_2 → DEh_2	0	0	0	0	0	0	0	0
CHh_2 → FRh_2	0	0	0	0	0	0	0	0
CHh_2 → IB-ITh_2	0	0	0	0	0	0	0	0
CY	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CYh_2 → GRh_2	0	0	0	0	0	0	0	0
CZ	**0**	**748**	**0**	**148**	**0**	**806**	**0**	**479**
CZh_2 → ATh_2	0	0	0	0	0	0	0	0
CZh_2 → DEh_2	0	748	0	148	0	806	0	479
CZh_2 → IB-SKh_2W	0	0	0	0	0	0	0	0
CZh_2 → PLh_2S	0	0	0	0	0	0	0	0

DECEMBER

COUNTRY	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
DE	**1,530**	**1,484**	**2,031**	**1,839**	**660**	**1,432**	**1,178**	**1,055**
DEh$_2$ → ATh$_2$	1	10	0	38	29	19	61	44
DEh$_2$ → BEh$_2$	20	32	79	24	20	54	27	42
DEh$_2$ → CHh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → CZh$_2$	117	203	225	394	98	7	186	12
DEh$_2$ → DKh$_2$	494	67	515	148	188	108	253	158
DEh$_2$ → FRh$_2$	8	28	104	0	0	39	64	9
DEh$_2$ → LUh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ → NLh$_2$	2	518	37	81	2	1,015	18	163
DEh$_2$ → PLh$_2$N	288	107	422	247	0	0	0	0
DEh$_2$ → PLh$_2$nbc	252	136	365	526	287	190	569	627
DEh$_2$ → Y-NOh$_2$	0	0	0	0	0	0	0	0
DEh$_2$ba → DEh$_2$	0	0	0	0	0	0	0	0
DEh$_2$bp → DEh$_2$	335	383	286	381	0	0	0	0
DEh$_2$bp → DEh$_2$ba	0	0	0	0	0	0	0	0
DEZ1a → DEZ1b	13		0		37		0	
DK	**39**	**596**	**101**	**783**	**57**	**619**	**112**	**780**
DKh$_2$ → DEh$_2$	39	596	101	783	57	619	112	780
DKh$_2$ → PLh$_2$N	0	0	0	0	0	0	0	0
DKh$_2$ → SEh$_2$	0	0	0	0	0	0	0	0
EE	**141**	**1,803**	**141**	**2,276**	**68**	**2,478**	**104**	**2,202**
EEh$_2$ → FIh$_2$S	73	0	28	0	45	0	40	0
EEh$_2$ → LVh$_2$	68	1,803	113	2,276	23	2,478	63	2,202
ES	**4,124**	**5,408**	**4,383**	**5,728**	**4,024**	**5,519**	**4,421**	**5,770**
ESh$_2$ → FRh$_2$S	4,094	5,231	4,352	5,515	3,994	5,343	4,394	5,563
ESh$_2$ → FRh$_2$SW	0	0	0	0	0	0	0	0
ESh$_2$ → ITh$_2$	0	0	0	0	0	0	0	0
ESh$_2$ → PTh$_2$	30	177	31	212	30	177	27	208

DECEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
	Unit: GWh/M							
FI	**4,705**	**20,758**	**5,965**	**20,004**	**4,891**	**21,037**	**6,080**	**20,520**
FIh_2 → FIh_2Al	1,287	5,406	1,531	4,924	1,372	5,336	1,585	5,084
FIh_2 → FIh_2N	1	1	0	26	0	5	0	48
FIh_2 → FIh_2S	4	6	20	0	3	2	13	0
FIh_2Al → DEh_2	1,650	5,927	2,331	5,496	1,742	5,953	2,402	5,715
FIh_2Al → FIh_2	22	18	45	6	22	8	34	6
FIh_2Al → PLh_2N	0	0	0	0	0	0	0	0
FIh_2Al → SEh_2	8	7	0	45	0	11	0	51
FIh_2N → FIh_2	1,041	1,300	1,295	1,220	1,072	1,368	1,290	1,264
FIh_2N → SEh_2	24	714	8	804	13	605	9	822
FIh_2S → EEh_2	95	1,967	145	2,454	49	2,619	94	2,378
FIh_2S → FIh_2	573	5,411	589	5,028	619	5,131	653	5,151
FIh_2S → FIh_2SZ1	0	0	0	0	0	0	0	0
FIh_2SZ1 → FIh_2S	0	0	0	0	0	0	0	0
FR	**6,860**	**10,219**	**7,768**	**9,950**	**6,713**	**10,541**	**7,833**	**9,892**
FRh_2 → BEh_2	0	231	0	97	0	266	0	145
FRh_2 → CHh_2	0	0	0	0	0	0	0	0
FRh_2 → DEh_2	2,692	3,493	3,194	3,067	2,696	3,644	3,307	3,046
FRh_2 → FRh_2N	0	0	0	0	0	0	0	0
FRh_2 → FRh_2S	0	0	20	0	0	0	10	0
FRh_2 → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2 → FRh_2Va	48	0	52	0	17	0	25	0
FRh_2 → LUh_2	0	0	0	0	0	0	0	0
FRh_2N → BEh_2	0	1,395	0	1,348	0	1,390	0	1,241
FRh_2N → FRh_2	0	0	0	0	0	0	0	0
FRh_2S → ESh_2	0	0	20	0	0	0	9	0
FRh_2S → FRh_2	4,053	4,977	4,390	5,232	3,964	5,120	4,416	5,256
FRh_2S → FRh_2SW	0	0	0	0	0	0	0	0
FRh_2SW → ESh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2	0	0	0	0	0	0	0	0
FRh_2SW → FRh_2S	0	0	0	0	0	0	0	0
FRh_2Va → BEH_2Mo	64	96	82	156	32	94	56	154
FRh_2Va → FRh_2	4	27	9	51	4	26	9	50
GR	**0**	**117**	**0**	**138**	**0**	**118**	**0**	**144**
GRh_2 → BGh_2	0	117	0	138	0	118	0	144
GRh_2 → CYh_2	0	0	0	0	0	0	0	0
GRh_2 → ITh_2	0	0	0	0	0	0	0	0

DECEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
HR	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$HRh_2 \rightarrow ALh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow BAh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HRh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
HU	**183**	**234**	**387**	**481**	**0**	**0**	**0**	**0**
$HUh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow$ IB-SKh_2C	0	44	0	21	0	0	0	0
$HUh_2 \rightarrow ROh_2$	183	190	387	460	0	0	0	0
$HUh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
$HUh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
IB	**4,890**	**15,179**	**5,609**	**14,503**	**672**	**16,450**	**793**	**15,751**
IB-$ITh_2 \rightarrow ATh_2$	4,043	3,856	4,176	3,793	672	4,135	793	3,854
IB-$ITh_2 \rightarrow CHh_2$	0	0	0	0	0	0	0	0
IB-$ITh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
IB-$SKh_2C \rightarrow HUh_2$	255	1,343	524	1,892	0	0	0	0
IB-$SKh_2C \rightarrow SKh_2E$	51	5	63	7	0	8	0	13
IB-$SKh_2C \rightarrow SKh_2W$	0	2,885	0	2,267	0	4,114	0	3,984
IB-$SKh_2E \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
IB-$SKh_2E \rightarrow SKh_2E$	0	4,323	0	4,276	0	4,305	0	4,228
IB-$SKh_2W \rightarrow ATh_2$	0	963	0	617	0	1,245	0	666
IB-$SKh_2W \rightarrow CZh_2$	130	1,697	133	1,506	0	2,618	0	2,967
IB-$SKh_2W \rightarrow SKh_2W$	410	107	714	146	0	25	0	40
IE	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$IEh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
IT	**4,043**	**3,856**	**4,176**	**3,793**	**672**	**4,135**	**793**	**3,854**
$ITh_2 \rightarrow ESh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow GRh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow$ IB-ITh_2	4,043	3,856	4,176	3,793	672	4,135	793	3,854
$ITh_2 \rightarrow MTh_2$	0	0	0	0	0	0	0	0
$ITh_2 \rightarrow SIh_2$	0	0	0	0	0	0	0	0
LT	**81**	**1,668**	**32**	**2,022**	**50**	**2,493**	**47**	**1,991**
$LTh_2 \rightarrow LVh_2$	81	5	32	2	50	5	47	3
$LTh_2 \rightarrow PLh_2nbc$	0	1,663	0	2,021	0	2,489	0	1,989

DECEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
LU	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$LUh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow DEh_2$	0	0	0	0	0	0	0	0
$LUh_2 \rightarrow FRh_2$	0	0	0	0	0	0	0	0
LV	**106**	**1,654**	**86**	**2,076**	**53**	**2,347**	**70**	**2,008**
$LVh_2 \rightarrow EEh_2$	75	0	29	0	46	0	42	0
$LVh_2 \rightarrow LTh_2$	31	1,654	57	2,076	7	2,347	28	2,008
MT	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$MTh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
NL	**1,867**	**1,960**	**1,655**	**2,596**	**1,967**	**1,504**	**1,871**	**1,768**
$NLh_2 \rightarrow BEh_2$	29	295	119	334	20	349	78	352
$NLh_2 \rightarrow DEh_2$	1,838	1,665	1,537	2,262	1,947	1,155	1,793	1,416
$NLh_2 \rightarrow UKh_2$	0	0	0	0	0	0	0	0
PL	**252**	**2,053**	**365**	**2,627**	**287**	**2,828**	**569**	**2,617**
$PLh_2N \rightarrow DEh_2$	0	114	0	18	0	0	0	0
$PLh_2N \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow FIh_2AI$	0	0	0	0	0	0	0	0
$PLh_2N \rightarrow PLh_2S$	0	17	0	63	0	0	0	0
$PLh_2nbc \rightarrow DEh_2$	0	933	0	328	0	1,851	0	872
$PLh_2nbc \rightarrow LTh_2$	92	0	46	0	56	0	53	0
$PLh_2nbc \rightarrow PLh_2N$	160	927	319	2,219	231	903	516	1,745
$PLh_2nbc \rightarrow PLh_2S$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow CZh_2$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2N$	0	0	0	0	0	0	0	0
$PLh_2S \rightarrow PLh_2nbc$	0	61	0	0	0	74	0	1
PT	**371**	**0**	**412**	**0**	**364**	**0**	**411**	**0**
$PTh_2 \rightarrow ESh_2$	371	0	412	0	364	0	411	0
RO	**0**	**1**	**0**	**6**	**0**	**0**	**0**	**0**
$ROh_2 \rightarrow BGh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow HUh_2$	0	1	0	6	0	0	0	0
$ROh_2 \rightarrow MDh_2$	0	0	0	0	0	0	0	0
$ROh_2 \rightarrow RSh_2$	0	0	0	0	0	0	0	0
SE	**398**	**553**	**851**	**626**	**396**	**644**	**855**	**691**
$SEh_2 \rightarrow DKh_2$	0	0	0	0	0	0	0	0
$SEh_2 \rightarrow FIh_2AI$	393	545	846	623	392	636	851	688
$SEh_2 \rightarrow FIh_2N$	4	8	5	3	4	8	4	3

DECEMBER	INFRASTRUCTURE LEVEL							
	ADVANCED				PCI/PMI			
	CLIMATE YEAR							
	1995		2009		1995		2009	
	SIMULATION YEAR							
COUNTRY	2030	2040	2030	2040	2030	2040	2030	2040
Unit: GWh/M								
SI	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$SIh_2 \rightarrow ATh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HRh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow HUh_2$	0	0	0	0	0	0	0	0
$SIh_2 \rightarrow ITh_2$	0	0	0	0	0	0	0	0
SK	**306**	**6,706**	**586**	**5,935**	**0**	**7,904**	**0**	**7,523**
$SKh_2E \rightarrow IB\text{-}SKh_2C$	0	4,098	0	4,022	0	4,114	0	3,984
$SKh_2E \rightarrow IB\text{-}SKh_2E$	0	0	0	0	0	0	0	0
$SKh_2W \rightarrow IB\text{-}SKh_2C$	306	91	586	123	0	8	0	13
$SKh_2W \rightarrow IB\text{-}SKh_2W$	0	2,517	0	1,790	0	3,782	0	3,526
UK	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
$UKh_2 \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow IEh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow NLh_2$	0	0	0	0	0	0	0	0
$UKh_2 \rightarrow UKh_2/INT$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow BEh_2$	0	0	0	0	0	0	0	0
$UKh_2/INT \rightarrow UKh_2$	0	0	0	0	0	0	0	0

Picture courtesy of LATVIJAS GAZE

LIST OF **FIGURES**

LIST OF **TABLES**

LIST OF **ABBREVIATIONS**

Annex C2	TYNDP 2024 Hydrogen Infrastructure Capacities
Annex D1	TYNDP 2024 Implementation Guidelines
Annex D2	TYNDP 2024 Hydrogen Infrastructure Gaps Identification methodology
d	Day
DGM	Dual Hydrogen/Natural Gas Model or Dual Gas Model
DHEM	Dual Hydrogen/Electricity Model
ENTSOG	European Network of Transmission System Operators for Gas
ENTSO-E	European Network of Transmission System Operators for Electricity
EU	European Union
ETS	European Union Emissions Trading System
FEED	Front-End Engineering Design
FID	Final Investment Decision
GCV	Gross Calorific Value or Higher Heating Value (25 °C/0 °C)
GWh	Gigawatt Hour
HCR	Hydrogen demand Curtailment Rate
H_2	Hydrogen
IGI	Hydrogen Infrastructure Gaps Identification

IGI indicator 1	Hydrogen Infrastructure Gaps Identification indicator for hydrogen market clearing price spreads
IGI indicator 2.1	Hydrogen Infrastructure Gaps Identification indicator for hydrogen demand curtailment for reference weather year
IGI indicator 2.2	Hydrogen Infrastructure Gaps Identification indicator for hydrogen demand curtailment for stressful weather year
IL	Infrastructure Level
IoSN	ENTSO-E's Identification of System Needs
MW	Megawatt
MWh	Megawatt Hour
NCV	Net Calorific Value or Lower Heating Value (25 °C/0 °C)
NT+	TYNDP 2024 National Trends+ scenario
PCI	Project of Common Interest
PMI	Project of Mutual Interest
RES	Renewable Energy Source(s)
TEN-E Regulation	Regulation (EU) 2022/869
TWh	Terawatt Hour
TYNDP	Ten-Year Network Development Plan
Union list	Union list of PCIs and PMIs
VoLL	Value of Lost Load
WTP_{H2}	Willingness To Pay
y	Year

COUNTRY CODES (ISO)

AL	Albania	**LU**	Luxembourg
AT	Austria	**LV**	Latvia
AZ	Azerbaijan	**LY**	Libya
BA	Bosnia and Herzegovina	**MA**	Morocco
BE	Belgium	**ME**	Montenegro
BG	Bulgaria	**MK**	North Macedonia
BY	Belarus	**MT**	Malta
CH	Switzerland	**NL**	Netherlands, the
CY	Cyprus	**NO**	Norway
CZ	Czech Republic	**PL**	Poland
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DK	Denmark	**RO**	Romania
DZ	Algeria	**RS**	Serbia
EE	Estonia	**RU**	Russia
ES	Spain	**SE**	Sweden
FI	Finland	**SI**	Slovenia
FR	France	**SK**	Slovakia
GR	Greece	**TM**	Turkmenistan
HR	Croatia	**TN**	Tunisia
HU	Hungary	**TR**	Turkey
IE	Ireland	**UA**	Ukraine
IT	Italy	**UK**	United Kingdom
LT	Lithuania		

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Avenue de Cortenbergh 100
1000 Brussels, Belgium

Co-Authors Mads Boesen, Maria Castro, Arturo de Onis Romero-Requejo, Axelle de Cadier de Veauce, Diana Fathelbajanova, Joan Frezouls, Alexander Kättlitz, Isabell Kolonko, Pierre Marani, Simona Marcu, Dante Powell, Rafail Tsalikoglou, Thilo von der Grün, Aisling Wall, Arnaud Weissrock, Kacper Zeromski, NeMo KG, INV WG, SCN WG.

Design DreiDreizehn GmbH, Berlin | www.313.de

european network
of transmission system operators
for gas

ENTSOG AISBL
Avenue de Cortenbergh 100 | 1000 Brussels, Belgium
Tel. +32 2 894 51 00

info@ENTSOG.eu | www.ENTSOG.eu