ANNEX

Expert consultations

Morocco

For the expert consultation in Morocco an overall number of 20 experts were consulted. Of these 20 experts, 16 were from Morocco and worked in Morocco whereas four were internationals working abroad on Morocco. 50 per cent of the experts came from academia and research institutions. Two experts were from national NGOs, two from governmental institutions, two were project developers and two industry representatives. The remaining two experts came from a development agency and a project funding institute. A balance between different fields of expertise was achieved by incorporating experts working in either the fossil fuel or the RE sector, as well as by including environmental and development experts.

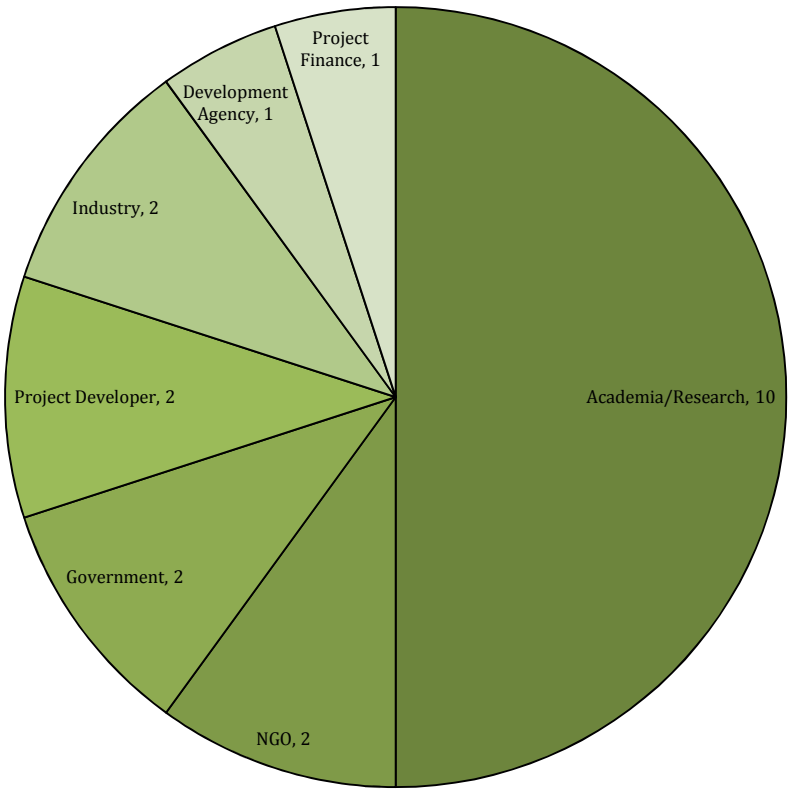

Figure 20: Expert consultation Morocco.

Jordan

In the expert consultation in Jordan, two surveys were conducted. The first round (Figure 22) on seven technologies (coal excluded) received a total of 46 valid responses, of which the majority of 20 participants were affiliated with academic research institutions. 4 respondents work in the industry or private sector, two respondents came from governmental organisations. One respondent was member of an NGO, three worked in areas others then mentioned above. 13 respondents did not specify their field of profession.

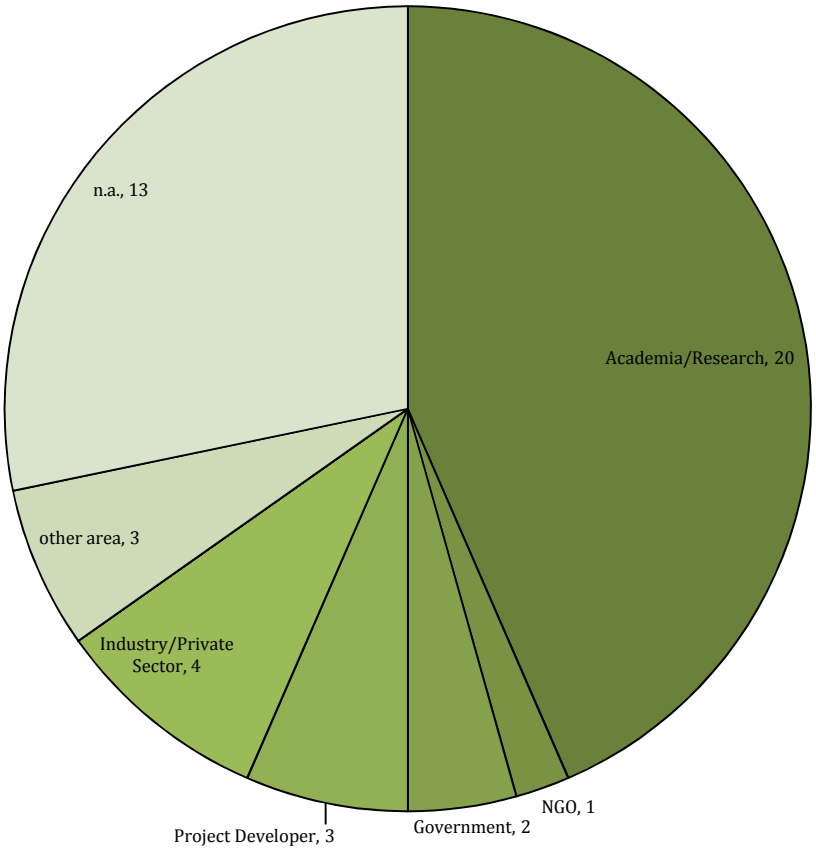

Figure 21: First round of expert consultation in Jordan.

The second expert consultation (Figure 23) was conducted on coal, though in the exact same design and method as the first survey. The second survey received 47 answers. Again, the majority of responses came from academia and research. Seven representatives of governmental organisations responded, while five representatives came were project developers or worked in industry and private sector respectively.Three participants stated they work in other areas, four did not specify.

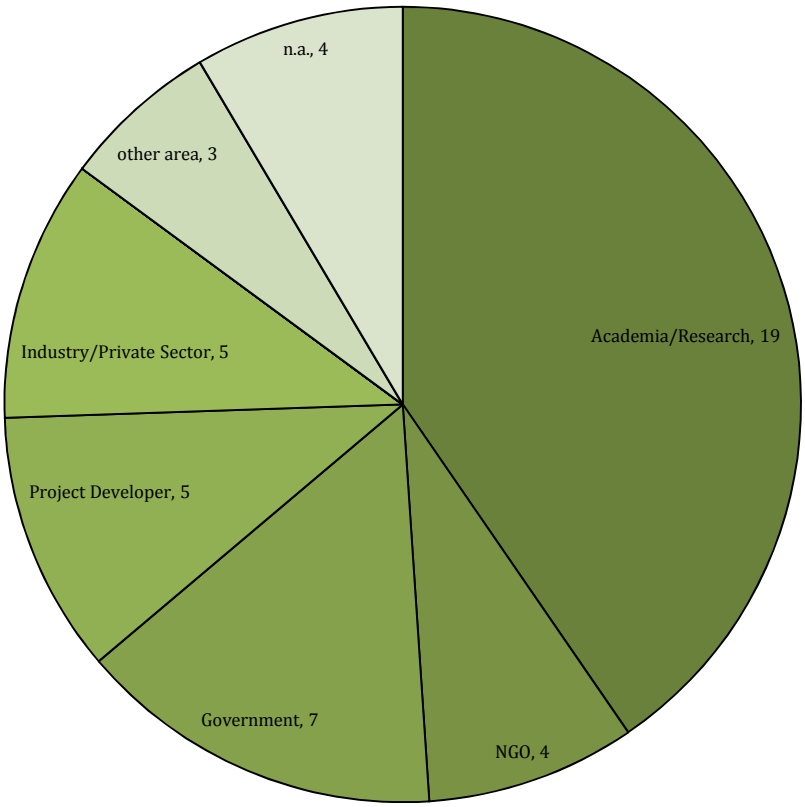

Figure 22: Second expert consultation on coal in Jordan.

Data sources used to determine LCOE

	Source(s)	Remarks	Average
Utility PV	Kost et al. (2013)	Provided ranges for location specific LCOEs	Simple average between both ranges provided
	Richts (2012)	Provided ranges for location specific LCOEs	
CSP	Kost et al. (2013)	Provided ranges for location specific LCOEs	Simple average between both ranges provided
	Richts (2012)	Provided ranges for location specific LCOEs	
Onshore Wind	Kost et al. (2013)	Provided ranges for location specific LCOEs	Simple average
Utility Hydro	Meta-study IRENA (2015) for Africa	Provided regional ranges for LCOEs and weighted averages	Simple average between weighted averages provided for both regions
	Meta-study IRENA (2015) for the Middle East	Provided regional ranges for LCOEs and weighted averages	
Nuclear	Meta-study WEC (2013)	Provided global ranges for LCOEs	Estimated value 25% above the bottom end (see text)
Coal	Meta-study WEC (2013)	Provided global ranges LCOEs	Estimated value 25% above the bottom end (see text)
Gas	Meta-study WEC (2013)	Provided global ranges LCOEs	Estimated value 25% above the bottom end (see text)
Oil	Kost et al. (2013)	Provided ranges for location specific LCOEs	Simple average

Table 34: References and additional information for the estimation of the LCOEs for different electricity generation technologies in MENA.

Data sources used to determine on-site job creation

	Country	Project	Capacity (MW)	Status	Construc-tion time (yr)	MCI total (Jobs)	MCI total (Jobs in total years)	MCI/MW (Job years/MW)	OM total (Job years/MW)	OM/MW (Jobs/MW)	Reference
PV	Morocco	Solar PV project - Erfud	25	in plan	1	200	200	8	25	1	ONEE (2015a)
	Morocco	Soar PV project - Missour	25	in plan	1	200	200	8	25	1	ONEE (2015b)
	Morocco	Solar PV project - Zagora	25	in plan	1	200	200	8	25	1	ONEE (2015c)
	Jordan	PV Plant North Jordan	20	in plan/construction	1.5	120	180	9	19	0.95	Al Shamil Engineering (2014)
	Jordan	Shams Ma'an	50	in plan/construction	1.25	500	625	12.5	25	0.5	ECO Consult (2014a)
	Jordan	Arabia One	10	in plan/construction	0.75	40-60 (peak: 100)	37.5	3.75	5	0.5	ECO Consult (2014b)
CSP	Morocco	Noor1	160	in plan/construction	2	1000	2000	12.5	60	0.375	Schinke et al. (2015)

	Morocco	Noor 2	200	in plan	2.1	540	1134	5.67	50	0.25	5 Capitals Environmental and Management Consulting (2015a)
	Morocco	Noor 3	150	in plan	2.5	530	1325	8.833	50	0.333	5 Capitals Environmental and Management Consulting (2015b)
	Israel	Ashalim	121	in plan/construction	2	1000	2000	16.529	45	0.372	BrightSource Energy (2015), NRL, National Renewable Energy Labratory (2015)
	UAE	Shams One	100	in operation	2	1200	2400	24	60	0.6	Goebel, O. & Luque, F. (2012)
Onshore Wind	Morocco	Tangiers 2	100	in plan/construction	2.33	450	1048.5	10.485	15-20	0.175	CLEAN TECH & Ecomed (2013)
	Tunisia	Sidi Daoud	34.32	In operation	1.5				11	0.32	STEG (2009)
	Morocco	Midelt	180	in plan	2	500	1000	5.556	6	0.033	DEKRA Ambio (2013a)
	Morocco	Khalladi	120	in plan	2	300	600	5	20	0.167	ACWA Power & UPC Renewables (2015)
	Morocco	Jbel Al Hadid	200	in plan/construction	2	500	1000	5	6	0.03	DEKRA Ambio (2013b)
Nuclear	Jordan	White Paper	2000	in plan	8	3455	27640	13.82	1080	0.54	WorleyParsons & Jordan Atomic Energy Commission (2011)

Coal	Morocco	Jorf Lasfar Extension 5&6	700	in operation	2,5	3000	7500	10.714	135	0.193	TAQA Morocco (n.d.), Jorf Lasfar Energy Company (2010)
	Morocco	Jorf Lasfar 1-4	1356	in operation					340	0.251	TAQA Morocco (2014)
	Morocco	Jorf Lafar 1-6	2056	in operation					480	0.233	TAQA Morocco (n.d.)
	Morocco	Safi energy hub	1386	In construction	3.83	3200	12256	8.8	150	0.108	Consortium GDF Suez, Mitsui, Nareva (2013)
	Sudan	Red Sea Coal-fired Plant	600	in plan	3	1000	3000	5	150	0.25	Sudanese Thermal Power Generating Company (2013)
	Morocco	Jerada Extension	350	in plan/construction	3	400	1200	3.429			CLEAN TECH (2014)
Gas	Morocco	Tahaddart cc power plant	384	in operation	2	*1	1442	3.755	40	0.104	Office National de L'Electricité and Energie Electrique de Tahaddart (n.d.), ONEE (2012)
	Egypt	Al-Minya	3100	in plan/construction	3.75	1500	5625	1.815	500	0.161	Integral Consult (2012)
	Jordan	Amman East IPP	370	in operation	2.33	600-700 (peak:1000)	1514.5	4.093	40-50	0.122	PB Power & Arab Centre for Engineering Studies (2006)

	Jordan	Al Qatrana IPP	373	in operation	2.25	(peak: 600-700)			50	0.134	Al-Rawabi Environment and Energy Consultancies (2008)
	Egypt	Helwan South	1950	in plan/construction	3.75	2250	8437.5	4.327	700	0.359	Engineering Consultants Group (2011)
Oil	Jordan	IPP4 Al-Manakher Power Project	250	in operation	1.42	600-700 (peak: 1000)	923	3.692	40	0.16	Parsons Brinckerhoff & Royal Scientific Society (2012), Citec (2014)
	Egypt	Combined Gas/Oil El-Ain Al-Sokhna	1300	in operation	3.75	1200-1500	5062.5	3.894	400-500	0.346	Engineering Consultants Group (2008)

Table 35: Literature used to derive direct on-site job for electricity projects in MENA.

Data sources used to determine land requirement

	References		Technology	Country	Project	Capacity (MW)	Total size (ha)	ha/MW
International data	ANL (1981)	Regional data	PV	Morocco	Noor IV	70	172	2.31
	BLM (2005)				Noor B	50	200	4
	Broesamle et al. (2001)				NoorL	50	200	4
	Central Electricity Authority (2007)			Israel	Ramat Hovav	37.5	46	1.23
	Dahle et al. (2008)				Ketura Sun	4.95	8.5	1.72
	Denholm et al. (2009)			Jordan	Shams Ma'an	52.2	200	3.83
	DOE (1983)				Ma'an Solar Park **	110	292.4	2.66
	DOE (2003)				Oryx	10	50	5
	Fluri (2009)				Sunrise	50	170	3.4
	Hang et al. (2008)				Shamsuna	10	18	1.8
	IEA (2000)			Egypt	Siwa	10	20	2
	IPCC (2012)				Kom Ombo	1750	3700	2.11
	Jacobsen (2009)			UAE	Masdar	10	21	2.1
	La Rovere et al. (2002)		CSP	Morocco	Noor I	160	444	2.78
	MIT (2006)				Noor II	200	641	3.21
	NEERI (2006)				Noor III*	150	750	5
	Skone et al. (2014)				Ain Beni Mathar	20	81	4.05
	NREL (2004)			Algeria	Hassi R'mel	20	71	3.55
	Heath et al. (2011)			Egypt	Kuraymat	20	71	3.55
	Mai et al. (2012)			UAE	Shams I*	100	234	2.34
	Ong et al. (2013)			Tunisia	TuNur (in planning)*	2250	10000	4.44
	Pasqualetti & Miller (1983)		Onshore Wind	Morocco	Fouma Aluad	50	22,70	0.45
	Robeck et al. (1980)				Essaouria Amogdoul	60.35	18	0.3
	San Diego Regional Renewable Energy Study Group (2005)				Akhefnir 1	200	72,1	0.36
	Turney & Fthenakis (2011)				Lafarge	32,2	9,5	0.3
					Tanger I, II	140	37,9	0.27
					Tarfaya	301	47	0.16
				Tunisia	Sidi Daoud	53.6	14.6	0.27
				Egypt	Zafarana Wind Farm	545	219	0.4
			Coal	Morocco	Jerrada	165	36	0.22
					Mohammedia	300	30	0.1

			Jorf Lasar	1360	90	0.07
		Israel	Orot Rabin	2590	137	0.05
			Rutenberg	2250	220	0.1
	Gas	Morocco	Mohammedia II	300	6	0.02
			Tahaddart	384	7	0.02
			Ain Beni Mathar	450	7	0,02
		Jordan	Amman East	380	33	0.09
			Aqaba	650	43	0.07
			Rehab	357	14	0.04
			Risha	150	25	0.17
			Samra	1031	36	0.03
		Egypt	6-Oct	600	6	0.01
			Al Amiriyah	100	5	0.05
			Banha	750	13	0.02
			Cairo North I, II	1500	18	0.01
			Cairo South I, II	615	13	0.02
			Damanhour	156	4	0.03
			Damietta	1200	12	0.01
			Damietta New	500	4	0.01
			El-Atf	750	6	0.01
			El-Seiuf	200	2	0.01
			Giza North I-III	2250	31	0.01
			Hurghada	143	5	0.03
			Karmouz	23	3	0.13
			Kuraymat II, III	1500	15	0.01
			Mahmoudia	312	12	0.04
			Marsa Matroh	60	4	0.07
			Nubaria I-III	2250	91	0.04
			Port Said East	682.5	14	0.02
			Port Said	73	1	0.01
			Shabab	1100	15	0.01
			Sidi Kir 3-6	1432.5	23	0.02
			Siouf	99	3	0.03
			Suez Gulf	682.5	15	0.02
			Talkha	1040	16	0.02
			Tebbin	700	5,4	0.01
			Wadi Hof	100	5	0.05

			West Damietta	750	24	0.03
		Tunisia	Carthage Power	471	6	0.01
			El Bibane	27	1	0.04
			Feriana	244	20	0.08
			Ghannouch	44	7	0.16
			Ghannouch	52	12	0.23
			Rades I, II	678	18	0.03
			Sousse	670	27	0.04
		Iraq	Khor Al Zibayr	252	41	0.16
		Lebanon	Baalbek	70	2	0.03
			Deir-Ammar	470	13	0.03
			Tyre (Sour)	70	3	0.04
			Zahrani	470	15	0.03
		UAE	Ameer I-III	1844	35	0.02
			Dubai Aluminium	2000	64	0.03
			Fujairah 1	881	31	0.04
			Ruwais (Takreer)	700	49	0.07
			Shuweihat I	1615	166	0.1
			Taweelah A1	1650	35	0.02
			Umm Al Nar	2746	245	0.02
		Algeria	Annaba	80	4	0.05
			Bab Ezzouar	108	3	0.03
			Boufarik	96	5	0.05
			F'Kirina	300	26	0.09
			Hadjret En-Nouss	1227	19	0.02
			Skikda	262	5	0.02
			Tiaret I, II	420	11	0.03
		Oman	AES Barka I	427	11	0.03
			Manah	267	7	0.03
		Saudi Arabia	Arar	310	23	0.07
			Dhuba	111	32	0.29
			Makkah	780	29	0.04
			Tabuk	444	59	0.13
	Oil	Morocco	Kenitra	300	6	0.02
			Mohammedia I	99	5	0.05
			Dakhla	23.4	3	0.13

			Laayoune	150	2	0.01
			Tantan	100	9	0.09
			Tetuan	105	7	0.07
			Tit Mellil	102	6	0.06
		Egypt	Abu Qir	2211	43	0.02
			Abu Sultan	600	21	0.04
			Assiut	90	2	0.02
			Ataka (Suez)	900	26	0.03
			Cairo West	1710	28	0.02
			Damanhour	495	24	0.05
			Tebbin	791	22	0.03
			El-Seiuf	200	6	0.03
			Kafr El-Dawar	440	7	0.02
			Kuriemat I	1254	44	0.04
			Oyoun Moussa	640	25	0.04
			Sharm El-Sheikh	178	8	0.04
			Shoubra El-Kheima	1260	12	0.01
			Sidi Krir 1, 2	640	16	0.03
			Talkha	420	11	0.03
			Walidia	624	20	0.03
		Jordan	Hussein	382	15	0.04
		Bahrain	Muharraq	30	4	0.13
		Israel	Eilat	100	8	0.08
			Eshkol	1062	36	0.03
			Haifa	426	18	0.04
			Kinorot	80	1	0.01
			Reading	428	13	0.03
		UAE	Madinat Zayed	118	14	0.12
		Saudi Arabia	Qurayyah	2500	100	0.04
			Rabigh	1572	82	0.05
			Riyadh PP5	528	42	0.08

Table 36: Data for deriving the indicator *"Land requirement"* (* taken from project documents; ** without Shams Ma'an).

Water Risk Index Morocco

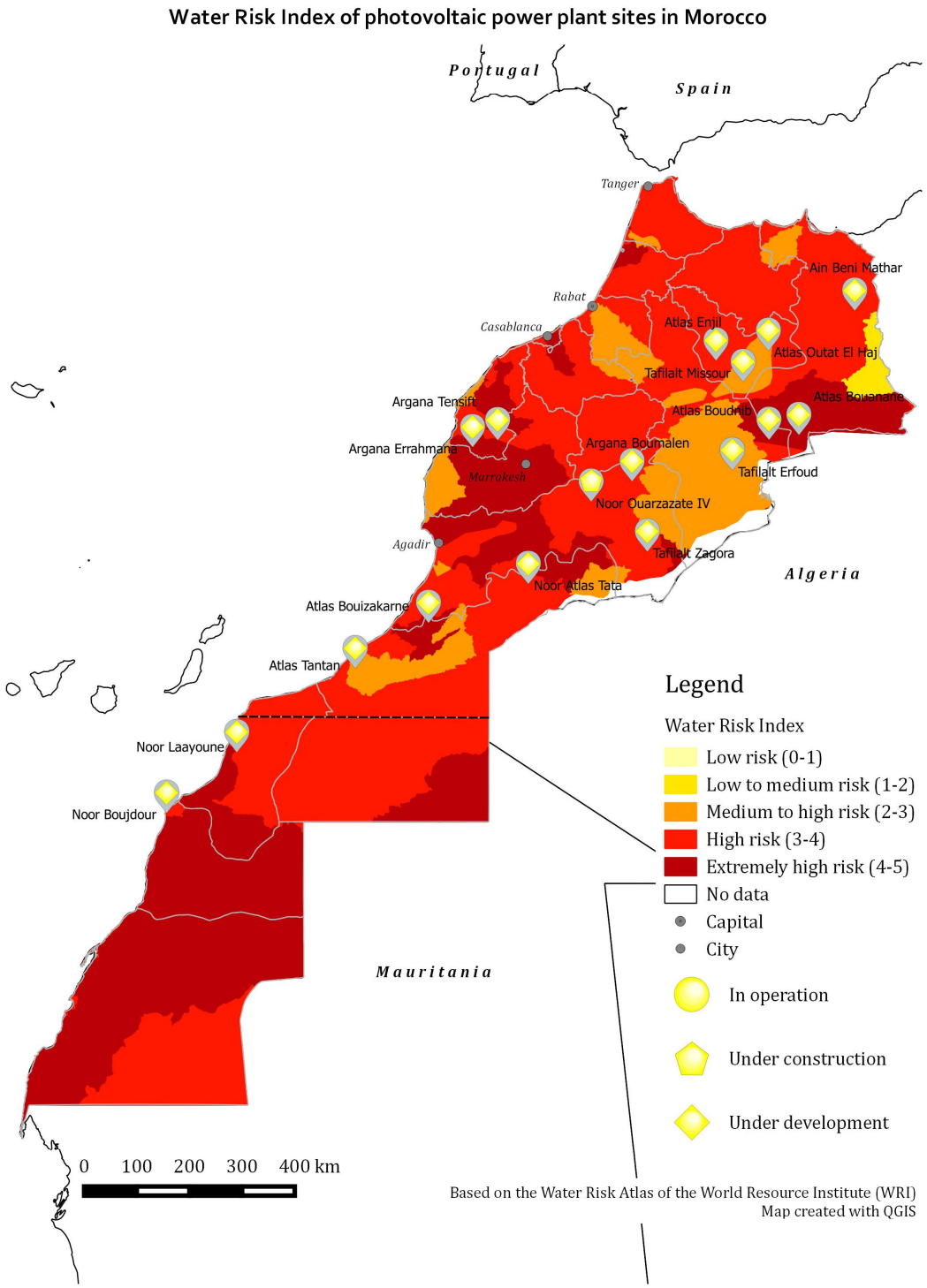

Figure 23: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of utility PV power plants in Morocco.

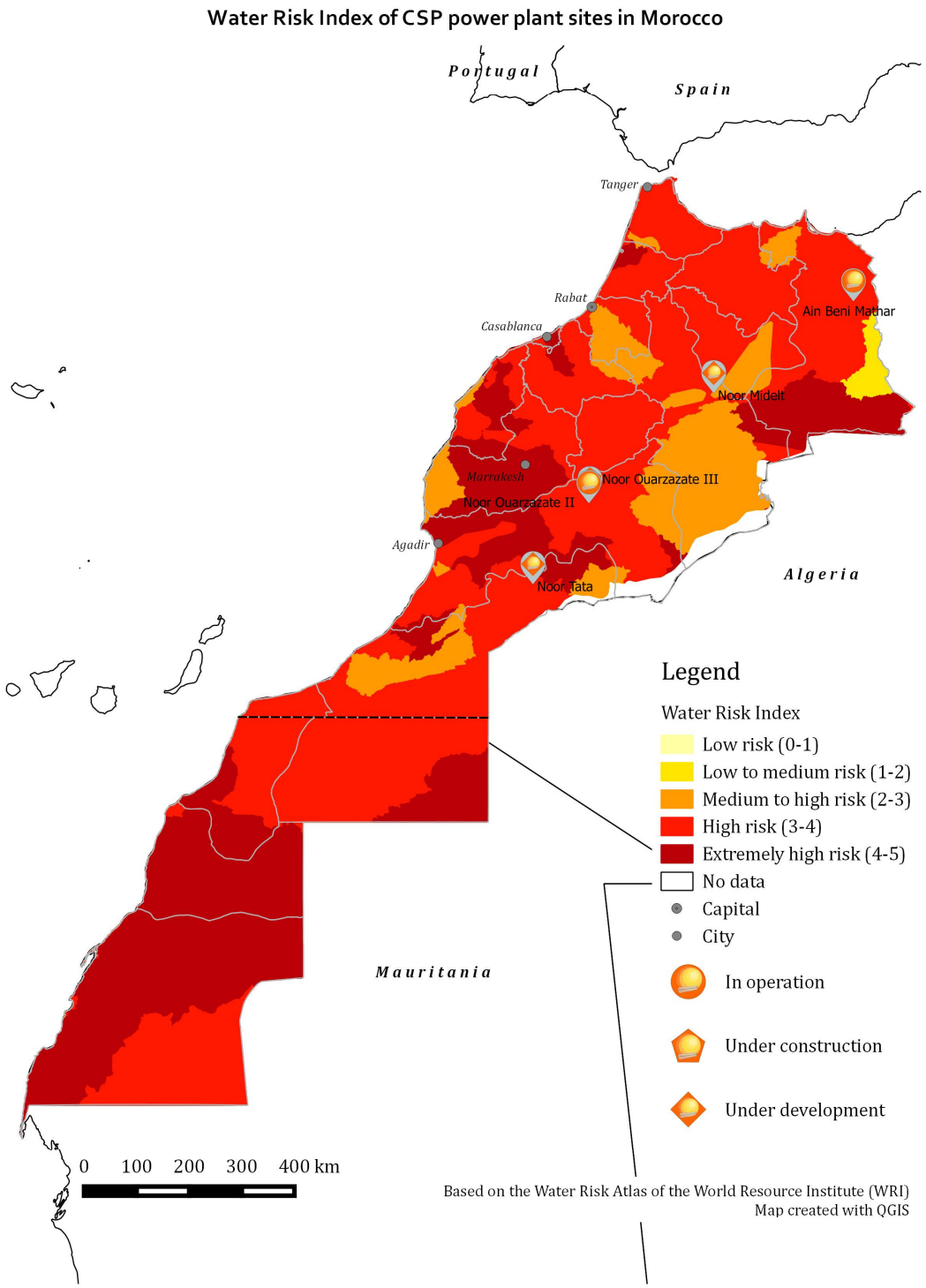

Figure 24: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of CSP power plants in Morocco.

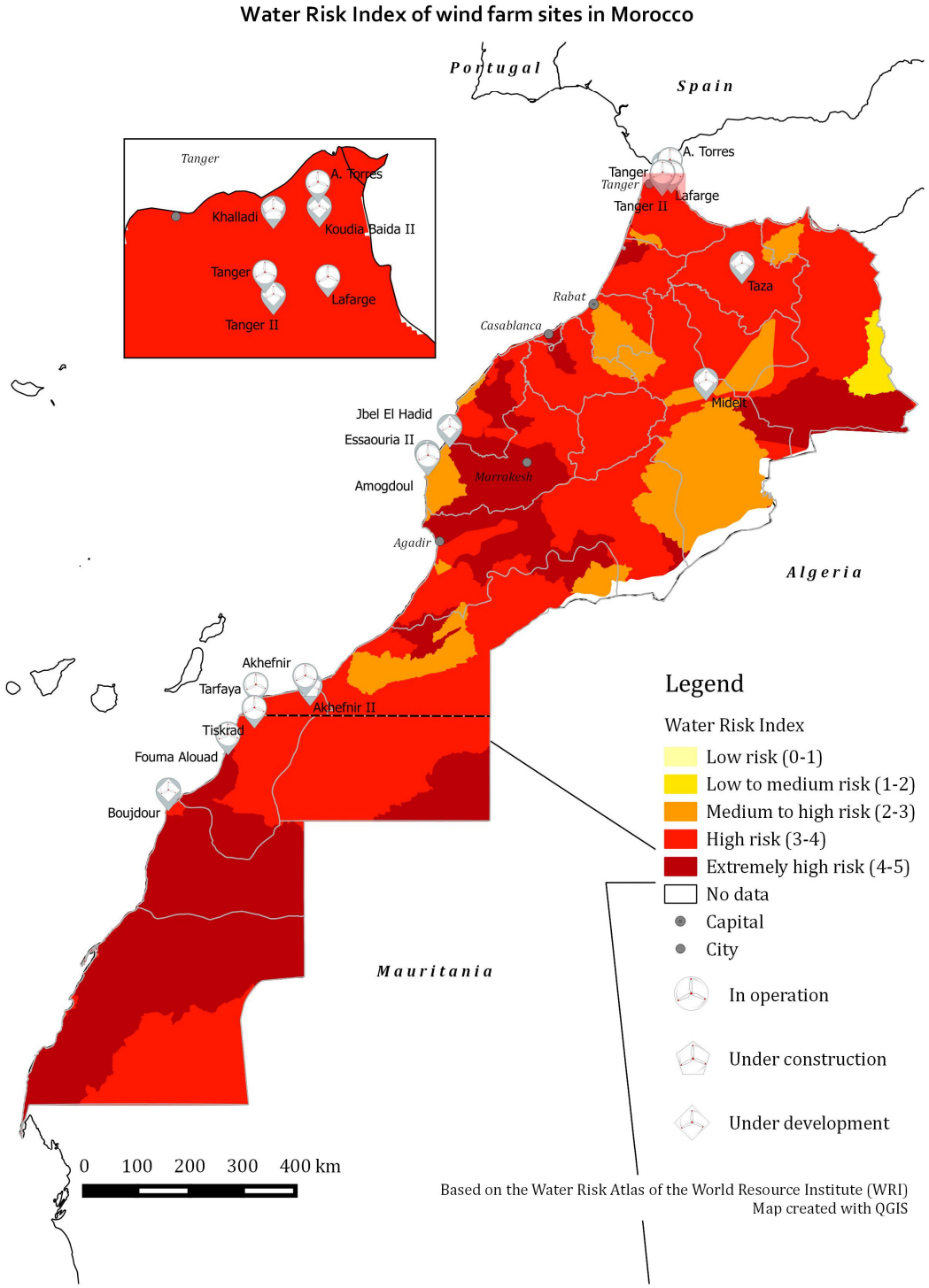

Figure 25: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of onshore wind power plants in Morocco.

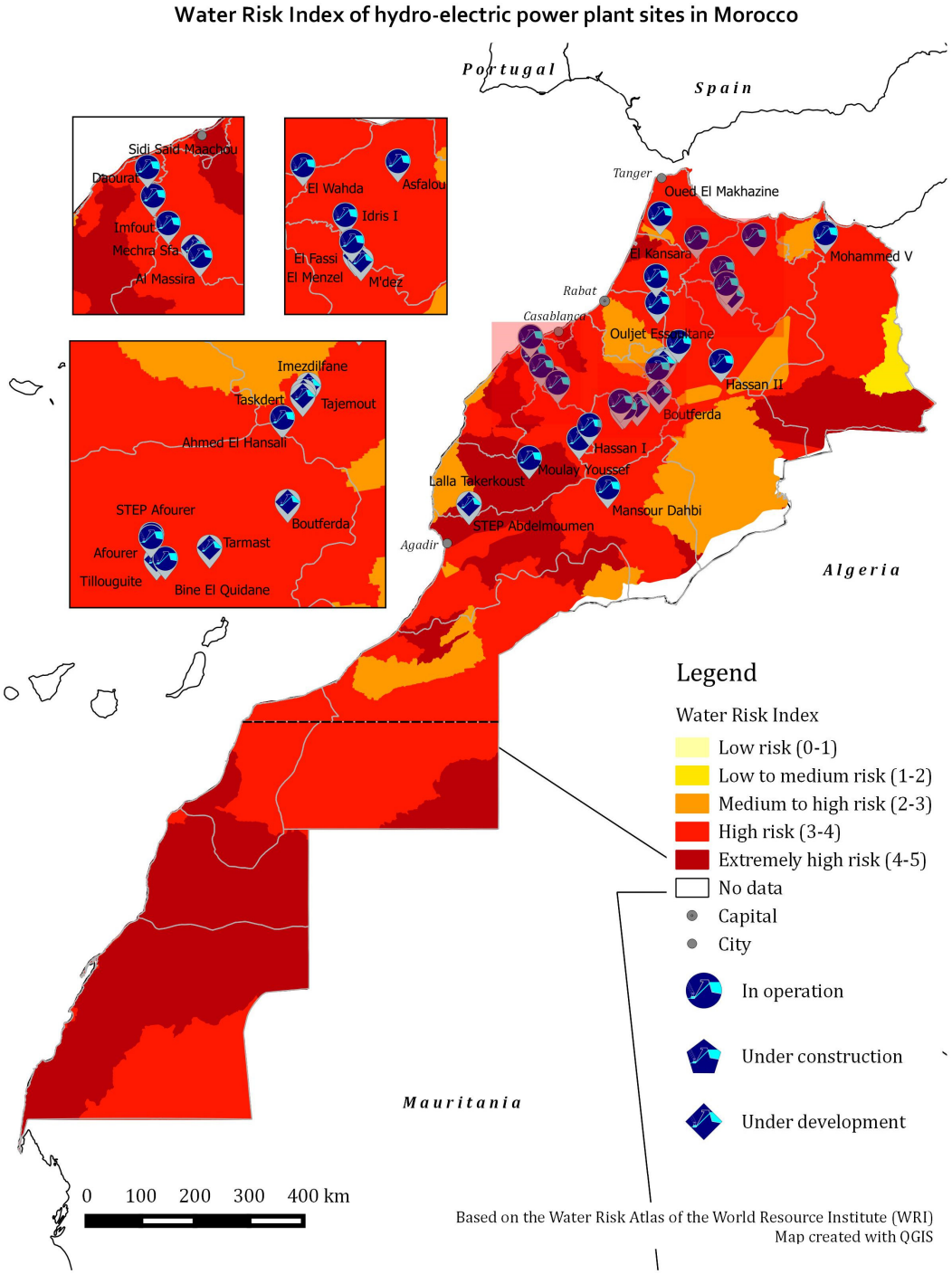

Figure 26: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of hydro-electric power plants in Morocco.

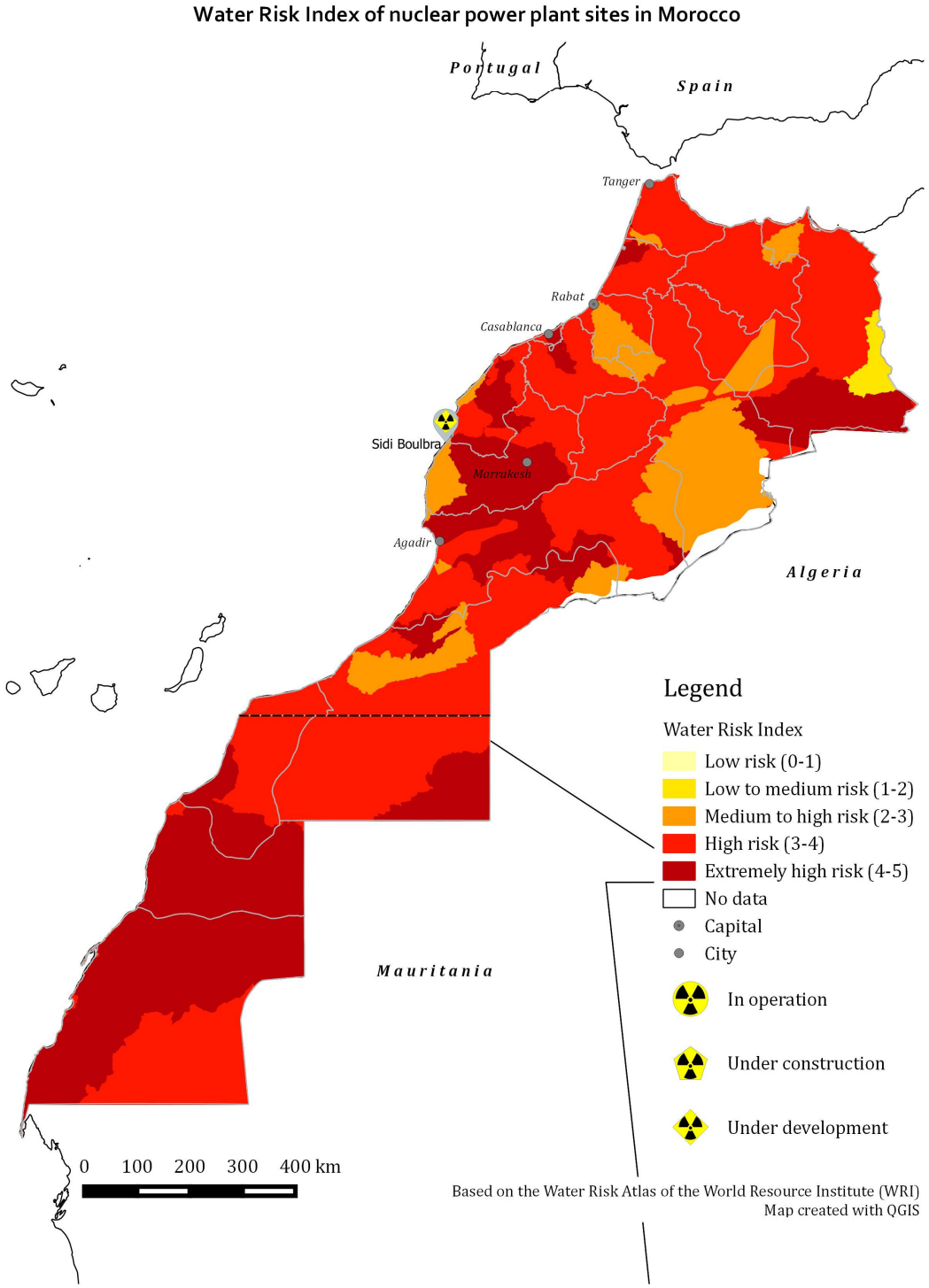

Figure 27: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of nuclear power plants in Morocco.

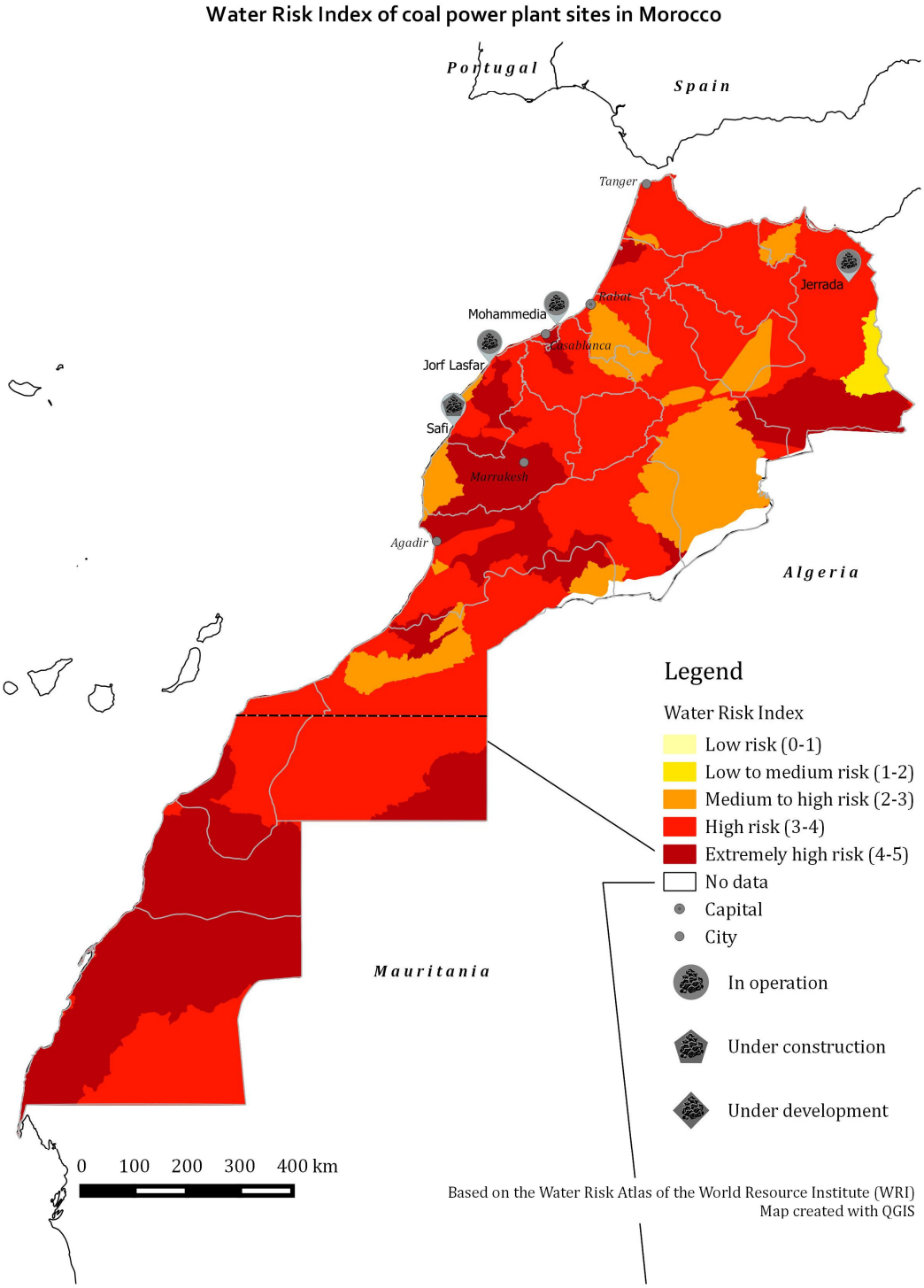

Figure 28: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of coal-fired power plants in Morocco.

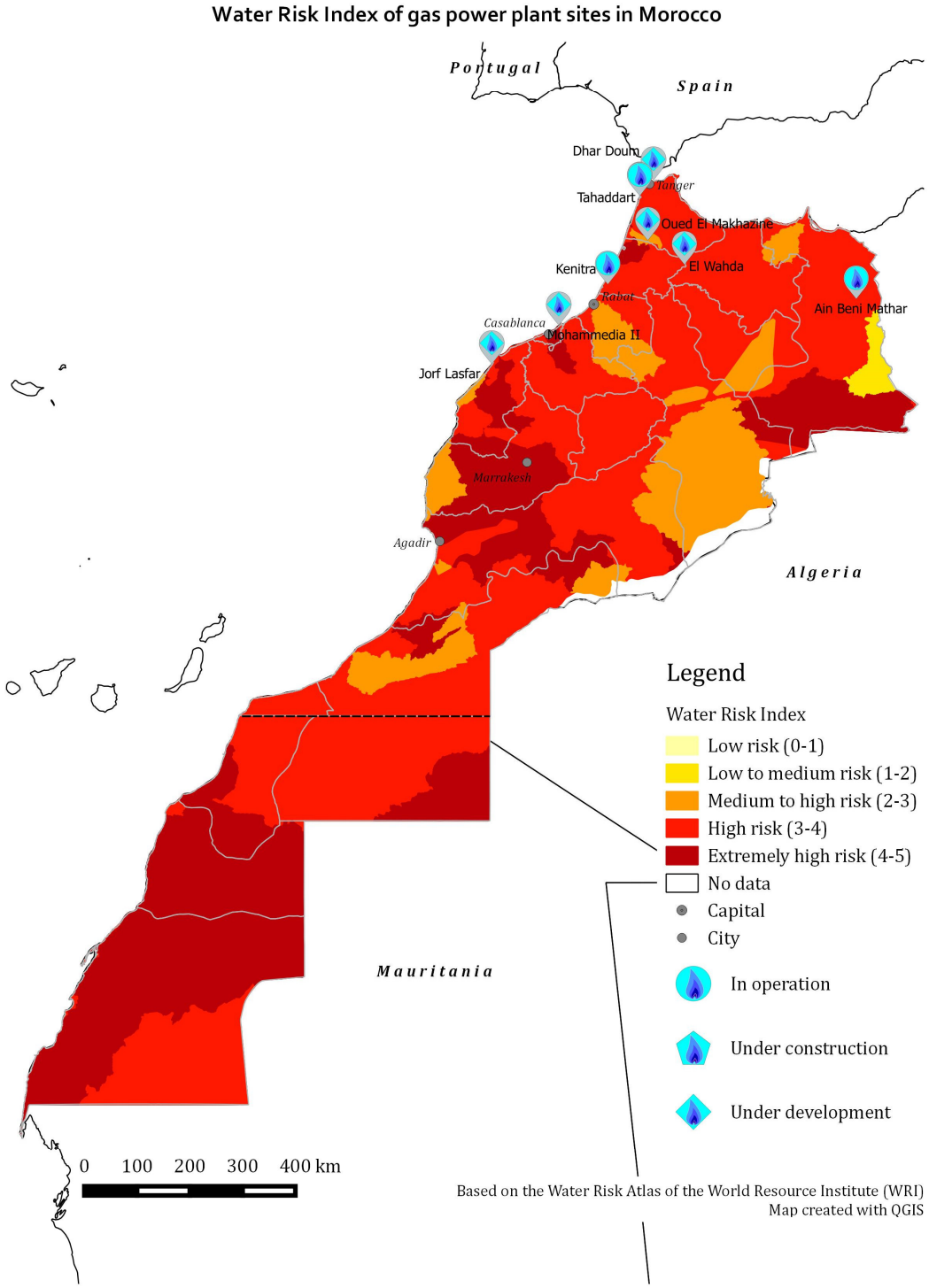

Figure 29: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of gas-fired power plants in Morocco.

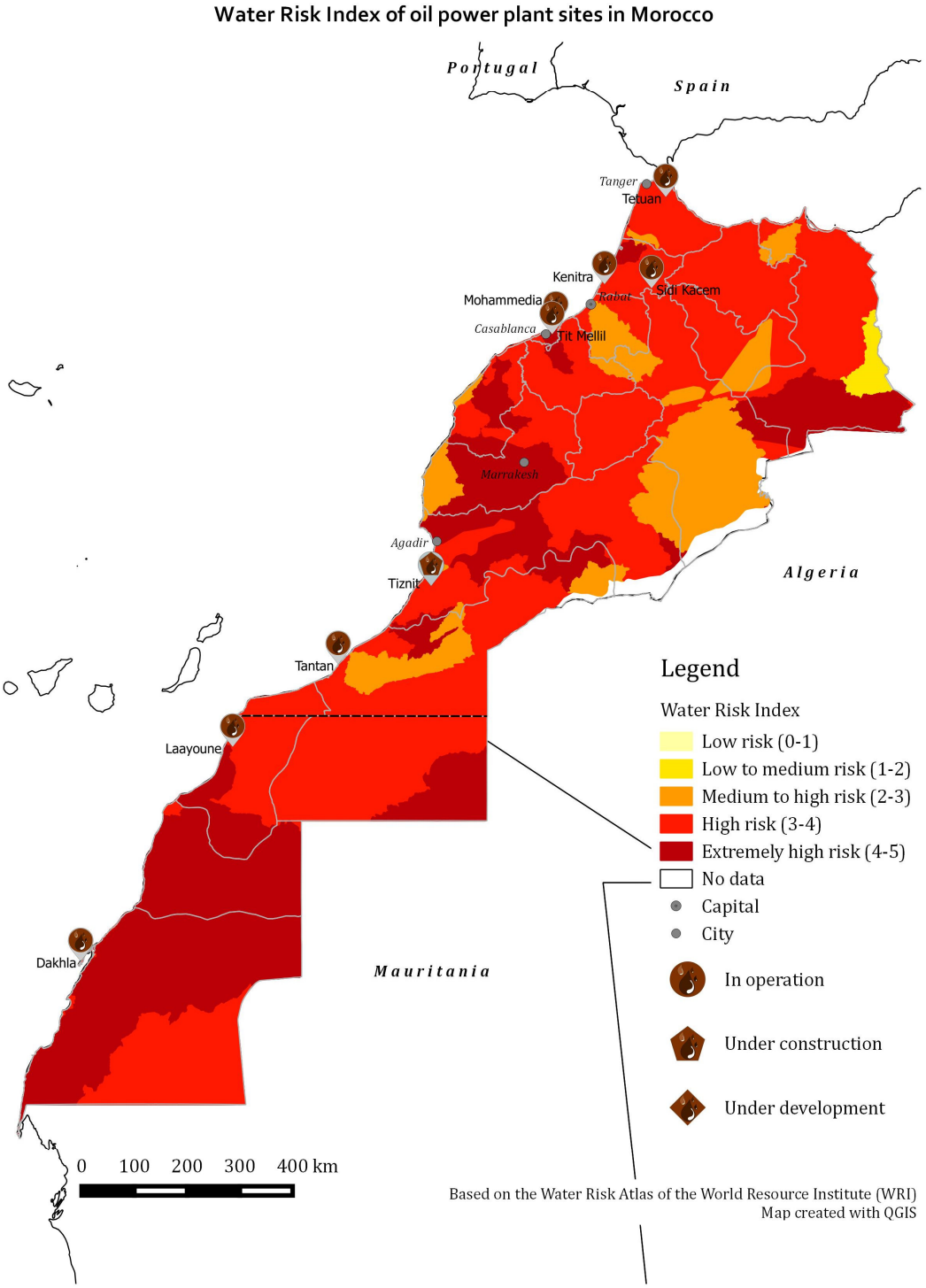

Figure 30: The WRI Water Risk Index (Gassert et al., 2014) in combination with the locations of oil-fired power plants in Morocco.

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