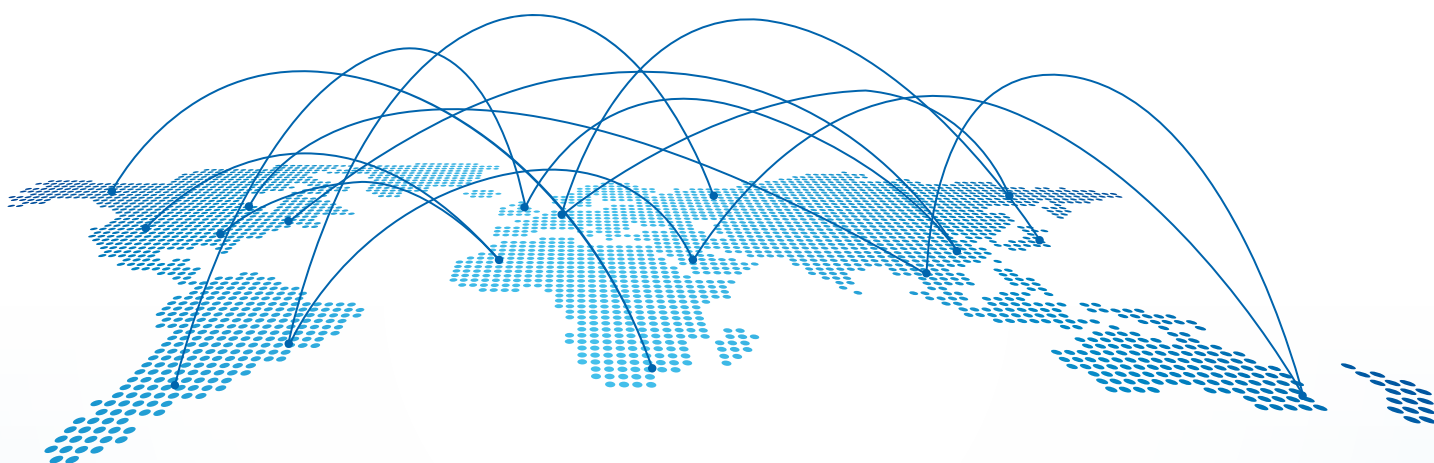


# INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

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## Annex document: criteria data tables

18th October 2018



The Weltenergieerat - Deutschland e. V., based in Berlin, represents the German energy system in the network of the World Energy Council. Among its member are over 60 companies and associations. The council looks at the entire energy spectrum with a fact-based eye in order to promote a better understanding of energy issues and solutions from a global perspective.

The following report is created by Frontier Economics and published on behalf of the Weltenergieerat - Deutschland (www.weltenergieerat.de). The study is a joined project with the following project partners:

- 50Hertz Transmission GmbH
- Bundesverband der Deutschen Luftverkehrswirtschaft e.V.
- DVGW Deutscher Verein des Gas- und Wasserfaches e.V.
- EnBW Energie Baden- Württemberg AG
- E.ON SE
- Innogy SE
- Institut für Wärme und Oeltechnik e. V. (IWO)
- Mitsubishi Hitachi Power Systems Europe GmbH
- Mineralölwirtschaftsverband e. V. (MWV)
- MEW Mittelständische Energiewirtschaft Deutschland e. V.
- Open Grid Europe GmbH
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- Australia
- Chile
- China
- Germany
- Ireland
- Morocco
- Netherlands
- New Zealand
- Norway
- Saudi Arabia
- United Kingdom

**Dr. Jens Perner**

 +4922133713102

 jens.perner@frontier-economics.com

**Dr. David Bothe**

 +4922133713106

 david.bothe@frontier-economics.com

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# 1 ANNEX TO SECTION 3.1 OF THE REPORT: CRITERIA DATA TABLES

## 1.1 RES availability, costs and energy framework

**Table 1** RES availability, costs and energy framework

Country	Country Code	Global Horizontal Irradiation (GHI) (kWh/m <sup>2</sup> )	PV Min (FLH-Min)	PV Max (FLH-Max)	PV LCOE 2030	PV generation as% of global PV in 2030	Wind generation as% of global wind in 2030	Total RES capacity 2017 (MW)	Total RES generation 2017 (TWh)	RES generation, 2010	RES generation, 2030 (TWh)	RES generation $\Delta$ 2010-2030 (%)
Afghanistan	AFG		1,500	1,800	67.9			339	0.9			
Albania	ALB	1,556	1,200	1,450	55.7			2,018	5.9			
Algeria	DZA	1,829	1,450	1,800				663	0.3			
American Samoa	ASM				67.9							
Andorra	AND		1,350	1,350	55.7			0	0.0			
Angola	AGO		1,400	1,600	55.8			2,800	5.1			
Antigua and Barbuda	ATG											
Argentina	ARG		750	1,550	49.4	0.64%	0.67%	11,559	36.3	36	128	256%
Armenia	ARM		1,300	1,300	55.7			1,320	2.2			
Aruba	ABW				49.4			38	0.2			
Australia	AUS		1,050	1,850	67.9	0.64%	1.06%	19,112	34.4	38	65	71%
Austria	AUT	1,194	1,050	1,250	55.7			19,880	47.2			
Azerbaijan	AZE		1,200	1,550	55.7			1,252	1.9			
Bahamas, The	BHS		1,600	1,700								
Bahrain	BHR	2,086	1,600	1,700				6	0.0			
Bangladesh	BGD		1,400	1,500	67.9			474	1.2			
Barbados	BRB							19	0.0			
Belarus	BLR		1,050	1,150	55.7			391	0.3			
Belgium	BEL	1,052	950	1,050	55.7	0.45%	0.43%	7,442	14.5	8	26	225%

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Global Horizontal Irradiation (GHI) (kWh/m <sup>2</sup> )	PV Min (FLH-Min)	PV Max (FLH-Max)	PV LCOE 2030	PV generation as% of global PV in 2030	Wind generation as% of global wind in 2030	Total RES capacity 2017 (MW)	Total RES generation 2017 (TWh)	RES generation, 2010	RES generation, 2030 (TWh)	RES generation Δ 2010-2030 (%)
Belize	BLZ		1,450	1,500				102	0.4			
Benin	BEN		1,500	1,600	55.8			6	0.0			
Bermuda	BMU				60.7			0	0.0			
Bhutan	BTN		1,400	1,550	67.9			1,615	7.7			
Bolivia	BOL		1,250	1,650	49.4			796	2.7			
Bosnia and Herzegovina	BIH	1,315	1,100	1,350	55.7							
Botswana	BWA		1,250	1,450	55.8			3	0.0			
Brazil	BRA		1,150	1,800	49.4	1.27%	3.78%	128,293	430.5	436	833	91%
British Virgin Islands	VGB				49.4							
Brunei Darussalam	BRN				67.9							
Bulgaria	BGR	1,406	1,150	1,300				4,144	8.8			
Burkina Faso	BFA		1,550	1,600	55.8			76	0.1			
Burundi	BDI		1,450	1,550	55.8			50	0.2			
Cabo Verde	CPV				55.8			39	0.2			
Cambodia	KHM		1,400	1,500	67.9			1,377	2.6			
Cameroon	CMR		1,450	1,600	55.8			741	4.4			
Canada	CAN		900	1,450	60.7	1.45%	1.30%	98,606	422.6	370	497	34%
Cayman Islands	CYM				49.4							
Central African Republic	CAF		1,400	1,550	55.8							
Chad	TCD		1,600	1,750	55.8			1	0.0			
Channel Islands	CHI				55.7							
Chile	CHL		750	1,650	49.4			10,821	32.9			
China	CHN		1,150	1,750	67.9	38.57%	25.51%	618,803	1,371.8	802	2,892	261%
Colombia	COL		1,200	1,850	49.4	0.00%	0.04%	12,037	46.1	41	63	54%
Comoros	COM							1	0.0			

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Congo, Dem. Rep.	COD		1,300	1,600	55.8			2,687	9.2			
Congo, Rep.	COG		1,250	1,400	55.8							
Costa Rica	CRI		1,350	1,750	49.4			2,964	10.6			
Cote d'Ivoire	CIV		1,400	1,600	55.8							
Croatia	HRV	1,334	1,100	1,350				2,860	7.5			
Cuba	CUB		1,500	1,800	49.4			638	0.8			
Curacao	CUW				49.4			57	0.2			
Cyprus	CYP	1,902	1,550	1,750	55.7	0.09%	0.00%	273	0.4	0	1	
Czech Republic	CZE	1,109	950	1,050				4,706	9.4			
Denmark	DNK	987	1,050	1,100	55.7	0.18%	0.79%	7,792	18.9	13	29	123%
Djibouti	DJI		1,600	1,750				0	0.0			
Dominica	DMA		1,850	1,900				7	0.0			
Dominican Republic	DOM		1,550	1,850	49.4	0.00%	0.08%			1	7	600%
Ecuador	ECU		1,200	1,700	49.4	0.09%	0.04%	4,688	13.6	9	44	389%
Egypt, Arab Rep.	EGY	2,126	1,600	1,900		0.09%	2.72%	3,717	15.3	14	86	514%
El Salvador	SLV		1,600	1,850	49.4			1,166	3.6			
Equatorial Guinea	GNQ				55.8							
Eritrea	ERI		1,600	1,800	55.8			1	0.0			
Estonia	EST		1,150	1,250				544	1.5			
Ethiopia	ETH		1,600	1,850	55.8	1.09%	0.16%	4,301	9.6	5	95	1800%
Faroe Islands	FRO				55.7			59	0.2			
Fiji	FJI				67.9			232	0.5			
Finland	FIN		850	1,250	55.7			7,556	30.5			
France	FRA	1,259	1,000	1,550	55.7	3.72%	3.58%	46,678	89.4	85	225	165%
French Polynesia	PYF				67.9							

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Country	Country Code	Global Horizontal Irradiation (GHI) (kWh/m <sup>2</sup> )	PV Min (FLH-Min)	PV Max (FLH-Max)	PV LCOE 2030	PV generation as% of global PV in 2030	Wind generation as% of global wind in 2030	Total RES capacity 2017 (MW)	Total RES generation 2017 (TWh)	RES generation, 2010	RES generation, 2030 (TWh)	RES generation Δ 2010-2030 (%)
Gabon	GAB		1,250	1,450	55.8			330	1.3			
Gambia, The	GMB		1,550	1,650	55.8							
Georgia	GEO		1,150	1,350	55.7			3,250	8.5			
Germany	DEU	1,066	900	1,230	55.7	5.08%	5.63%	113,058	187.0	104	286	175%
Ghana	GHA		1,450	1,600	55.8			1,611	5.9			
Gibraltar	GIB				55.7			0	0.0			
Greece	GRC	1,637	1,300	1,800	55.7			8,711	14.9			
Greenland	GRL				55.7			91	0.0			
Grenada	GRD							2	0.0			
Guam	GUM				67.9			0	0.0			
Guatemala	GTM		1,500	1,850	49.4			2,753	6.0			
Guinea	GIN		1,500	1,600	55.8			370	0.4			
Guinea-Bissau	GNB		1,550	1,700	55.8							
Guyana	GUY		1,450	1,700				44	0.0			
Haiti	HTI		1,500	1,600	49.4			1	0.1			
Honduras	HND		1,500	1,750	49.4			1,597	3.8			
Hong Kong SAR, China	HKG				67.9							
Hungary	HUN	1,266	1,100	1,200				1,116	3.2			
Iceland	ISL		750	950	55.7			2,700	18.8			
India	IND		1,400	1,850	67.9	7.44%	13.58%	106,282	210.5	137	593	333%
Indonesia	IDN		1,300	1,750	67.9	1.18%	0.24%	9,095	30.7	27	220	715%
Iran, Islamic Rep.	IRN		1,500	1,800		0.18%	0.63%	12,263	14.5	0	61	
Iraq	IRQ	1,898	1,500	1,600				2,311	2.6			
Ireland	IRL	926	800	1,050	55.7			3,607	7.9			
Isle of Man	IMN				55.7							
Israel	ISR	2,008	1,600	1,800				914	1.0			
Italy	ITA	1,494	1,200	1,650	55.7	3.36%	1.14%	51,951	108.9	66	136	106%



INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

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Jamaica	JAM		1,650	1,800				189	0.3			
Japan	JPN		1,100	1,450	67.9	6.81%	0.71%	82,696	166.8	99	236	138%
Jordan	JOR	2,083	1,550	1,800				576	0.2			
Kazakhstan	KAZ		1,200	1,550	55.7	0.09%	0.55%	2,901	9.4	8	30	275%
Kenya	KEN		1,500	1,850	55.8	0.00%	0.08%	1,642	7.8	4	12	200%
Kiribati	KIR				67.9			3	0.0			
Korea, Dem. People's Rep.	PRK				67.9	1.81%	1.06%			6	74	1133%
Korea, Rep.	KOR				67.9							
Kosovo	XKX				55.7			96	0.1			
Kuwait	KWT		1,500	1,750		0.45%	0.31%	41	0.0	0	16	
Kyrgyz Republic	KGZ				55.7							
Lao PDR	LAO				67.9			5,046	17.9			
Latvia	LVA		1,100	1,250				1,779	2.8			
Lebanon	LBN	1,903	1,450	1,750				312	0.5			
Lesotho	LSO		1,100	1,100	55.8			75	0.5			
Liberia	LBR				55.8			92	0.0			
Libya	LBY	2,002	1,450	1,800				5	0.0			
Liechtenstein	LIE		1,050	1,050	55.7			0	0.0			
Lithuania	LTU		1,050	1,200				821	1.7			
Luxembourg	LUX		900	1,000	55.7			300	0.4			
Macao SAR, China	MAC				67.9							
Macedonia, FYR	MKD				55.7							
Madagascar	MDG		1,350	1,550	55.8			177	1.0			
Malawi	MWI		1,400	1,650	55.8			374	1.2			
Malaysia	MYS		1,350	1,650	67.9	0.09%	0.00%	7,332	15.1	8	46	475%
Maldives	MDV				67.9			10	0.0			
Mali	MLI		1,550	1,600	55.8			190	1.0			

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Global Horizontal Irradiation (GHI) (kWh/m <sup>2</sup> )	PV Min (FLH-Min)	PV Max (FLH-Max)	PV LCOE 2030	PV generation as% of global PV in 2030	Wind generation as% of global wind in 2030	Total RES capacity 2017 (MW)	Total RES generation 2017 (TWh)	RES generation, 2010	RES generation, 2030 (TWh)	RES generation Δ 2010-2030 (%)
Malta	MLT		1,650	1,700				115	0.1			
Marshall Islands	MHL				67.9							
Mauritania	MRT		1,500	1,950				167	0.3			
Mauritius	MUS				55.8			191	0.7			
Mexico	MEX		1,550	1,950	49.4	1.18%	1.50%	19,025	48.1	48	115	140%
Micronesia, Fed. Sts.	FSM				67.9							
Moldova	MDA	1,276	1,150	1,250	55.7							
Monaco	MCO				55.7			0	0.0			
Mongolia	MNG		1,400	1,750	67.9			155	0.2			
Montenegro	MNE	1,468	1,100	1,350	55.7			727	1.5			
Morocco	MAR	1,897	1,500	1,850		0.45%	0.43%	2,566	4.7	4	27	575%
Mozambique	MOZ		1,200	1,500	55.8			2,233	16.3			
Myanmar	MMR				67.9			3,132	9.0			
Namibia	NAM		1,300	1,550	55.8			391	1.5			
Nauru	NRU				67.9			1	0.0			
Nepal	NPL		1,550	1,750	67.9			1,008	2.2			
Netherlands	NLD	1,025	900	1,100	55.7			7,706	13.7			
New Caledonia	NCL				67.9							
New Zealand	NZL		750	900	67.9			7,206	35.4			
Nicaragua	NIC		1,500	1,850	49.4			682	2.3			
Niger	NER		1,650	1,800	55.8			9	0.0			
Nigeria	NGA		1,450	1,750	55.8	0.54%	0.00%	2,064	5.4	6	39	550%
Northern Mariana Islands	MNP				67.9							
Norway	NOR		750	1,050	55.7			33,283	140.6			
Oman	OMN	2,202	1,600	1,850				8	0.0			
Pakistan	PAK		1,550	1,800	67.9			9,252	34.5			
Palau	PLW				67.9			1	0.0			

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Country	Country Code	Global Horizontal Irradiation (GHI) (kWh/m <sup>2</sup> )	PV Min (FLH-Min)	PV Max (FLH-Max)	PV LCOE 2030	PV generation as% of global PV in 2030	Wind generation as% of global wind in 2030	Total RES capacity 2017 (MW)	Total RES generation 2017 (TWh)	RES generation, 2010	RES generation, 2030 (TWh)	RES generation Δ 2010-2030 (%)
Panama	PAN		1,300	1,600	49.4			2,063	6.7			
Papua New Guinea	PNG		1,300	1,650	67.9							
Paraguay	PRY		1,050	1,150	49.4			8,849	55.9			
Peru	PER		1,450	1,800	49.4			5,768	23.8			
Philippines	PHL		1,350	1,750	67.9			7,092	20.8			
Poland	POL	1,071	950	1,050		0.18%	0.71%	8,110	22.7	11	42	282%
Portugal	PRT	1,632	1,300	1,650	55.7			13,508	24.4			
Puerto Rico	PRI		1,650	1,850	49.4			369	0.4			
Qatar	QAT	2,134	1,500	1,850				43	0.2			
Romania	ROU	1,301	1,100	1,250				11,197	26.2			
Russian Federation	RUS		850	1,550	55.7	0.18%	0.31%	51,779	168.6	170	244	44%
Rwanda	RWA		1,400	1,500	55.8			113	0.3			
Samoa	WSM				67.9			27	0.0			
San Marino	SMR				55.7			0	0.0			
Sao Tome and Principe	STP				55.8							
Saudi Arabia	SAU	2,216	1,550	1,900		1.27%	0.59%	92	0.1	0	86	
Senegal	SEN		1,500	1,750	55.8			185	0.4			
Serbia	SRB	1,472	1,100	1,200	55.7			2,462	10.1			
Seychelles	SYC				55.8			8	0.0			
Sierra Leone	SLE		1,350	1,500	55.8			92	0.1			
Singapore	SGP				67.9			273	0.9			
Sint Maarten (Dutch part)	SXM				49.4							
Slovak Republic	SVK	1,182										
Slovenia	SVN	1,270	1,150	1,300				1,457	4.4			
Solomon Islands	SLB				67.9							
Somalia	SOM		1,550	1,950				6	0.0			

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South Africa	ZAF		1,000	1,300	55.8	1.54%	0.43%	4,959	6.1	4	48	1100%
South Sudan	SSD				55.8			0	0.0			
Spain	ESP	1,659	1,350	1,900	55.7			47,989	97.1			
Sri Lanka	LKA		1,450	1,700	67.9			1,936	6.4			
St. Kitts and Nevis	KNA											
St. Lucia	LCA											
St. Martin (French part)	MAF				49.4							
St. Vincent and the Grenadines	VCT											
Sudan	SDN		1,550	1,850				2,131	8.5			
Suriname	SUR		1,500	1,750				188	1.1			
Swaziland	SWZ		1,050	1,150	55.8			186	0.6			
Sweden	SWE		750	1,250	55.7	0.00%	0.47%	28,217	102.4	83	120	45%
Switzerland	CHE	1,233	1,050	1,250	55.7			16,858	41.1			
Syrian Arab Republic	SYR	1,945	1,550	1,750								
Tajikistan	TJK		1,500	1,600	55.7			5,325	16.9			
Tanzania	TZA		1,500	1,800	55.8			659	2.3			
Thailand	THA		1,350	1,600	67.9			9,699	21.1			
Timor-Leste	TLS				67.9							
Togo	TGO		1,450	1,550	55.8			70	0.2			
Tonga	TON				67.9	0.00%	0.00%	6	0.0	0	0	
Trinidad and Tobago	TTO		1,600	1,600								
Tunisia	TUN	1,830	1,400	1,750				347	0.6			
Turkey	TUR	1,661	1,350	1,750	55.7	1.27%	3.23%	38,725	83.7	37	230	522%
Turkmenistan	TKM		1,350	1,550	55.7			0	0.0			

Country	Country Code	Global Horizontal Irradiation (GHI) (kWh/m <sup>2</sup> )	PV Min (FLH-Min)	PV Max (FLH-Max)	PV LCOE 2030	PV generation as% of global PV in 2030	Wind generation as% of global wind in 2030	Total RES capacity 2017 (MW)	Total RES generation 2017 (TWh)	RES generation, 2010	RES generation, 2030 (TWh)	RES generation Δ 2010-2030 (%)
Turks and Caicos Islands	TCA				49.4							
Tuvalu	TUV				67.9			1	0.0			
Uganda	UGA		1,450	1,750	55.8			841	3.6			
Ukraine	UKR		1,100	1,350	55.7	0.27%	0.31%	6,487	7.1	13	33	154%
United Arab Emirates	ARE	2,164	1,600	1,900		0.91%	0.00%			0	14	
United Kingdom	GBR	972	800	1,150	55.7	1.36%	3.23%	40,789	82.9	28	142	407%
United States	USA		1,350	1,950	60.7	6.17%	9.65%	229,913	562.5	470	757	61%
Uruguay	URY		850	900	49.4	0.09%	0.12%	3,717	12.8	9	16	78%
Uzbekistan	UZB		1,350	1,600	55.7			1,797	14.6			
Vanuatu	VUT				67.9			9	0.0			
Venezuela, RB	VEN		1,500	1,950	49.4							
Vietnam	VNM		1,050	1,550	67.9							
Virgin Islands (U.S.)	VIR				49.4							
West Bank and Gaza	PSE											
Yemen, Rep.	YEM	2,286	1,600	1,850				400	0.1			
Zambia	ZMB		1,450	1,650	55.8			2,435	13.1			
Zimbabwe	ZWE		1,350	1,550	55.8			888	5.1			

Source: GHI based on Beták et. al (2012): Solar Resource and Photovoltaic Electricity Potential in EU-MENA Region. FLH based Agora Energiewende PV Calculator of Levelized Cost of Electricity for Photovoltaics (2015) based on Pietzcker et.al. (2014): Using the sun to decarbonize the power sector: The economic potential of photovoltaics and concentrating solar power, in: Applied Energy, Vol. 135, pp. 704-720. PV LCOE based on Ram et al. (2017): Global Energy System based on 100% Renewable Energy - Power Sector, Study by Lappeenranta University of Technology and Energy Watch Group, Lappeenranta, Berlin. Generation and capacity indicators based on Irena.

## 1.2 Region, development status, resource availability and logistics

**Table 2 Overview: Region, development status, resource availability and logistics**

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Afghanistan	AFG	South Asia	Low income	PV, Combination	652,860	53	4.07	2.14
Albania	ALB	Europe & Central Asia	Low & middle income		27,400	105	2.93	2.41
Algeria	DZA	Arab World	Low & middle income	Combination	2,381,741	17	3.76	2.77
American Samoa	ASM	East Asia & Pacific	Low & middle income		200	278		
Andorra	AND	Europe & Central Asia	High income		470	164	3.44	
Angola	AGO	Sub-Saharan Africa	Lower middle income	PV	1,246,700	23	0.88	2.24
Antigua and Barbuda	ATG	Caribbean small states	High income		440	229		
Argentina	ARG	Latin America & Caribbean	Low & middle income	PV, Combination	2,736,690	16	2.69	2.96
Armenia	ARM	Europe & Central Asia	Lower middle income		28,470	103	4.34	2.21
Aruba	ABW	Latin America & Caribbean	High income		180	582		
Australia	AUS	East Asia & Pacific	High income	PV	7,682,300	3	3.41	3.79
Austria	AUT	Europe & Central Asia	High income		82,523	106	0.51	4.10
Azerbaijan	AZE	Europe & Central Asia	Low & middle income		82,663	118	4.34	
Bahamas, The	BHS	Caribbean small states	High income		10,010	39		2.75
Bahrain	BHR	Arab World	High income		771	1,848	5.00	3.31
Bangladesh	BGD	South Asia	Lower middle income		130,170	1,252	0.28	2.66
Barbados	BRB	Caribbean small states	High income		430	663		
Belarus	BLR	Europe & Central Asia	Low & middle income		202,910	47	1.33	2.40
Belgium	BEL	Europe & Central Asia	High income		30,280	374	3.64	4.11
Belize	BLZ	Caribbean small states	Low & middle income		22,810	16	0.38	
Benin	BEN	Sub-Saharan Africa	Low income		112,760	96	0.00	2.43
Bermuda	BMU	North America	High income		50	1,308		
Bhutan	BTN	South Asia	Lower middle income		38,117	21	0.00	2.32

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Bolivia	BOL	Latin America & Caribbean	Lower middle income	PV	1,083,300	10	0.54	2.25
Bosnia and Herzegovina	BIH	Europe & Central Asia	Low & middle income		51,200	69	0.46	2.60
Botswana	BWA	Sub-Saharan Africa	Low & middle income	PV	566,730	4	2.40	3.05
Brazil	BRA	Latin America & Caribbean	Low & middle income	PV	8,358,140	25	0.86	3.09
British Virgin Islands	VGB	Latin America & Caribbean	High income		150	204		
Brunei Darussalam	BRN	East Asia & Pacific	High income		5,270	80		2.87
Bulgaria	BGR	Central Europe and the Baltics	Low & middle income		108,560	66	1.78	2.81
Burkina Faso	BFA	Sub-Saharan Africa	Low income		273,600	68	0.08	2.73
Burundi	BDI	Sub-Saharan Africa	Low income		25,680	410	0.00	2.51
Cabo Verde	CPV	Sub-Saharan Africa	Lower middle income		4,030	134		
Cambodia	KHM	East Asia & Pacific	Lower middle income		176,520	89	0.42	2.80
Cameroon	CMR	Sub-Saharan Africa	Lower middle income		472,710	50	0.01	2.15
Canada	CAN	North America	High income	Wind	9,093,510	4	1.13	3.93
Cayman Islands	CYM	Latin America & Caribbean	High income		240	253		
Central African Republic	CAF	Sub-Saharan Africa	Low income		622,980	7	0.00	
Chad	TCD	Sub-Saharan Africa	Low income	PV, Combination	1,259,200	11	0.42	2.16
Channel Islands	CHI	Europe & Central Asia	High income		190	866		
Chile	CHL	Latin America & Caribbean	High income	Combination	743,532	24	4.09	3.25
China	CHN	East Asia & Pacific	Low & middle income	PV	9,388,211	147	3.29	3.66
Colombia	COL	Latin America & Caribbean	Low & middle income		1,109,500	44	0.32	2.61
Comoros	COM	Arab World	Low income		1,861	428		2.58
Congo, Dem. Rep.	COD	Sub-Saharan Africa	Low income		2,267,050	35	0.00	2.38

INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Congo, Rep.	COG	Sub-Saharan Africa	Lower middle income		341,500	15	0.00	2.38
Costa Rica	CRI	Latin America & Caribbean	Low & middle income		51,060	95	0.97	2.65
Cote d'Ivoire	CIV	Sub-Saharan Africa	Lower middle income		318,000	75	0.14	2.60
Croatia	HRV	Central Europe and the Baltics	Low & middle income		55,960	75	0.51	3.16
Cuba	CUB	Latin America & Caribbean	Low & middle income		104,020	110	2.86	2.35
Curacao	CUW	Latin America & Caribbean	High income		444	360		
Cyprus	CYP	Europe & Central Asia	High income		9,240	127		3.00
Czech Republic	CZE	Central Europe and the Baltics	High income		77,210	137	1.80	3.67
Denmark	DNK	Europe & Central Asia	High income	Wind	42,262	136	0.54	3.82
Djibouti	DJI	Arab World	Lower middle income		23,180	41	0.23	2.32
Dominica	DMA	Caribbean small states	Low & middle income		750	98		
Dominican Republic	DOM	Latin America & Caribbean	Low & middle income		48,310	220	3.78	2.63
Ecuador	ECU	Latin America & Caribbean	Low & middle income		248,360	66	1.92	2.78
Egypt, Arab Rep.	EGY	Arab World	Lower middle income	PV, Combination	995,450	96	1.48	3.18
El Salvador	SLV	Latin America & Caribbean	Lower middle income		20,720	306	0.75	2.71
Equatorial Guinea	GNQ	Sub-Saharan Africa	Low & middle income		28,050	44	0.00	1.88
Eritrea	ERI	Sub-Saharan Africa	Low income		101,000		3.50	2.17
Estonia	EST	Central Europe and the Baltics	High income		42,390	31	3.46	3.36
Ethiopia	ETH	Sub-Saharan Africa	Low income		1,000,000	102	0.63	2.38
Faroe Islands	FRO	Europe & Central Asia	High income		1,396	35		
Fiji	FJI	East Asia & Pacific	Low & middle income		18,270	49		2.32
Finland	FIN	Europe & Central Asia	High income		303,890	18	1.72	3.92



## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
France	FRA	Europe & Central Asia	High income		547,557	122	2.15	3.90
French Polynesia	PYF	East Asia & Pacific	High income		3,660	77		
Gabon	GAB	Sub-Saharan Africa	Low & middle income		257,670	8	0.00	2.19
Gambia, The	GMB	Sub-Saharan Africa	Low income		10,120	201		
Georgia	GEO	Europe & Central Asia	Lower middle income		69,490	65	2.46	2.35
Germany	DEU	Europe & Central Asia	High income	Wind	348,900	236	1.75	4.23
Ghana	GHA	Sub-Saharan Africa	Lower middle income		227,540	124	0.45	2.66
Gibraltar	GIB	Europe & Central Asia	High income		10	3,441		
Greece	GRC	Europe & Central Asia	High income	Wind	128,900	84	4.11	3.24
Greenland	GRL	Europe & Central Asia	High income	Wind	410,450	0		
Grenada	GRD	Caribbean small states	Low & middle income		340	316		
Guam	GUM	East Asia & Pacific	High income		540	302		
Guatemala	GTM	Latin America & Caribbean	Lower middle income		107,160	155	0.82	2.48
Guinea	GIN	Sub-Saharan Africa	Low income		245,720	50	0.01	2.36
Guinea-Bissau	GNB	Sub-Saharan Africa	Low income		28,120	65		2.37
Guyana	GUY	Caribbean small states	Low & middle income		196,850	4	0.64	2.67
Haiti	HTI	Latin America & Caribbean	Low income		27,560	394	2.85	1.72
Honduras	HND	Latin America & Caribbean	Lower middle income		111,890	81	0.72	2.46
Hong Kong SAR, China	HKG	East Asia & Pacific	High income		1,050	6,987		4.07
Hungary	HUN	Central Europe and the Baltics	High income		90,530	108	0.76	3.43
Iceland	ISL	Europe & Central Asia	High income	Wind	100,250	3	0.00	3.35
India	IND	South Asia	Lower middle income		2,973,190	445	3.66	3.42
Indonesia	IDN	East Asia & Pacific	Lower middle income	<	1,811,570	144	2.96	2.98
Iran, Islamic Rep.	IRN	Middle East & North Africa	Low & middle income	PV, Combination	1,628,760	49	4.86	2.60

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Iraq	IRQ	Arab World	Low & middle income		434,320	86	4.49	2.15
Ireland	IRL	Europe & Central Asia	High income	Wind	68,890	69	1.73	3.79
Isle of Man	IMN	Europe & Central Asia	High income		570	147		
Israel	ISR	Middle East & North Africa	High income		21,640	395	4.99	3.66
Italy	ITA	Europe & Central Asia	High income		294,140	206	3.60	3.76
Jamaica	JAM	Caribbean small states	Low & middle income		10,830	266		2.40
Japan	JPN	East Asia & Pacific	High income		364,560	348	2.31	3.97
Jordan	JOR	Arab World	Lower middle income	PV	88,780	107	4.84	2.96
Kazakhstan	KAZ	Europe & Central Asia	Low & middle income	Wind	2,699,700	7	4.66	2.75
Kenya	KEN	Sub-Saharan Africa	Lower middle income	Combination	569,140	85	0.57	3.33
Kiribati	KIR	East Asia & Pacific	Lower middle income		810	141		
Korea, Dem. People's Rep.	PRK	East Asia & Pacific	Low income		120,410	211		
Korea, Rep.	KOR	East Asia & Pacific	High income		97,480	526		3.72
Kosovo	XKX	Europe & Central Asia	Lower middle income		10,887	167	2.68	
Kuwait	KWT	Arab World	High income		17,820	227	5.00	3.15
Kyrgyz Republic	KGZ	Europe & Central Asia	Lower middle income		191,800	32		2.16
Lao PDR	LAO	East Asia & Pacific	Lower middle income		230,800	29		2.07
Latvia	LVA	Central Europe and the Baltics	High income		62,180	32	0.81	3.33
Lebanon	LBN	Arab World	Low & middle income		10,230	587	4.89	2.72
Lesotho	LSO	Sub-Saharan Africa	Lower middle income		30,360	73	1.52	2.03
Liberia	LBR	Sub-Saharan Africa	Low income		96,320	48	0.01	2.20
Libya	LYB	Arab World	Low & middle income	PV	1,759,540	4	4.74	2.26
Liechtenstein	LIE	Europe & Central Asia	High income		160	235	0.53	
Lithuania	LTU	Central Europe and the Baltics	High income		62,650	46	2.15	3.63
Luxembourg	LUX	Europe & Central Asia	High income		2,590	225	2.77	4.22
Macao SAR, China	MAC	East Asia & Pacific	High income		30	20,204		

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Macedonia, FYR	MKD	Europe & Central Asia	Low & middle income		25,220	83		2.51
Madagascar	MDG	Sub-Saharan Africa	Low income		581,800	43	0.94	2.15
Malawi	MWI	Sub-Saharan Africa	Low income		94,280	192	0.00	
Malaysia	MYS	East Asia & Pacific	Low & middle income		328,550	95	1.31	3.43
Maldives	MDV	South Asia	Low & middle income		300	1,426		2.51
Mali	MLI	Sub-Saharan Africa	Low income	PV	1,220,190	15	0.35	2.50
Malta	MLT	Middle East & North Africa	High income		320	1,367		3.07
Marshall Islands	MHL	East Asia & Pacific	Low & middle income		180	295		
Mauritania	MRT	Arab World	Lower middle income	Combination	1,030,700	4	0.75	1.87
Mauritius	MUS	Sub-Saharan Africa	Low & middle income		2,030	622		
Mexico	MEX	Latin America & Caribbean	Low & middle income	PV	1,943,950	66	3.85	3.11
Micronesia, Fed. Sts.	FSM	East Asia & Pacific	Lower middle income		700	150		
Moldova	MDA	Europe & Central Asia	Lower middle income		32,870	124	2.75	2.61
Monaco	MCO	Europe & Central Asia	High income		2	19,250	3.51	
Mongolia	MNG	East Asia & Pacific	Lower middle income	Wind	1,553,560	2	3.77	2.51
Montenegro	MNE	Europe & Central Asia	Low & middle income		13,450	46	1.03	2.38
Morocco	MAR	Arab World	Lower middle income	PV	446,300	79	4.50	2.67
Mozambique	MOZ	Sub-Saharan Africa	Low income		786,380	37	0.60	2.68
Myanmar	MMR	East Asia & Pacific	Lower middle income		653,080	81	0.17	2.46
Namibia	NAM	Sub-Saharan Africa	Low & middle income	PV, Combination	823,290	3	2.61	2.74
Nauru	NRU	East Asia & Pacific	Low & middle income		20	652		
Nepal	NPL	South Asia	Low income		143,350	202	2.18	2.38
Netherlands	NLD	Europe & Central Asia	High income		33,690	506	2.27	4.19
New Caledonia	NCL	East Asia & Pacific	High income		18,280	15		
New Zealand	NZL	East Asia & Pacific	High income	Wind	263,310	18	0.62	3.39
Nicaragua	NIC	Latin America & Caribbean	Lower middle income		120,340	51	0.39	2.53

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Niger	NER	Sub-Saharan Africa	Low income	PV	1,266,700	16	0.21	2.56
Nigeria	NGA	Sub-Saharan Africa	Lower middle income		910,770	204	0.65	2.63
Northern Mariana Islands	MNP	East Asia & Pacific	High income		460	120		
Norway	NOR	Europe & Central Asia	High income	Wind	365,245	14	0.54	3.73
Oman	OMN	Arab World	High income	PV, Combination	309,500	14	4.94	3.23
Pakistan	PAK	South Asia	Lower middle income	PV	770,880	251	4.42	2.92
Palau	PLW	East Asia & Pacific	High income		460	47		
Panama	PAN	Latin America & Caribbean	Low & middle income		74,340	54	0.00	3.34
Papua New Guinea	PNG	East Asia & Pacific	Lower middle income		452,860	18	0.12	2.51
Paraguay	PRY	Latin America & Caribbean	Low & middle income		397,300	17	0.00	2.56
Peru	PER	Latin America & Caribbean	Low & middle income	PV	1,280,000	25	3.17	2.89
Philippines	PHL	East Asia & Pacific	Lower middle income		298,170	347	2.80	2.86
Poland	POL	Central Europe and the Baltics	High income		306,190	124	2.02	3.43
Portugal	PRT	Europe & Central Asia	High income		91,605	113	3.30	3.41
Puerto Rico	PRI	Latin America & Caribbean	High income		8,870	385		
Qatar	QAT	Arab World	High income		11,610	221	5.00	3.60
Romania	ROU	Central Europe and the Baltics	Low & middle income		230,080	86	1.44	2.99
Russian Federation	RUS	Europe & Central Asia	Low & middle income	Wind	16,376,870	9	1.70	2.57
Rwanda	RWA	Sub-Saharan Africa	Low income		24,670	483	0.00	2.99
Samoa	WSM	East Asia & Pacific	Low & middle income		2,830	69		
San Marino	SMR	Europe & Central Asia	High income		60	553	5.00	
Sao Tome and Principe	STP	Sub-Saharan Africa	Lower middle income		960	208		2.33

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Saudi Arabia	SAU	Arab World	High income	PV	2,149,690	15	5.00	3.16
Senegal	SEN	Sub-Saharan Africa	Low income		192,530	80	0.77	2.33
Serbia	SRB	Europe & Central Asia	Low & middle income		87,460	81		2.76
Seychelles	SYC	Sub-Saharan Africa	High income		460	206		
Sierra Leone	SLE	Sub-Saharan Africa	Low income		72,180	102	0.01	2.03
Singapore	SGP	East Asia & Pacific	High income		709	7,909	5.00	4.14
Sint Maarten (Dutch part)	SXM	Latin America & Caribbean	High income		34	1,176		
Slovak Republic	SVK	Central Europe and the Baltics	High income		48,086	113		3.34
Slovenia	SVN	Central Europe and the Baltics	High income		20,140	103	0.58	3.18
Solomon Islands	SLB	East Asia & Pacific	Lower middle income		27,990	21		2.42
Somalia	SOM	Arab World	Low income	Combination	627,340	23	1.64	1.75
South Africa	ZAF	Sub-Saharan Africa	Low & middle income	PV, Combination	1,213,090	46	3.04	3.78
South Sudan	SSD	Sub-Saharan Africa	Low income		0		0.00	
Spain	ESP	Europe & Central Asia	High income	Wind, Combination	500,210	93	3.93	3.73
Sri Lanka	LKA	South Asia	Lower middle income		62,710	338	2.98	
St. Kitts and Nevis	KNA	Caribbean small states	High income		260	211		
St. Lucia	LCA	Caribbean small states	Low & middle income		610	292		
St. Martin (French part)	MAF	Latin America & Caribbean	High income		54	587		
St. Vincent and the Grenadines	VCT	Caribbean small states	Low & middle income		390	281		
Sudan	SDN	Arab World	Lower middle income	PV	2,376,000	23	1.45	2.53
Suriname	SUR	Caribbean small states	Low & middle income		156,000	4	0.24	
Swaziland	SWZ	Sub-Saharan Africa	Lower middle income		17,200	78	2.52	
Sweden	SWE	Europe & Central Asia	High income		407,310	24	1.62	4.20
Switzerland	CHE	Europe & Central Asia	High income		39,516	212	1.21	3.99

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
Syrian Arab Republic	SYR	Arab World	Lower middle income		183,630	100		1.60
Tajikistan	TJK	Europe & Central Asia	Lower middle income		138,786	63	3.38	2.06
Tanzania	TZA	Sub-Saharan Africa	Low income		885,800	63	0.95	2.99
Thailand	THA	East Asia & Pacific	Low & middle income		510,890	135	1.90	3.26
Timor-Leste	TLS	East Asia & Pacific	Lower middle income		14,870	85	3.05	
Togo	TGO	Sub-Saharan Africa	Low income		54,390	140	0.12	2.62
Tonga	TON	East Asia & Pacific	Low & middle income		720	149		
Trinidad and Tobago	TTO	Caribbean small states	High income		5,130	266		2.40
Tunisia	TUN	Arab World	Lower middle income		155,360	73	3.74	2.50
Turkey	TUR	Europe & Central Asia	Low & middle income		769,630	103	4.10	3.42
Turkmenistan	TKM	Europe & Central Asia	Low & middle income		469,930	12	4.26	2.21
Turks and Caicos Islands	TCA	Latin America & Caribbean	High income		950	37		
Tuvalu	TUV	East Asia & Pacific	Low & middle income		30	370		
Uganda	UGA	Sub-Saharan Africa	Low income		200,520	207	0.00	3.04
Ukraine	UKR	Europe & Central Asia	Lower middle income		579,290	78	3.10	2.74
United Arab Emirates	ARE	Arab World	High income	PV	83,600	111	5.00	3.94
United Kingdom	GBR	Europe & Central Asia	High income	Wind	241,930	271	2.48	4.07
United States	USA	North America	High income		9,147,420	35	3.24	3.99
Uruguay	URY	Latin America & Caribbean	High income		175,020	20	0.61	2.97
Uzbekistan	UZB	Europe & Central Asia	Lower middle income		425,400	75	4.12	2.40
Vanuatu	VUT	East Asia & Pacific	Lower middle income		12,190	22		
Venezuela, RB	VEN	Latin America & Caribbean	Low & middle income	Solar, Combination	882,050	36	1.94	2.39
Vietnam	VNM	East Asia & Pacific	Lower middle income		310,070	305	1.02	2.98
Virgin Islands (U.S.)	VIR	Latin America & Caribbean	High income		350	307		

Country	Country Code	Region	Income	PV, Wind or Combination	Land Area 2017 (km <sup>2</sup> )	Population Density 2016 (people/km <sup>2</sup> )	Water stress BAU 2030 (0=low; 5=high)	Logistics performance 2016 (1=low; 5=high)
West Bank and Gaza	PSE	Arab World	Lower middle income		6,020	756		
Yemen, Rep.	YEM	Arab World	Lower middle income	PV	527,970	52	4.88	
Zambia	ZMB	Sub-Saharan Africa	Lower middle income		743,390	22	0.08	2.43
Zimbabwe	ZWE	Sub-Saharan Africa	Low income		386,850	42	0.95	2.08

Source: World Bank: Region, Income, Land Area, Population Density, Logistics performance; PV, Wind or Combination: Frontier Economics based on World Bank Group (<https://www.globalwindatlas.info/> and <http://globalsolaratlas.info/>); Water stress: World Energy Council: World Energy Scenarios 2016, <https://www.worldenergy.org/wp-content/uploads/2016/10/World-Energy-Scenarios-2016-Full-report.pdf>.

## 1.3 Political criteria and international trade

**Table 3 Political criteria and international trade**

Country	Country Code	EU/ OECD	Development HPIC (heavily indebted poor country)	Corruption Perception Index (Rank)	Risk premium (%)	EOB Index (Rank)	Access to electricity (% of population)	Exports of goods and services 2015 (% of GDP)	Imports of goods and services 2015 (% of GDP)	EU imports mineral fuels, lubricants and related 2017 (mio. of ECU/ EUR)	Energy imports, net 2014 (% of energy use)	Oil production 2017 (mio. t)	Oil production 2017 (% of total production in mio. t)
Afghanistan	AFG		HIPC, Fragile & conflict affected	177		183	84	7.00	48.80				
Albania	ALB			91		65	100	27.39	44.74	152.3	13.8		
Algeria	DZA			112		166	99	23.19	36.55	17712.4	-177.1	66.6	1.52
American Samoa	ASM							64.80	99.70				
Andorra	AND						100			0			
Angola	AGO			167	-2.71	175	41	33.45	36.88	1919.3	-541.0	81.8	1.87
Antigua and Barbuda	ATG				5.83	107	97	44.12	49.12	3.7			
Argentina	ARG			85		117	100	11.01	11.85	29.9	13.0	27.4	0.62
Armenia	ARM			107	7.53	47	100	29.73	41.87	0	71.3		
Aruba	ABW						96						
Australia	AUS	OECD		13		14	100	19.68	21.13	3454.1	-192.0	14.8	0.34
Austria	AUT	OECD, EU		16		22	100	52.93	49.20		62.4		
Azerbaijan	AZE			122		57	100	37.79	34.81	9233.8	-310.4	39.2	0.89
Bahamas, The	BHS			28	3.11	119	100	36.70	41.40				
Bahrain	BHR			103		66	100	82.42	71.65	451.7	-61.6		
Bangladesh	BGD			143	7.02	177	76	17.34	24.75	0	16.8		
Barbados	BRB			25	4.74	132	100	35.23	43.77	0			
Belarus	BLR			68		38	100	58.01	57.90	630.2	86.8		
Belgium	BEL	OECD, EU		16		52	100	80.77	79.41		76.3		
Belize	BLZ				9.61	121	92	58.54	67.70	0			



## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

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Benin	BEN		HIPC, Fragile & conflict affected	85		151	41	28.22	39.80	0	46.6		
Bermuda	BMU						100						
Bhutan	BTN			26		75	100	33.22	61.73				
Bolivia	BOL		HIPC, Fragile & conflict affected	112		152	93	30.87	37.06	0	-178.0		
Bosnia and Herzegovina	BIH			91		86	100	34.58	53.23	316.2	22.7		
Botswana	BWA			34		81	61	52.23	53.56	0	44.5		
Brazil	BRA			96	38.64	125	100	12.89	14.07	1935.6	11.9	142.7	3.25
British Virgin Islands	VGB												
Brunei Darussalam	BRN			32		56	100	52.21	32.69	0	-357.4		
Bulgaria	BGR	EU		71		50	100	64.11	63.96		36.6		
Burkina Faso	BFA		HIPC, Fragile & conflict affected	74		148	19	26.05	36.29	0			
Burundi	BDI		HIPC, Fragile & conflict affected	157		164	8	6.25	29.74	0			
Cabo Verde	CPV			48	8.74	127	93						
Cambodia	KHM			161		135	50	61.72	66.15	0	33.1		
Cameroon	CMR		HIPC, Fragile & conflict affected	153		163	60	22.26	27.61	827.5	-28.3		
Canada	CAN	OECD		8	2.20	18	100	31.53	34.00	2352.7	-67.9	236.3	5.39
Cayman Islands	CYM						100						
Central African Republic	CAF		HIPC, Fragile & conflict affected	156		184	14	12.61	34.58	0			
Chad	TCD		HIPC, Fragile & conflict affected	165		180	9	29.83	37.32	181.2		5.4	0.12
Channel Islands	CHI						100						

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Chile	CHL	OECD		26		55	100	29.68	29.79	16.5	64.2		
China	CHN			77		78	100	21.97	18.49	439.6	15.0	191.5	4.37
Colombia	COL			96		59	99	15.25	23.37	2526.3	-274.1	44.8	1.02
Comoros	COM		HIPC, Fragile & conflict affected	148		158	78	17.79	47.29				
Congo, Dem. Rep.	COD		HIPC, Fragile & conflict affected	161		182	17	27.73	31.61	304.5	2.0		
Congo, Rep.	COG		HIPC, Fragile & conflict affected	161		179	57	69.28	96.37		-496.6		
Costa Rica	CRI			38		61	100	30.04	31.87	0	49.8		
Cote d'Ivoire	CIV		HIPC, Fragile & conflict affected	103		139	64	37.72	25.83		7.1		
Croatia	HRV	EU		57		51	100	48.72	46.33		45.9		
Cuba	CUB			62			100	17.15	14.45	18.5	49.8		
Curacao	CUW						100				99.9		
Cyprus	CYP	EU		42		53	100	64.87	64.07		94.0		
Czech Republic	CZE	OECD, EU		42		30	100	81.05	75.05		29.0		
Denmark	DNK	OECD, EU		2		3	100	55.68	48.38		0.9	6.7	0.15
Djibouti	DJI			122		154	52			0			
Dominica	DMA			42	6.18	98	100	50.06	58.81				
Dominican Republic	DOM			135		99	100	24.72	29.28	8.3	86.7		
Ecuador	ECU			117		118	100	21.26	23.99	0	-114.7	28.5	0.65
Egypt, Arab Rep.	EGY			117	-2.74	128	100	13.18	21.66	2769.8	-7.4		
El Salvador	SLV			112		73	99	25.79	41.90	0	49.2		
Equatorial Guinea	GNQ			171		173	68	57.82	43.70	1006.8		9.5	0.22

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Eritrea	ERI		HIPC, Fragile & conflict affected	165		189	47			0	22.3		
Estonia	EST	OECD, EU		21		12	100	78.61	74.60		3.4		
Ethiopia	ETH		HIPC, Fragile & conflict affected	107		161	43	9.36	30.29	0	5.9		
Faroe Islands	FRO						100						
Fiji	FJI					101	99	49.60	55.22	0			
Finland	FIN	OECD, EU		3		13	100	36.49	36.97		46.2		
France	FRA	OECD, EU		23		31	100	29.67	31.18		43.5		
French Polynesia	PYF						100						
Gabon	GAB			117		167	91	46.13	28.26	422.3	-213.4	10.0	0.23
Gambia, The	GMB		HIPC, Fragile & conflict affected	130		146	48	24.70	50.42				
Georgia	GEO			46		9	100	44.74	62.27	69.9	68.8		
Germany	DEU	OECD, EU		12		20	100	46.87	38.88		60.9		
Ghana	GHA		HIPC, Fragile & conflict affected	81		120	79	43.85	55.40	464.4	-8.2		
Gibraltar	GIB						100				100.0		
Greece	GRC	OECD, EU		59		67	100	31.72	31.67		62.0		
Greenland	GRL						100	32.05	50.49				
Grenada	GRD			52	4.92	142	92	58.01	56.72	0			
Guam	GUM						100	18.36	53.61				
Guatemala	GTM			143		97	92	21.16	30.15	12.8	32.8		
Guinea	GIN		HIPC, Fragile & conflict affected	148		153	34			0			
Guinea-Bissau	GNB		HIPC, Fragile & conflict affected	171		176	15	27.86	32.90	0			

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Guyana	GUY		HIPC, Fragile & conflict affected	91	11.32	126	84	43.83	63.44	0			
Haiti	HTI		HIPC, Fragile & conflict affected	157		181	39	20.01	50.54	0	22.0		
Honduras	HND		HIPC, Fragile & conflict affected	135		115	88	46.00	63.09	0	53.0		
Hong Kong SAR, China	HKG			13	4.30	5	100	195.88	193.50		98.7		
Hungary	HUN	OECD, EU		66		48	100	90.21	81.35		55.6		
Iceland	ISL	OECD		13		23	100	53.19	45.86	3.3	11.0		
India	IND			81		100	85	19.94	22.25	2453.1	34.3	40.4	0.92
Indonesia	IDN			96		72	98	21.15	20.72	414.3	-103.1	46.4	1.06
Iran, Islamic Rep.	IRN			130		124	100	19.74	19.27	8998.9	-33.4		
Iraq	IRQ			169		168	100	34.92	40.92	13062	-229.4	221.5	5.05
Ireland	IRL	OECD, EU		19		17	100	124.64	91.54		84.3		
Isle of Man	IMN						100						
Israel	ISR	OECD		32	3.33	54	100	31.27	28.26	838.9	67.0		
Italy	ITA	OECD, EU		54	3.38	46	100	29.93	27.00		75.0	4.1	0.09
Jamaica	JAM			68	10.54	70	98	29.91	46.20	0	82.0		
Japan	JPN	OECD		20	1.27	34	100	17.59	18.01	222.1	94.0		
Jordan	JOR			59		103	100			6.2	96.8		
Kazakhstan	KAZ			122		36	100	28.52	24.53	15378.3	-116.9	86.9	1.98
Kenya	KEN			143	8.05	80	56	16.65	27.72	0.1	17.2		
Kiribati	KIR					157	85	9.82	103.45				
Korea, Dem. People's Rep.	PRK			171			39				-74.8		
Korea, Rep.	KOR	OECD		51		4	100	45.34	38.38		81.7		

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Kosovo	XKX				7.01	40	100	21.94	51.16		27.4		
Kuwait	KWT			85		96	100	53.77	44.93	3899.9	-391.1	146.0	3.33
Kyrgyz Republic	KGZ			135		77	100	35.19	75.77		49.5		
Lao PDR	LAO			135		141	87	33.95	51.85				
Latvia	LVA	OECD, EU		40		19	100	60.40	60.91		45.2		
Lebanon	LBN			143	3.91	133	100	26.90	47.18	0.9	97.9		
Lesotho	LSO			74	4.88	104	30	40.39	81.77				
Liberia	LBR		HIPC, Fragile & conflict affected	122		172	20	19.47	106.55	0.1			
Libya	LBY			171		185	99			11445.7	-103.0	40.8	0.93
Liechtenstein	LIE						100			3.2			
Lithuania	LTU	EU		38		16	100	75.84	76.32		75.0		
Luxembourg	LUX	OECD, EU		8		63	100	222.70	187.47		96.0		
Macao SAR, China	MAC						100	77.91	38.74				
Macedonia, FYR	MKD			107		11	100	48.80	65.03		51.8		
Madagascar	MDG		HIPC, Fragile & conflict affected	155		162	23	32.06	35.53	0.1			
Malawi	MWI		HIPC, Fragile & conflict affected	122	16.52	110	11	29.33	35.83	0			
Malaysia	MYS			62		24	100	70.60	62.95	113.7	-5.5	32.2	0.73
Maldives	MDV			112	7.26	136	100	78.39	69.24	0			
Mali	MLI		HIPC, Fragile & conflict affected	122		143	35	24.04	39.59	0			
Malta	MLT	EU		46		84	100	143.37	136.12		98.4		
Marshall Islands	MHL					149	93	37.21	91.46	0			
Mauritania	MRT		HIPC, Fragile & conflict affected	143		150	42	37.10	72.26	13.7			

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Mauritius	MUS			54	5.82	25	99	48.79	58.84	2.3	84.5		
Mexico	MEX	OECD		135	1.31	49	100	35.12	37.06	3432.6	-10.8	109.5	2.50
Micronesia, Fed. Sts.	FSM					155	75	26.27	77.49				
Moldova	MDA			122	-1.14	44	100	42.80	73.86	4.3	90.0		
Monaco	MCO						100						
Mongolia	MNG			103		62	82	45.65	44.64	0	-168.1		
Montenegro	MNE			64	6.01	42	100	42.12	60.57	0	27.6		
Morocco	MAR			81		69	100	34.80	42.39	85	90.7		
Mozambique	MOZ		HIPC, Fragile & conflict affected	153	1.04	138	24	32.22	71.99	344	-54.6		
Myanmar	MMR			130		171	57	20.80	26.56		-33.0		
Namibia	NAM			53		106	52	39.05	69.87	0	74.4		
Nauru	NRU						99	45.35	101.67				
Nepal	NPL			122		105	91	11.62	41.47	0	16.7		
Netherlands	NLD	OECD, EU		8		32	100	83.43	72.87		19.8		
New Caledonia	NCL						100						
New Zealand	NZL	OECD		1		1	100	27.86	27.15	0.1	17.1		
Nicaragua	NIC		HIPC, Fragile & conflict affected	151		131	82	39.98	58.19	0	40.9		
Niger	NER		HIPC, Fragile & conflict affected	112		144	16	18.27	40.85	0	-5.8		
Nigeria	NGA			148	3.13	145	59	10.63	10.49	14120.9	-93.0	95.3	2.17
Northern Mariana Islands	MNP						100	55.73	68.38				
Norway	NOR	OECD		3		8	100	37.72	32.09	40631.1	-582.9	88.8	2.02
Oman	OMN			68		71	100	51.10	42.50	16.8	-206.2	47.6	1.08
Pakistan	PAK			117		147	99	10.60	17.05	0	24.1		

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Palau	PLW					130	99	60.16	70.16	0			
Panama	PAN			96		79	93	49.45	56.20	0	80.9		
Papua New Guinea	PNG			135	4.04	109	23			0.1			
Paraguay	PRY			135		108	98	42.29	41.49	0	-36.9		
Peru	PER			96		58	95	21.30	23.71	673.7	-14.9	5.4	0.12
Philippines	PHL			111	4.14	113	91	28.40	34.29	0	45.8		
Poland	POL	OECD, EU		36		27	100	49.52	46.43		28.4		
Portugal	PRT	OECD, EU		29		29	100	40.40	39.82		71.7		
Puerto Rico	PRI					64	100	67.28	41.92				
Qatar	QAT			29		83	100	56.06	36.00	4592.5	-399.0	79.9	1.82
Romania	ROU	EU		59		45	100	41.01	41.64		16.8	3.6	0.08
Russian Federation	RUS			135		35	100	28.67	20.60		-83.7	554.4	12.64
Rwanda	RWA		HIPC, Fragile & conflict affected	48		41	29	14.27	35.07				
Samoa	WSM					87	100	27.47	48.69				
San Marino	SMR					93	100			0.1			
Sao Tome and Principe	STP		HIPC, Fragile & conflict affected	64		169	65						
Saudi Arabia	SAU			57		92	100	33.45	38.90	16641.9	-191.5	561.7	12.80
Senegal	SEN		HIPC, Fragile & conflict affected	66		140	65	29.44	46.26	4.3	52.7		
Serbia	SRB			77		43	100	46.67	56.43	660.5	28.8		
Seychelles	SYC			36	5.93	95	100			11.8			
Sierra Leone	SLE		HIPC, Fragile & conflict affected	130	8.54	160	20	19.21	47.07	0			
Singapore	SGP			6		2	100	177.93	152.01	1445.4	97.7		

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Sint Maarten (Dutch part)	SXM						100						
Slovak Republic	SVK	OECD, EU		54		39	100	92.97	91.36		58.8		
Slovenia	SVN	OECD, EU		34		37	100	76.99	68.40		44.5		
Solomon Islands	SLB			85	9.64	116	48	46.09	54.52				
Somalia	SOM		HIPC, Fragile & conflict affected	180		190	30	14.50	61.65				
South Africa	ZAF			71	3.23	82	84	30.37	31.46	646.7	-14.5		
South Sudan	SSD			179	3.37	187	9	9.78	57.58		-1,058.1	5.3	0.12
Spain	ESP	OECD, EU		42		28	100	32.94	30.67		69.4		
Sri Lanka	LKA			91	0.50	111	96	21.01	28.54	0.3	50.3		
St. Kitts and Nevis	KNA					134	100	60.48	59.03				
St. Lucia	LCA			48	4.58	91	98	40.14	41.71				
St. Martin (French part)	MAF						72						
St. Vincent and the Grenadines	VCT			40	6.43	129	100	36.98	54.49				
Sudan	SDN		HIPC, Fragile & conflict affected	175		170	39	8.18	10.92	0	-9.0	4.2	0.10
Suriname	SUR			77		165	87	38.46	55.84	0	-43.8		
Swaziland	SWZ			85		112	66	49.63	50.11	0			
Sweden	SWE	OECD, EU		6		10	100	45.55	40.69		28.3		
Switzerland	CHE	OECD		3	3.64	33	100	62.14	50.63	668.6	47.1		
Syrian Arab Republic	SYR			178		174	100				47.8		
Tajikistan	TJK			161		123	100	10.50	42.29	0	36.2		
Tanzania	TZA		HIPC, Fragile & conflict affected	103	-0.22	137	33	21.62	24.77	0	10.7		



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Thailand	THA			96	2.84	26	100	69.09	57.50	1.8	41.6	16.8	0.38
Timor-Leste	TLS			91		178	63	4.35	57.93				
Togo	TGO		HIPC, Fragile & conflict affected	117		156	47	42.22	67.60	12.9	20.0		
Tonga	TON					89	97	17.02	64.72				
Trinidad and Tobago	TTO			77	7.84	102	100	52.09	46.18	445.8	-102.7		
Tunisia	TUN			74		88	100	40.09	50.96	483.1	36.2	2.4	0.06
Turkey	TUR	OECD		81		60	100	23.35	25.95	629.9	74.2		
Turkmenistan	TKM			167			100			210.5	-191.5	12.4	0.28
Turks and Caicos Islands	TCA						96						
Tuvalu	TUV						99						
Uganda	UGA		HIPC, Fragile & conflict affected	151	8.00	122	27	18.44	29.22	0			
Ukraine	UKR			130		76	100	52.60	54.48	870.1	27.2		
United Arab Emirates	ARE			21		21	100	100.41	96.02	3155.7	-183.8	176.3	4.02
United Kingdom	GBR	OECD, EU		8		7	100	27.38	29.10		39.7	46.6	1.06
United States	USA	OECD		16	3.19	6	100	12.50	15.39	15134.2	9.2		
Uruguay	URY			23	2.67	94	100	22.48	22.85	0	44.4		
Uzbekistan	UZB			157		74	100	19.52	21.35	9.2		2.5	0.06
Vanuatu	VUT			71		90	58						
Venezuela, RB	VEN			169		188	100						
Vietnam	VNM			107		68	100	89.78	88.99	23.1		16.1	0.37
Virgin Islands (U.S.)	VIR						100	40.69	41.25				
West Bank and Gaza	PSE					114	100	18.45	59.48				

## INTERNATIONAL ASPECTS OF A POWER-TO-X ROADMAP

Country	Country Code	EU/OECD	Development HPIC (heavily indebted poor country)	Corruption Perception Index (Rank)	Risk premium (%)	EOB Index (Rank)	Access to electricity (% of population)	Exports of goods and services 2015 (% of GDP)	Imports of goods and services 2015 (% of GDP)	EU imports mineral fuels, lubricants and related 2017 (mio. of ECU/EUR)	Energy imports, net 2014 (% of energy use)	Oil production 2017 (mio. t)	Oil production 2017 (% of total production in mio. t)
Yemen, Rep.	YEM			175		186	72	10.24	22.49				
Zambia	ZMB		HIPC, Fragile & conflict affected	96	-8.78	85	27	37.14	42.73	0			
Zimbabwe	ZWE			157		159	38	23.46	46.02	0			

Source: World Bank: EU/OECD, Development HPIC, Risk premium, EOB (Ease of Doing Business) Index, Access to electricity, Exports and Imports of goods and services, Energy imports net; Transparency International: Corruption Perception Index; Eurostat: EU Imports Mineral Fuels, Lubricants and Related 2017; BP Statistical Review: Oil production 2017.



