Energy Institute Hrvoje Požar
Croatia

Technical support to the Energy Community and its Secretariat to assess the candidate Projects of Energy Community Interest in electricity, smart gas grids, hydrogen, electrolysers, and carbon dioxide transport and storage, in line with the EU Regulation 2022/869

- Presentation of scenarios and assumptions -

TEN-E (PECI) Groups meeting – 3rd meeting of the “Electricity” Group

16 May 2024

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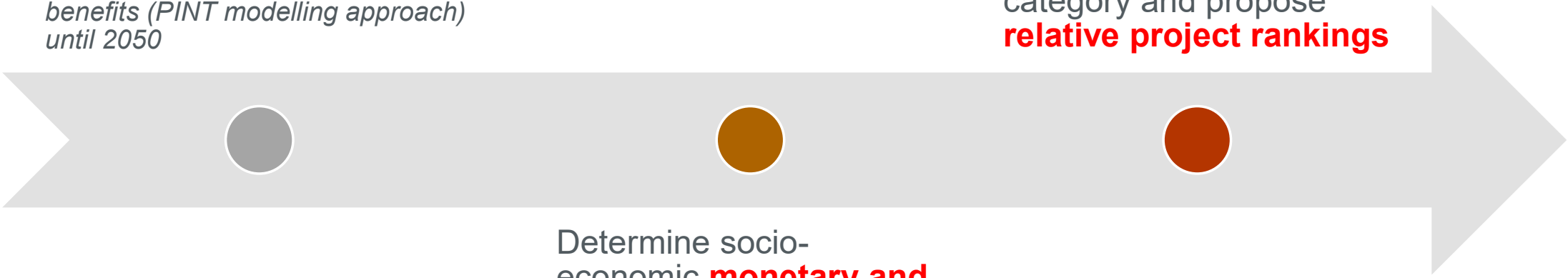
Approach for project assessment

Develop a **reference scenario**, against which all projects will be assessed

- *Each project will be added to the reference scenario to determine its benefits (PINT modelling approach) until 2050*



Determine socio-economic **monetary and non-monetary benefits** and costs for each project (project-specific CBA and MCA)

Compare individual project assessment results between projects in the same project category and propose **relative project rankings**

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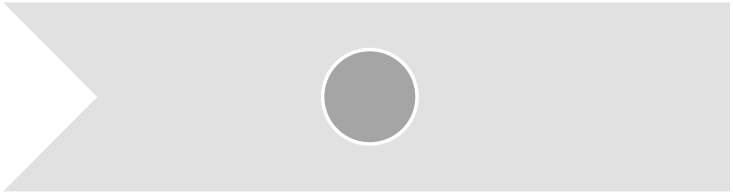
Approach for project assessment

Develop a **reference scenario**, against which all projects will be assessed

- *Each project will be added to the reference scenario to determine its benefits (PINT modelling approach) until 2050*



- For project assessment electricity model will be developed using appropriate **modelling tools**
- To determine costs and benefits of the project, **a reference case, i.e. reference scenario** will be established (against which all projects will be assessed)
  - Reference case assumes an energy system/network without any of the project candidates
- **Put IN one at the Time (PINT)** - each new investment/project will be added to reference scenario one by one
- Simulation results for the reference case will be used for comparison with a scenario with the project, to calculate the **benefits of adding a certain project into the system**

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Market and network models

- **PLEXOS** – tool for the project assessment
  - enables modelling and analyses of **electricity market**
  - extensive experience of EIHP experts in various applications of PLEXOS for energy system analyses (including project assessments and CBA analyses)
- EIHP has developed a **detailed regional electricity market model of SEE countries (including WB6**) in PLEXOS
- **PSS/E** – additional tool for electricity network analyses

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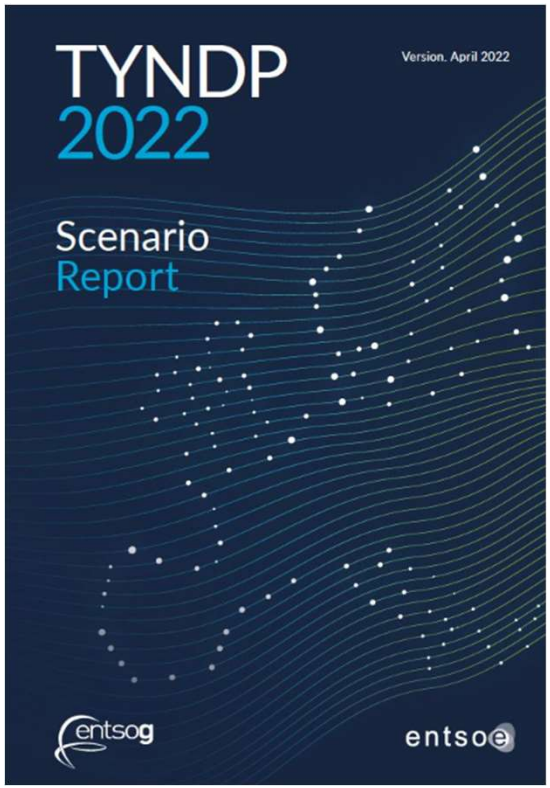
Modelling scenarios

- Modelling scenarios have to be in line with the latest **ENTSO-E scenarios** developed under Ten Year Network Development Plan 2024 or 2022
- The final report and datasets for the TYNDP 2024 have not been published yet -> the data from the **TYNDP 2022 scenarios will be used**
- ENTSO-E TYNDP 2022 scenarios used for project assessment:
  - **National Trends (NT) for 2030/2040**
  - **Distributed Energy (DE) for 2050**
- *Under the TYNDP 2022 the NT scenario reflects national energy and climate policies (NECPs, national long-term strategies, hydrogen strategies…) based on the joint European targets*



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General modelling assumptions

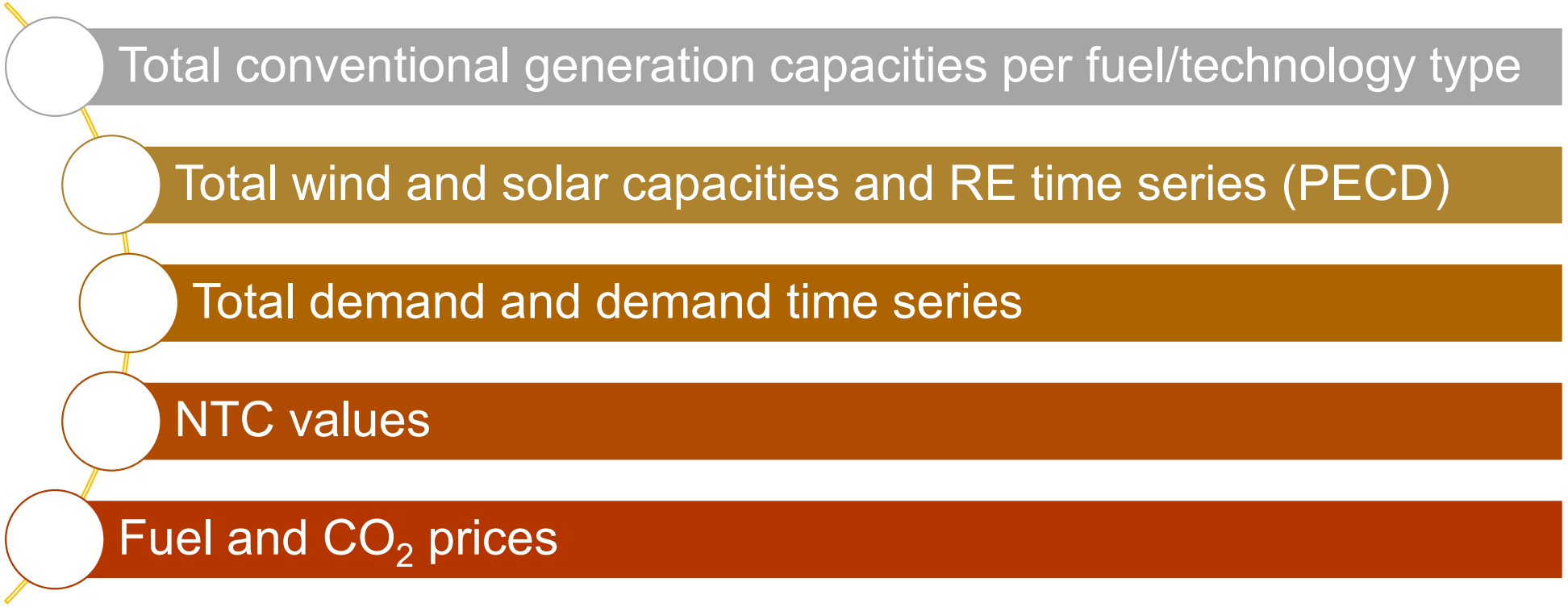
- **Geographical scope**: Albania, Bosnia and Herzegovina, Georgia, Kosovo, Moldova, Montenegro, North Macedonia, Serbia and Ukraine
- **Time horizon:** 2030/2040/2050
- **Climatic year:** 2009 as the most representative year in the TYNDP 2022
- **Hydrological conditions:** Average/Normal
- **Modelling tools:** PLEXOS Energy Modelling Software, PSS/E

General modelling assumptions

- **Approach for neighbouring countries**: use of the best available data and models (ENTSO-E TYNDP, EIHP in house data sets and developed models)
  - Some countries presented on a unit-by-unit level (e.g. Croatia, Bulgaria, Romania), others modelled on a fuel/technology level (e.g. Hungary, Italy, Slovakia and Poland)
  - Power systems of other countries, that have borders with neighbouring countries of CPs, such as Austria, shall be considered in regional PLEXOS model as **spot markets**
    - Hourly market prices are insensitive to price fluctuations in the CPs region and its neighbouring countries

Input data based on the TYNDP 2022 scenarios

- Input data and assumptions based on the **ENTSO-E TYNDP 2022** scenarios:



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Input data based on the TYNDP scenarios

- Total conventional generation capacities per fuel/technology type

	GENERAL DATA					
Power plant name	Unit	PEMMDB Fuel type	Pmax - Net maximum generating capacity (MW)	Pmin - Net minimum stable generation (MW)	Commissioning date (dd/mm/yyyy)	Decommissioning date (dd/mm/yyyy)
TPP Gacko	WTGACKG1_1	Lignite old 1	276	180	09/02/1983	01/01/2050
TPP Kakanj	WTKAKAG7_7	Lignite old 1	208	140	27/12/1989	01/01/2050
TPP Kakanj	WTKAKAG8_1	Lignite new	270	133	01/01/2026	01/01/2050
TPP Stanari	WTSTANG_1	Lignite old 2	275	150	20/09/2016	01/01/2050
TPP Tuzla	WTTUZG7_1	Lignite new	410	180	01/01/2024	01/01/2050
TPP Tuzla	WTTUZLG6_6	Lignite old 1	200	115	30/09/1978	01/01/2050
TPP Ugljevik	WTUGLJG1_1	Lignite old 1	279	155	20/11/1985	01/01/2050

- *Data in country-specific questionnaires regarding **thermal and hydro power plants** verified by national authorities*

Node	Node/Line	Scenario	Year	Parameter	Climate Year	Fuel	Category	Value
BA00	BA00	Distributed Energy	2030	Capacity (MW)	CY 2009	Coal & Lignite	Electricity Market	1,918
BA00	BA00	National Trends	2030	Capacity (MW)	CY 2009	Coal & Lignite	Electricity Market	1,918
BA00	BA00	National Trends	2040	Capacity (MW)	CY 2009	Coal & Lignite	Electricity Market	1,918

EIHP

Input data based on the TYNDP scenarios

- Total wind and solar capacities and RE time series (PECD)

		TYNDP 2022 National Trends Scenario		TYNDP 2022 Distributed Energy Scenario
		2030	2040	2050
Total installed capacity - Wind	(MW)	443	723	605
Total installed capacity - Solar		563	998	11553

Market Nc MK00
Year 2030
Scenario

Date	Hour	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
01.01.	1	0.040205	0.387636	0.35635	0.098609	0.390016	0.046124	0.030488	0.261201	0.008913	0.008923	0.638432	0.061176	0.01344	0.019683	0.341037	0.033754	0.000199	0.0432
01.01.	2	0.037582	0.344127	0.336965	0.0942	0.406891	0.041457	0.043384	0.308038	0.010782	0.007807	0.62691	0.067	0.016879	0.022738	0.320277	0.027207	0.000509	0.03415
01.01.	3	0.031374	0.276314	0.243514	0.085288	0.382697	0.04373	0.049117	0.370779	0.010991	0.007867	0.617154	0.067926	0.017403	0.037892	0.28804	0.026887	0.000902	0.027696
01.01.	4	0.02638	0.239768	0.200519	0.070535	0.328768	0.051209	0.073196	0.417801	0.012246	0.006234	0.597891	0.077524	0.017112	0.053707	0.242136	0.033537	0.001374	0.021387
01.01.	5	0.025426	0.156804	0.166258	0.06332	0.289493	0.052449	0.090775	0.447971	0.013548	0.005634	0.659732	0.0943	0.018242	0.093958	0.192014	0.033219	0.001765	0.020731
01.01.	6	0.028096	0.101502	0.14003	0.048395	0.268557	0.046358	0.089832	0.437592	0.017359	0.003682	0.713801	0.107294	0.021005	0.142413	0.147097	0.025933	0.002641	0.022189
01.01.	7	0.034705	0.067374	0.103223	0.034374	0.239853	0.044902	0.081388	0.439582	0.022169	0.003596	0.728972	0.122412	0.022888	0.181849	0.111454	0.023752	0.003105	0.02538
01.01.	8	0.041166	0.038475	0.083741	0.024245	0.194095	0.047307	0.092651	0.416216	0.021925	0.003391	0.743815	0.127617	0.019545	0.228663	0.099435	0.025223	0.004694	0.027025
01.01.	9	0.042212	0.037066	0.044438	0.016674	0.149128	0.045086	0.104138	0.383222	0.017894	0.004343	0.796632	0.149885	0.016157	0.244915	0.072939	0.023746	0.005353	0.027674
01.01.	10	0.038251	0.080366	0.031945	0.0083	0.086688	0.034066	0.053737	0.395479	0.008705	0.006305	0.74203	0.163004	0.013202	0.298976	0.046867	0.019821	0.002096	0.019777
01.01.	11	0.014061	0.191589	0.058738	0.006213	0.055804	0.021475	0.056351	0.392355	0.007385	0.006636	0.742579	0.177068	0.018637	0.334038	0.02083	0.008743	0.000541	0.009156
01.01.	12	0.012378	0.255661	0.076432	0.003966	0.046479	0.028267	0.096648	0.383633	0.016282	0.003365	0.771173	0.182356	0.022287	0.337513	0.011876	0.016664	0.001561	0.011942
01.01.	13	0.017951	0.2772	0.080843	0.00242	0.033246	0.039855	0.09637	0.334274	0.023666	0.003099	0.773929	0.182114	0.019974	0.409531	0.006624	0.018278	0.001564	0.016023
01.01.	14	0.03269	0.290408	0.077402	0.001743	0.014622	0.045766	0.058891	0.306887	0.027548	0.003112	0.733326	0.176124	0.020933	0.63182	0.0031	0.024596	0.001347	0.018566
01.01.	15	0.053726	0.293687	0.067953	0.001271	0.009784	0.034024	0.051182	0.237831	0.022379	0.004998	0.606121	0.159788	0.027844	0.729486	0.002819	0.027017	0.001419	0.017984
01.01.	16	0.083678	0.17162	0.070482	0.001635	0.026439	0.030625	0.044922	0.246028	0.01586	0.007962	0.386748	0.160184	0.035047	0.760629	0.007118	0.029451	0.001221	0.017023
01.01.	17	0.096032	0.106547	0.06788	0.00143	0.018476	0.029766	0.037365	0.272718	0.008617	0.010042	0.272912	0.182318	0.044634	0.745995	0.013889	0.049579	0.001505	0.017597
01.01.	18	0.112414	0.074671	0.05464	0.001167	0.012429	0.027198	0.034711	0.289079	0.005314	0.014449	0.203618	0.185432	0.067803	0.700664	0.01811	0.056902	0.00115	0.028242
01.01.	19	0.119814	0.054258	0.045089	0.000754	0.007634	0.029442	0.032709	0.291822	0.00374	0.018835	0.137081	0.177524	0.097868	0.658521	0.02042	0.054292	0.000695	0.038448
01.01.	20	0.129163	0.038122	0.040775	0.00117	0.004488	0.035571	0.032316	0.269787	0.002977	0.02656	0.086559	0.15195	0.105215	0.591412	0.023201	0.051725	0.001095	0.045549
01.01.	21	0.137477	0.02551	0.037925	0.002147	0.001658	0.04279	0.03541	0.245844	0.002579	0.033893	0.089857	0.13437	0.099388	0.545796	0.02759	0.053421	0.001727	0.034649
01.01.	22	0.143234	0.018765	0.039274	0.003128	0.001707	0.035612	0.043159	0.231014	0.002893	0.032246	0.074975	0.112885	0.078751	0.501575	0.033462	0.052977	0.001699	0.022668
01.01.	23	0.139049	0.018242	0.0391	0.006387	0.003521	0.045237	0.045281	0.217602	0.004955	0.029294	0.067061	0.097416	0.045161	0.47953	0.031554	0.034758	0.001137	0.022986

LT00 LU00 LUB1 LUF1 LUG1 LUV1 LV00 MA00 MD00 ME00 MK00 MT00 NL0

- *Data in country-specific questionnaires regarding **wind and solar power plants** verified by national authorities*
- *Hourly RE generation profiles available for each country and different climate years (PECD)*

Input data based on the TYNDP scenarios

- Total electricity demand and demand time series

		TYNDP 2022 National Trends Scenario		TYNDP 2022 Distributed Energy Scenario
		2030	2040	2050
Total ELECTRICITY demand	(GWh)	12640	12681	14457

ENTSO-E Demand Database

Country:	Boznia				max peak (MW)	2245		max Annual Demand (TWh)	12.80				min off peak (MW)	835			
ket Node:	BA00				climate year with max peak	1996		average yearly demand (TWh)	12.67				climate year with min off peak	1985			
Year:	2030				average max peak (MW)	2124		min Annual Demand (TWh)	12.46				average off peak (MW)	884			
Scenario:	nal Trends							te year with highest Demand	2003								
idar Year:	2018	886	905	902	835	907	898	866	901	895	883	914	890	881	873	871	897
	Yearly pea	2076	2110	2070	2194	2141	2149	2089	2092	2071	2092	2104	2169	2073	2148	2245	2070
	Annual de	12.61324	12.65609	12.60978	12.75585	12.69315	12.73598	12.71957	12.54965	12.52857	12.73564	12.64079	12.73734	12.6211	12.674	12.78822	12.6581
		Load (MW) built for Climatic Variations from YEAR:															
Date	Hour	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
01.01.	1	1243	1434	1319	1460	1375	1317	1341	1386	1402	1305	1468	1513	1363	1337	1340	1442
01.01.	2	1171	1357	1249	1376	1296	1245	1270	1310	1323	1229	1385	1426	1286	1258	1264	1362
01.01.	3	1132	1315	1211	1331	1254	1207	1231	1268	1281	1187	1339	1378	1245	1215	1222	1318
01.01.	4	1109	1293	1192	1304	1229	1186	1212	1245	1257	1163	1313	1350	1221	1189	1199	1293
01.01.	5	1108	1296	1198	1302	1228	1188	1217	1246	1257	1162	1310	1346	1220	1184	1199	1293
01.01.	6	1135	1335	1243	1330	1257	1224	1260	1280	1292	1189	1337	1372	1249	1201	1231	1325
01.01.	7	1210	1424	1334	1412	1341	1307	1351	1365	1377	1268	1414	1454	1330	1272	1318	1410
01.01.	8	1339	1566	1460	1565	1487	1436	1481	1505	1521	1407	1563	1613	1471	1413	1459	1558
01.01.	9	1459	1686	1569	1700	1614	1550	1592	1627	1646	1532	1696	1754	1594	1546	1584	1684
01.01.	10	1525	1743	1618	1773	1683	1607	1644	1689	1710	1603	1767	1834	1660	1627	1653	1749
01.01.	11	1540	1741	1612	1785	1697	1610	1641	1695	1715	1620	1775	1849	1670	1652	1669	1753
01.01.	12	1543	1728	1594	1785	1699	1602	1625	1688	1709	1626	1769	1852	1668	1664	1673	1746
01.01.	13	1534	1706	1569	1772	1689	1585	1603	1672	1692	1618	1752	1840	1656	1662	1665	1729
01.01.	14	1546	1711	1578	1779	1699	1594	1612	1679	1698	1632	1756	1848	1664	1676	1681	1732
01.01.	15	1541	1703	1565	1776	1696	1585	1601	1673	1692	1627	1751	1845	1660	1674	1676	1728
01.01.	16	1538	1702	1567	1772	1691	1585	1601	1671	1690	1623	1750	1841	1656	1669	1671	1725
01.01.	17	1592	1756	1634	1822	1737	1642	1664	1722	1744	1674	1805	1892	1705	1719	1722	1773
01.01.	18	1653	1836	1736	1882	1790	1720	1757	1791	1816	1729	1873	1948	1763	1763	1779	1838

AL00 AT00 BE00 BA00 BG00 CH00 CY00 CZ00 DE00 DKE1 DKW1 DZ00 EE00 EG00 ES00 FI00 FR00 FR15 GR00 GR03 HR00

- *Total **electricity demand** provided by national authorities; TYNDP 2022 used where data is missing*
- *Hourly demand profiles available for each country and each climate year*

Input data based on the TYNDP scenarios

- NTC values

Interconnection	MK00-AL00						MK00-BG00						MK00-GR00						MK00-RS00						MK00-XK00					
From:	MK00			AL00			MK00			BG00			MK00			GR00			MK00			RS00			MK00			XK00		
To:	AL00			MK00			BG00			MK00			GR00			MK00			RS00			MK00			XK00			MK00		
Year	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050	2030	2040	2050
NTC (MW)	500	500	500	500	500	500	400	400	400	500	500	500	850	850	850	1100	1100	1100	330	330	330	350	350	350	270	270	270	300	300	300

Node/Line	Generator	Parameter	Category	Case	Scenario	Year	Climate Y	Value
AL00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	500
AL00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	500
AL00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	500
AL00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	-500
AL00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	-500
AL00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	-500
BG00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	500
BG00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	500
BG00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	500
BG00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	-400
BG00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	-400
BG00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	-400
GR00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	1100
GR00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	1100
GR00-MK00		Export Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	1100
GR00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	-850
GR00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	-850
GR00-MK00		Import Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	-850
MK00-RS00		Export Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	450
MK00-RS00		Export Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	450
MK00-RS00		Export Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	450
MK00-RS00		Import Capacity (MW)	Electricity Market		Distributed Energy	2030	2009	-540
MK00-RS00		Import Capacity (MW)	Electricity Market		Distributed Energy	2040	2009	-540
MK00-RS00		Import Capacity (MW)	Electricity Market		Distributed Energy	2050	2009	-540

- ***NTC values*** *for each border and year provided by the national authorities*

Input data based on the TYNDP scenarios

- **Fuel and CO_2 prices**
  - Can be subject to **sensitivity analysis**

€/GJ	2030	2040	2050
Nuclear	0.47		
Biomethane	20.74	16.94	13.97
Shale Oil	1.86	2.71	3.93
Lignite:			
Group 1 (BG, MK and CZ)	1.40		N.a
Group 2 (SK, DE, RS, PL, ME, UK, IE and BA)	1.80		N.a
Group 3 (SI, RO and HU)	2.37		N.a
Group 4 (GR and TR)	3.10		N.a

	Unit	Scenarios	2030	2040	2050
CO_2	€/tonne	**NT**	**70**	**90**	N.a
		DE	78	123	**168**
Hard coal	€/GJ	**NT**	**2.48**	**2.41**	N.a
		DE	1.97	1.92	**1.87**
Light oil		**NT**	**13.78**	**15.41**	N.a
		DE	10.09	9.61	**9.12**
Natural gas		**NT**	**6.23**	**6.90**	N.a
		DE	4.02	4.07	**4.07**
Biomethane		**NT**	**20.74**	**16.94**	N.a
		DE	20.74	16.94	**13.97**
Synthetic methane		**NT**	**28.09**	**23.35**	N.a
		DE	28.96	23.35	**18.09**
Renewable H2 imports		**NT**	**20.25**	**16.08**	N.a
		DE	20.63	16.08	**12.52**
Decarbonised H2 imports		**NT**	**20.25**	**16.08**	N.a
		DE	17.11	17.55	**17.91**

EIHP

Thank you for your attention

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