



# ROADMAP FOR A RENEWABLE ENERGY FUTURE

REmap results by country Status as of March, 2016







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The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as the principal platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy, in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity.

The full version of the REmap report 2016 edition can be downloaded through <a href="https://www.irena.org/Publications">www.irena.org/Publications</a>. All REmap related publications and other supporting material are available at <a href="https://www.irena.org/remap">www.irena.org/remap</a>



For further information or to provide feedback, please contact the REmap team at remap@irena.org

### Note about Data Status

REmap is an ongoing project and country analyses are constantly updated as new information, government plans, and markets developments occur. The information presented in this document is the status of data and REmap findings as of March 2016 and is background information to the 2016 edition of REmap that was released on 17 March, 2016. For more information please email the REmap team at remap@irena.org.

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# REmap: ROADMAP FOR A

## RENEWABLE ENERGY FUTURE

Doubling renewables in the global energy mix by 2030 is not only feasible, but cheaper than not doing so. Economic savings would far exceed the costs. It would create more jobs, boost economic growth and save millions of lives annually through reduced air pollution. It would also, when coupled with greater energy efficiency, put the world on track to keep the rise of temperatures within 2°C, in line with the Paris Agreement.

But to meet that goal, renewable energy deployment must happen six times faster than today.

The second edition of IRENA's global roadmap provides an in-depth perspective on the energy transition in 40 economies, representing 80% of global energy use. It offers concrete technology options and outlines solutions to accelerate renewable energy growth.

The age of renewables is here. But without concerted action, they cannot reach their potential soon enough to meet international climate and development targets. For decision makers in the public and private sectors alike, this roadmap sends an alert – on the opportunities at hand and the costs of not taking them.

These REmap country results are part of IRENA's REmap: Roadmap for a Renewable Energy
Future report.

Methodology and definitions can be found in the full version of the report in the section REmap: Country process and analytical approach and the Appendix: REmap methodology and data. Additional information is available on the REmap website at <a href="www.irena.org/remap">www.irena.org/remap</a> in the Datasheets and Sources and Methodology sections of the webpage.













### Abbreviations:

BF - blast furnace

bln - billion

CO - coke oven

CO2 - carbon dioxide (CO2)

CSP - concentrated solar power

DH - district heat

EJ - exajoule

excl. - excluding

GW - gigawatt

Mt - megatonne

N/A - not available/applicable

PJ - petajoule

PV - photovoltaic

RE - renewable energy

TWh - terawatt-hour

**UAE - United Arab Emirates** 

UK – United Kingdom of Great Britain and Northern Ireland

USA - United States of America

USD - United States dollar

yr - year







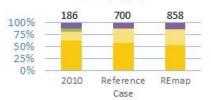
# **REmap Country Results - Argentina**

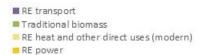
			Unit	2010	Reference Case 2030	REmap 2030	
		Total installed power generation capacity	GW	29	60	62	
		Renewable capacity	GW	10	36	42	
		Hydropower (excl. pumped hydro)	GW	10	23	23	
		Wind	GW	0	6	9	
		Biofuels (solid, liquid, gaseous)	GW	0	3	4	
		Solar PV	GW	0	4	6	
Ë		CSP	GW	0	0	0	
oac	Power sector	Geothermal	GW	0	0	0	
g		Marine, other	GW	0	0	0	
Þ		Non-renewable capacity	GW	19	24	21	
Energy generation and capacity		Total electricity generation	TWh	125	236	236	
<u>.</u>	Po	Renewable generation	TWh	36	128	144	
rat		Hydropower	TWh	34	85	85	
ne		Wind	TWh	0	17	26	
ge		Biofuels (solid, liquid, gaseous)	TWh	2	19	22	
€		Solar PV	TWh	0	7	11	
Je.		CSP	TWh	0	0	0	
늅		Geothermal	TWh	0	0	0	
		Marine, other	TWh	0	0	0	
		Non-renewable generation	TWh	89	108	92	
		Total district heat generation	PJ PJ	<b>0</b>	<b>0</b>	<b>0</b>	
	품	Biofuels (solid, liquid, gaseous) Other renewables	PJ PJ	0	0	0	
		Non-renewable DH	PJ	0	0	0	
		Total direct uses of energy	PJ	836	2 056	2 067	
		Direct uses of renewable energy	PJ	46	215	287	
	t Y	Solar thermal - Buildings	PJ	0	40	70	
Η.	ans	Solar thermal - Industry	PJ	0	10	30	
ses	<u>=</u>	Geothermal	PJ	0	0	0	
t U	bu	Bioenergy (traditional) - Buildings	PJ	13	0	0	
.ec	38 g	Bioenergy (modern) - Buildings	PJ	0	57	62	
i <u>=</u>	Buildings and Industry	Bioenergy - Industry	PJ	33	108	125	
e '		Non-renewable - Buildings	PJ	485	1 106	1 081	
Final energy use - direct uses <sup>1</sup>		Non-renewable - Industry	PJ	286	629	593	
ξ		Non-renewable - BF/CO	PJ	19	106	106	
neı		Total fuel consumption	PJ	647	1 544	1 534	
<u> </u>	بو	Liquid biofuels	PJ	23	79	115	
na	ansport	Conventional biogasoline	PJ	13	29	41	
Œ	sus	Advanced biogasoline	PJ	0	0	0	
	i i	Biodiesel (conventional and advanced)	PJ	10	50	74	
		Biomethane  Non-renewable fuels	PJ PJ	0 624	4 1 461	5 1 415	
Total	l final onor	y consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	2 036	4 682	4 684	
TOtal		e in electricity generation		29%	54%	61%	
S		e in district heat generation		0%	0%	0%	
are		e in Buildings - final energy use, direct uses (mo	odern)	0%	8%	11%	
sh		e in Industry - final energy use, direct uses	,	10%	16%	21%	
RE shares		e in Transport fuels		4%	5%	8%	
		of modern RE in TFEC <sup>3</sup>		9%	15%	18%	
Σ		costs [USD bln/yr in 2030]		N/A	N/A	- 2	
Ē		stment needs [USD bln/yr (2010-2030)]		N/A	6	7	
<u>:</u>		nent support for renewables [USD bln/yr in 203	80]	N/A	N/A	0.4	
pu		from reduced externalities - air pollution (aver	-				
<u></u>		yr in 2030]		N/A	N/A	1.0	
Financial indicators	_	from reduced externalities - CO <sub>2</sub> (USD 50/tonn	e CO2)	N/A	N/A	0.7	
nai	[USD bln/yr in 2030]						
证	CO2 emissions from energy [Mt/yr] 137 263 249						

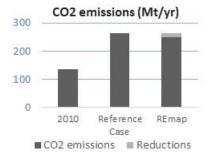
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



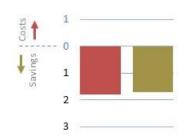
# Final RE use by sector (%) and total (PJ/yr)







### Costs and savings (USD bln in 2030)



 Savings from reduced externalities - air pollution and CO2
 System costs

### References for further consultation:

- Escenarios Energéticos de Argentina, Plataforma Escenarios Energéticos Argentina 2035 (2015).

















# **REmap Country Results - Australia**

					Reference	REmap
			Unit	2010	Case 2030	2030
		Total installed power generation capacity	GW	58	71	91
		Renewable capacity	GW	12	22	52
		Hydropower (excl. pumped hydro)	GW	7	8	10
		Wind	GW	5	9	19
		Biofuels (solid, liquid, gaseous)	GW	0	1	2
_		Solar PV	GW	1	4	21
<u> </u>		CSP	GW	0	0	0
ЭaС	_	Geothermal	GW	0	1	1
<u> </u>	양	Marine, other	GW	0	0	0
٦	se	Non-renewable capacity	GW	45	49	39
Energy generation and capacity	Power sector	Total electricity generation	TWh	262	317	334
<u>.</u>	Q	Renewable generation	TWh	38	64	137
į		Hydropower	TWh	17	19	27
Je I		Wind	TWh	14	27	54
ge e		Biofuels (solid, liquid, gaseous)	TWh	5	8	15
≥		Solar PV	TWh	1	7	35
ē		CSP	TWh	0	0	0
ᇤ		Geothermal	TWh	0	4	6
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	225	253	197
		Total district heat generation	PJ	0	0	0
	품	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	_	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	1 303	2 218	2 192
		Direct uses of renewable energy	PJ	183	212	379
₩	ust	Solar thermal - Buildings	PJ PJ	11	12	30
es	<u>n</u>	Solar thermal - Industry	PJ PJ	0	0	35 0
n	ē	Geothermal Bioenergy (traditional) - Buildings	PJ PJ	0	0	0
SC SC	Sal	Bioenergy (modern) - Buildings	PJ PJ	54	41	66
÷	ing	Bioenergy - Industry	PJ	118	159	248
	Buildings and Industry	Non-renewable - Buildings	PJ	240	361	296
Se		Non-renewable - Industry	PJ	782	1 557	1 429
<u>&gt;</u>		Non-renewable - BF/CO	PJ	97	89	89
Final energy use - direct uses $^{ m 1}$		Total fuel consumption	PJ	1 466	1 928	1 821
en		Liquid biofuels	PJ	9	11	53
<u>a</u>	ort	Conventional biogasoline	PJ	6	5	17
ᇤ	ansport	Advanced biogasoline	PJ	0	3	3
	Trai	Biodiesel (conventional and advanced)	PJ	3	3	33
		Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	1 457	1 917	1 768
Tota		gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	3 593	5 236	5 182
		re in electricity generation		14%	20%	41%
RE shares		re in district heat generation		0%	0%	0%
hai		re in Buildings - final energy use, direct uses (mo	dern)	21%	13%	25%
N S		re in Industry - final energy use, direct uses		13%	9%	17%
~		re in Transport fuels		1%	1%	3%
		of modern RE in TFEC <sup>3</sup>		8%	8%	17%
ors		costs [USD bln/yr in 2030]		N/A	N/A	2
ate		estment needs [USD bln/yr (2010-2030)]	.01	N/A	1	5
dic		nent support for renewables [USD bln/yr in 203		N/A	N/A	2.5
al in	_	s from reduced externalities - air pollution (aver /yr in 2030]	age)	N/A	N/A	14.7
Financial indicators		s from reduced externalities - CO2 (USD 50/tonn /yr in 2030]	e CO2)	N/A	N/A	3.9
뜌	-	nissions from energy [Mt/yr]		375	507	429

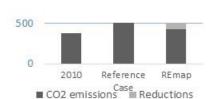
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



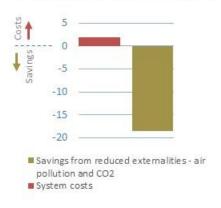
# Final RE use by sector (%) and total (PJ/yr)



### CO2 emissions (Mt/yr)



### Costs and savings (USD bln in 2030)



- Australian Energy Projections 2014-15 to 2049-50, BREE (2014).
- "Chapter 3: THE OUTLOOK FOR GAS IN THE TRANSPORT FUEL MARKET", Transport Fuels from Australia, CSIRO

















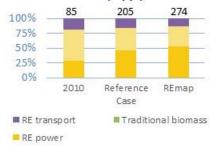
# **REmap Country Results - Belgium**

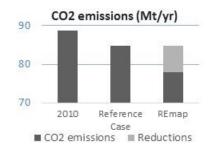
	•					
				2010	Reference	REmap
			Unit	2010	Case 2030	2030
		Total installed power generation capacity	GW	18	25	32
		Renewable capacity	GW	4	11	20
		Hydropower (excl. pumped hydro)	GW	1	0	0
		Wind	GW	1	4	6
		Biofuels (solid, liquid, gaseous)	GW	1	2	2
		Solar PV	GW	1	5	11
<u>:</u>		CSP	GW	0	0	0
ac	_	Geothermal	GW	0	0	0
Energy generation and capacity	cto	Marine, other	GW	0	0	0
ō	se	Non-renewable capacity	GW	14	14	13
a	/er	Total electricity generation	TWh	94	84	85
e G	Power sector	Renewable generation	TWh	8	26	41
ati		Hydropower	TWh	0	0	0
er		Wind	TWh	1	11	18
e		Biofuels (solid, liquid, gaseous)	TWh	6	10	10
> 50		Solar PV	TWh	1	5	13
50		CSP	TWh	0	0	0
ä		Geothermal	TWh	0	0	0
ш		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	86	58	44
		Total district heat generation	PJ	36	44	44
	_	Biofuels (solid, liquid, gaseous)	PJ	4	6	10
	ద	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	32	38	34
		Total direct uses of energy	PJ	750	<b>726</b>	<b>722</b>
		Direct uses of renewable energy	PJ	42	720	82
			PJ PJ	0	12	17
+	nsı	Solar thermal - Buildings				
es	<u>n</u>	Solar thermal - Industry	PJ	0	0	2
ns	Buildings and Industry	Geothermal	PJ	0	0	0
t		Bioenergy (traditional) - Buildings	PJ	0	0	0
<u>=</u>		Bioenergy (modern) - Buildings	PJ	11	13	13
0		Bioenergy - Industry	PJ	31	45	50
Se	Bui	Non-renewable - Buildings	PJ	418	386	377
n /		Non-renewable - Industry	PJ	247	233	226
50		Non-renewable - BF/CO	PJ	43	37	37
Final energy use - direct uses <sup>1</sup>		Total fuel consumption	PJ	379	333	324
<u>e</u>	ť	Liquid biofuels	PJ	15	33	35
i.	nsport	Conventional biogasoline	PJ	3	6	6
ш	sus	Advanced biogasoline	PJ	0	0	0
	Tra	Biodiesel (conventional and advanced)	PJ	12	27	29
		Biomethane	PJ	0	0	0
T-1-1	C l	Non-renewable fuels	PJ	364	299	289
lotal		ergy consumption (electricity, DH, direct uses)	PJ	1 452	1 404	1 396
10		share in electricity generation		8%	31%	48%
RE shares		share in district heat generation		10%	15%	22%
Ъа		share in Buildings - final energy use, direct uses (n	nodern)	3%	6%	7%
ь S		share in Industry - final energy use, direct uses		11%	16%	19%
~		share in Transport fuels		4% 6%	10%	11%
		Share of modern RE in TFEC <sup>3</sup>			15%	20%
ors		stem costs [USD bln/yr in 2030]		N/A	N/A	-0.1
atc		investment needs [USD bln/yr (2010-2030)]		N/A	1	2
dic		restment support for renewables [USD bln/yr in 20	-	N/A	N/A	0.1
ij		vings from reduced externalities - air pollution (ave bln/yr in 2030]	erage)	N/A	N/A	0.3
Financial indicators	Sav	vings from reduced externalities - CO₂ (USD 50/ton [USD bln/yr in 2030]	ine	N/A	N/A	0.3
H.		2 emissions from energy [Mt/yr]		89	85	78

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

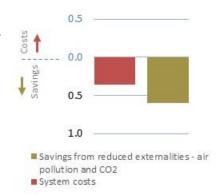


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Het Belgische energiesysteem in 2050: Waar naartoe. Federaal Planbureau (2014).
- Potentieel studie hernieuwbare energie 2030 in Vlaanderen, VITO (2014).
- Towards 100% renewable energy in Belgium by 2015, VITO (2013).

















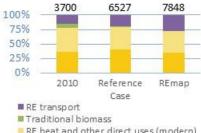
# **REmap Country Results - Brazil**

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	115	249	257
		Renewable capacity	GW	91	203	224
		Hydropower (excl. pumped hydro)	GW	82	131	134
		Wind	GW	1	36	42
		Biofuels (solid, liquid, gaseous)	GW	8	25	25
		Solar PV	GW	0	10	21
<u>;;</u>		CSP	GW	0	1	2
Sac	<u>.                                    </u>	Geothermal	GW	0	0	0
g	Power sector	Marine, other	GW	0	0	0
٦		Non-renewable capacity	GW	24	45	33
Energy generation and capacity	۷ei	Total electricity generation	TWh	515	994	994
ĕ	Pov	Renewable generation	TWh	437	834	884
rat		Hydropower	TWh	403	610	622
ne		Wind	TWh	2	96	116
ge		Biofuels (solid, liquid, gaseous)	TWh	32	111	112
<b>№</b>		Solar PV	TWh	0	14	30
Je I		Coothormal	TWh	0	2	4
ѿ		Geothermal Marine other	TWh TWh	0	0	0
		Marine, other Non-renewable generation	TWh	78	160	110
		Total district heat generation	PJ	0	0	0
	_	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	3 442	5 526	5 485
		Direct uses of renewable energy	PJ	1 774	2 611	2 866
	idustry	Solar thermal - Buildings	PJ	0	23	94
C 1		Solar thermal - Industry	PJ	0	0	163
Se	드	Geothermal	PJ	0	0	10
7	anc	Bioenergy (traditional) - Buildings	PJ	225	149	0
ē.	gs	Bioenergy (modern) - Buildings	PJ	108	102	154
<del>i</del>	Buildings and Industry	Bioenergy - Industry	PJ	1 441	2 337	2 445
Final energy use - direct uses $^{\mathrm{1}}$		Non-renewable - Buildings	PJ	316	432	432
ž		Non-renewable - Industry	PJ	1 352	2 483	2 187
<u></u>		Non-renewable - BF/CO	PJ	0	0	0
ne		Total fuel consumption	PJ	2 924	6 355	6 344
<u>e</u>	ť	Liquid biofuels	PJ	589	1 228	2 187
ij.	ansport	Conventional biogasoline	PJ	389	892	1 544
ш	ans	Advanced biogasoline Biodiesel (conventional and advanced)	PJ PJ	200	330	224 418
	Ĕ	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	2 335	5 128	4 157
Tota	l final energ	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	8 294	15 534	15 422
		re in electricity generation		85%	84%	89%
S		re in district heat generation		0%	0%	0%
RE shares		re in Buildings - final energy use, direct uses (mo	odern)	17%	18%	37%
s		re in Industry - final energy use, direct uses	•	52%	48%	54%
뿚	RE shar	re in Transport fuels		20%	19%	34%
	Share o	of modern RE in TFEC <sup>3</sup>		43%	42%	51%
Σ	System	costs [USD bln/yr in 2030]		N/A	N/A	- 11
at c	RE inve	estment needs [USD bln/yr (2010-2030)]		N/A	17	22
ig Si	Investn	nent support for renewables [USD bln/yr in 203	30]	N/A	N/A	3.0
Financial indicators	_	s from reduced externalities - air pollution (aver /yr in 2030]	age)	N/A	N/A	19.5
nanci	_	s from reduced externalities - $CO_2$ (USD 50/tonn/yr in 2030]	e CO2)	N/A	N/A	6.3
這	CO2 en	nissions from energy [Mt/yr]		347	690	564

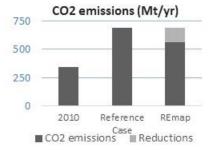
### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



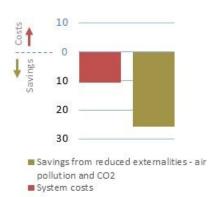
### Final RE use by sector (%) and total (PJ/yr)



RE heat and other direct uses (modern) RE power



### Costs and savings (USD bln in 2030)



- Plano Nacional de Energia 2050, Ministério de Minas e Energia. Empresa de Pesquisa Energética (2014).
- Plano Decenal de Energia 2024, Ministério de Minas e Energia. Empresa de Pesquisa Energética (2015).













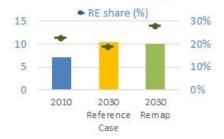




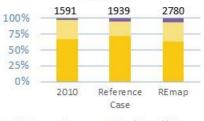
# **REmap Country Results - Canada**

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	129	166	187
		Renewable capacity	GW	81	113	147
		Hydropower (excl. pumped hydro)	GW	75	87	90
		Wind	GW	4	18	31
		Biofuels (solid, liquid, gaseous)	GW	2	4	12
		Solar PV	GW	0	5	13
<u>;;</u>	Power sector	CSP	GW	0	0	0
Sac		Geothermal	GW	0	0	1
<u> </u>		Marine, other	GW	0	0	0
٦		Non-renewable capacity	GW	48	53	40
Energy generation and capacity	۷ei	Total electricity generation	TWh	610	751	785
ĕ	Pov	Renewable generation	TWh	370	497	615
rat		Hydropower	TWh	351	432	447
ne		Wind	TWh	9	33	76
ge		Biofuels (solid, liquid, gaseous)	TWh	9	16	60
<b>№</b>		Solar PV	TWh	1	16	25
Je I		Coothormal	TWh	0	0	7
ѿ		Geothermal Marine, other	TWh TWh	0	0	0
		Non-renewable generation	TWh	240	254	170
		Total district heat generation	PJ	19	34	34
	_	Biofuels (solid, liquid, gaseous)	PJ	2	0	20
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	17	34	14
		Total direct uses of energy	PJ	2 770	5 171	5 114
		Direct uses of renewable energy	PJ	481	447	828
	stry	Solar thermal - Buildings	PJ	0	3	8
C 1	qui	Solar thermal - Industry	PJ	0	0	15
Se	드	Geothermal	PJ	0	3	3
7	anc	Bioenergy (traditional) - Buildings	PJ	0	0	0
ē.	gs	Bioenergy (modern) - Buildings	PJ	94	145	213
<del>i</del>	Buildings and Industry	Bioenergy - Industry	PJ	387	296	589
Final energy use - direct uses $^{\mathrm{1}}$		Non-renewable - Buildings	PJ	1 204	1 942	1 766
ž		Non-renewable - Industry	PJ	1 085	2 743	2 481
<u></u>		Non-renewable - BF/CO	PJ	0	39	39
ne		Total fuel consumption	PJ	2 449	2 762	2 331
<u>e</u>	ť	Liquid biofuels	PJ	52	99	195
ij.	od	Conventional biogasoline	PJ	42	62	94
ш	ansport	Advanced biogasoline Biodiesel (conventional and advanced)	PJ PJ	9	19 18	51 50
	F	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	2 398	2 663	2 135
Tota	l final energ	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	7 152	10 371	10 003
		re in electricity generation		61%	66%	78%
S		re in district heat generation		11%	0%	59%
RE shares		re in Buildings - final energy use, direct uses (mo	odern)	7%	7%	11%
s		re in Industry - final energy use, direct uses	•	26%	10%	20%
器	RE shar	re in Transport fuels		2%	4%	8%
	Share o	Share of modern RE in TFEC <sup>3</sup>			19%	28%
ร	System	costs [USD bln/yr in 2030]		N/A	N/A	6
ato .	RE inve	estment needs [USD bln/yr (2010-2030)]		N/A	6	11
Sign	Investn	nent support for renewables [USD bln/yr in 203	80]	N/A	N/A	5.1
Financial indicators	[USD bln/	s from reduced externalities - air pollution (aver /yr in 2030]		N/A	N/A	14.7
nanci	[USD bln/	s from reduced externalities - CO2 (USD 50/tonn /yr in 2030]	e CO2)	N/A	N/A	5.2
证	CO2 en	nissions from energy [Mt/yr]		448	593	489

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

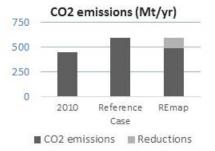


# Final RE use by sector (%) and total (PJ/yr)

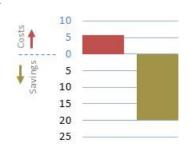


■ RE transport ■ Traditional biomass

■ RE power



### Costs and savings (USD bln in 2030)



 Savings from reduced externalities - air pollution and CO2
 System costs

- References for further consultation:
- Canada's Energy Future 2016: Energy Supply and Demand Projections to 2040, NEB (2016).
- Report on Energy Supply and Demand in Canada, Government of Canada (2016).













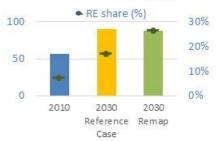




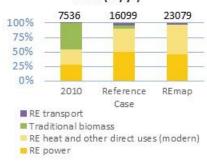
# **REmap Country Results - China**

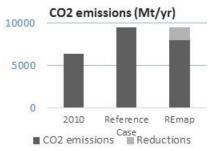
Total installed power generation capacity   GW   998   2 467   275					2010	Reference	REmap
Renewable capacity				Unit		Case 2030	2030
Hydropower (excl. pumped hydro)   GW   213   400   400   400   400   401   401   402   401   402   401   402   402   400   402   400   402   400   402   400   402   400   402   4							2 731
Wind   GW   45   315   56							1 484
Biofuels (solid, liquid, gaseous)   GW   6   38   67							400
Solar PV   GW   2   300   42							562
CSP   GW   0							67
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   565   10   10   10   10   10   10   10   1	>						422
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   565   10   10   10   10   10   10   10   1	cit						31
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   565   1   1   1   1   1   1   1   1   1	ba	Έ					1
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   565   1   1   1   1   1   1   1   1   1	ä	ğ					0
Marine, other   TWh   0   0   0   0   0   0   0   0   0	פר	. Se		GW			1 248
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   566   10   10   10   10   10   10   10	ā	Ver	Total electricity generation	TWh	4 234	9 315	9 466
Marine, other   TWh   0   0   0   0   0   0   0   0   0	Ö	Q	Renewable generation			2 891	3 809
Marine, other   TWh   0   0   0   0   0   0   0   0   0	ati	_	Hydropower	TWh	722	1 600	1 600
Marine, other   TWh   0   0   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   5 65   1   1   1   1   1   1   1   1   1	ĕ		Wind	TWh	45	648	1 200
Marine, other   TWh   0   0   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   5 65   1   1   1   1   1   1   1   1   1	Ser		Biofuels (solid, liquid, gaseous)	TWh	33	192	358
Marine, other   TWh   0   0   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   5 65   1   1   1   1   1   1   1   1   1	~~ ~		Solar PV	TWh	1	425	595
Marine, other   TWh   0   0   0   0   0   0   Non-renewable generation   TWh   3 433   6 424   5 65   1   1   1   1   1   1   1   1   1	erg		CSP	TWh	0	18	46
Non-renewable generation   TWh   3 433   6 424   5 65	Ë		Geothermal	TWh	1	9	9
Total district heat generation			Marine, other	TWh	0	0	0
Biofuels (solid, liquid, gaseous)			Non-renewable generation	TWh	3 433	6 424	5 657
Other renewables			Total district heat generation	PJ	2 934	3 530	3 530
Non-renewable DH		I	Biofuels (solid, liquid, gaseous)	PJ	34	41	1 401
Total direct uses of energy		۵	Other renewables	PJ	0	0	0
Direct uses of renewable energy   PJ   5 310   7 236   10 2			Non-renewable DH	PJ	2 900	3 489	2 129
Solar thermal - Buildings			Total direct uses of energy	PJ	36 167	43 488	41 758
Non-renewable - Industry   PJ   19 743   24 135   21 8     Non-renewable - BF/CO   PJ   5 231   6 035   6 03     Total fuel consumption   PJ   7 226   17 372   16 4     Liquid biofuels   PJ   51   751   75     Conventional biogasoline   PJ   32   516   51     Advanced biogasoline   PJ   0   2   2     Biodiesel (conventional and advanced)   PJ   18   233   23     Biomethane   PJ   0   0   0   0     Non-renewable fuels   PJ   7 175   16 622   15 6     Total final energy consumption (electricity, DH, direct uses)   PJ   7 175   16 622   15 6     RE share in electricity generation   19%   31%   409     RE share in Buildings - final energy use, direct uses (modern)   16%   44%   679     RE share in Industry - final energy use, direct uses (modern)   16%   44%   679     RE share in Transport fuels   1%   4%   59     Share of modern RE in TFEC 3   7%   17%   269			Direct uses of renewable energy	PJ	5 310	7 236	10 258
Non-renewable - Industry		St.	Solar thermal - Buildings	PJ	860	2 674	3 244
Non-renewable - Industry	S 1	ä		PJ	0	84	1 219
Non-renewable - Industry	Se	드	Geothermal	PJ	150	301	446
Non-renewable - Industry	t T	2	Bioenergy (traditional) - Buildings	PJ	3 400	891	0
Non-renewable - Industry	ec .ec	SS		PJ	793	2 407	3 632
Non-renewable - Industry	ġ	Buildin					1 717
Non-renewable - Industry	(I)			PJ	5 883	6 083	3 593
Biodiesel (conventional and advanced)   PJ   18   233   23   23   23   23   23   23	nse						21 872
Biodiesel (conventional and advanced)   PJ   18   233   23   23   23   23   23   23	>>						6 035
Biodiesel (conventional and advanced)   PJ   18   233   23   23   23   23   23   23	erg						16 409
Biodiesel (conventional and advanced)   PJ   18   233   23   23   23   23   23   23	en						751
Biodiesel (conventional and advanced)   PJ   18   233   23   23   23   23   23   23	a	ort		PJ			516
Biodiesel (conventional and advanced)   PJ   18   233   23   23   23   23   23   23	뜶	gs					2
Biomethane PJ 0 0 0 0 0 Non-renewable fuels PJ 7 175 16 622 15 6 15 6 16 622 15 6 6 15 6 16 622 15 6 6 16 622 15 6 6 16 622 15		ran		PJ	18	233	233
Total final energy consumption (electricity, DH, direct uses) <sup>2</sup> PJ 57 156 90 172 88 2  RE share in electricity generation 19% 31% 409  RE share in district heat generation 1% 1% 409  RE share in Buildings - final energy use, direct uses (modern) 16% 44% 679  RE share in Industry - final energy use, direct uses 1% 4% 129  RE share in Transport fuels 1% 4% 5%  Share of modern RE in TFEC <sup>3</sup> 7% 17% 269		F	Biomethane	PJ	0	0	0
RE share in electricity generation 19% 31% 409 RE share in district heat generation 1% 1% 409 RE share in Buildings - final energy use, direct uses (modern) 16% 44% 679 RE share in Industry - final energy use, direct uses 1% 4% 129 RE share in Transport fuels 1% 4% 5% Share of modern RE in TFEC 3 7% 17% 269			Non-renewable fuels	PJ	7 175	16 622	15 658
RE share in district heat generation 1% 1% 409 RE share in Buildings - final energy use, direct uses (modern) 16% 44% 679 RE share in Industry - final energy use, direct uses 1% 4% 129 RE share in Transport fuels 1% 4% 5% Share of modern RE in TFEC 3 7% 17% 269	Tota	l final energ	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	57 156	90 172	88 213
RE share in district heat generation 1% 1% 409 RE share in Buildings - final energy use, direct uses (modern) 16% 44% 679 RE share in Industry - final energy use, direct uses 1% 4% 129 RE share in Transport fuels 1% 4% 5% Share of modern RE in TFEC 3 7% 17% 269							40%
Share of modern RE in TFEC <sup>3</sup> 7% 17% 269	S		, 5				40%
Share of modern RE in TFEC <sup>3</sup> 7% 17% 269	are			odern)	16%	44%	67%
Share of modern RE in TFEC <sup>3</sup> 7% 17% 269	sh		5, ,	,			12%
Share of modern RE in TFEC <sup>3</sup> 7% 17% 269	<b>H</b>						5%
<del></del>			•				26%
System costs [USD bln/yr in 2030] N/A N/A 46	γ				N/A	N/A	46
RE investment needs [USD bln/yr (2010-2030)] N/A 105 16	to						160
Investment support for renewables [USD bln/yr in 2030]  N/A  N/A  103  16  16  16  17  105  16  17  105  105  105  105  105  105  105	Ca			RO1			56.4
Savings from reduced externalities - air pollution (average)	ibr			-	IV/A	IV/A	30.4
[USD bln/yr in 2030] N/A N/A 116	ial ir	[USD bln/	/yr in 2030]	· .	N/A	N/A	116.1
Savings from reduced externalities - $CO_2$ (USD 50/tonne CO2) N/A N/A 74. [USD bln/yr in 2030]	Financial indicators			e CO2)	N/A	N/A	74.4
CO2 emissions from energy [Mt/yr] 6 394 9 499 8 03	进	CO2 en	nissions from energy [Mt/yr]		6 394	9 499	8 010

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

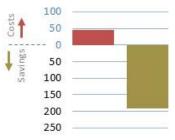


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

### References for further consultation:

- World Energy Outlook 2012 & 2015, IEA (2012; 2015).

















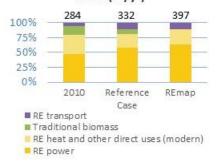
# **REmap Country Results - Colombia**

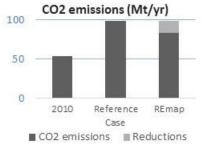
Total installed power generation capacity   GW   9   16   22				Unit	2010	Reference Case 2030	REmap 2030
Renewable capacity			Total installed power generation capacity		13		
Hydropower (excl. pumped hydro)   GW   9   15   17				GW			
Wind   GW   O   1   3   3   3   3   3   4   4   4   4   5   5   4   4   5   5				GW	9	15	17
Solar PV				GW	0	1	3
Solar PV			Biofuels (solid, liquid, gaseous)	GW	0	0	1
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23   23   23   24   25   24   25   28   24   25   28   28   27   25   28   28   28   28   28   28   28				GW	0	0	2
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23   23   23   24   25   24   25   28   24   25   28   28   27   25   28   28   28   28   28   28   28	<u>₹</u> .		CSP	GW	0	0	0
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23   23   23   24   25   24   25   28   24   25   28   28   27   25   28   28   28   28   28   28   28	aci		Geothermal	GW	0	0	0
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23   23   23   24   25   24   25   28   24   25   28   28   27   25   28   28   28   28   28   28   28	ä	Ę	Marine, other	GW	0	0	0
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23   23   23   24   25   24   25   28   24   25   28   28   27   25   28   28   28   28   28   28   28	ğ	sec	Non-renewable capacity	GW	3	6	4
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23   23   23   24   25   24   25   28   24   25   28   28   27   25   28   28   28   28   28   28   28	a	er	Total electricity generation	TWh	56	98	103
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23	<u> </u>	Pow	Renewable generation	TWh	41	63	80
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23	aţi		Hydropower	TWh	40	58	66
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23	ē		Wind	TWh	0	1	6
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23	e .		Biofuels (solid, liquid, gaseous)	TWh	1	2	3
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23	‱ ≥		Solar PV	TWh	0	0	4
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23	9		CSP	TWh	0	0	0
Marine, other   TWh   0   0   0   Non-renewable generation   TWh   15   35   23   23	Ë		Geothermal	TWh	0	2	3
Total district heat generation			Marine, other	TWh	0	0	0
Biofuels (solid, liquid, gaseous)			Non-renewable generation	TWh	15	35	23
Other renewables			Total district heat generation	PJ	0	0	0
Non-renewable DH		Į.	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
Total direct uses of energy		Δ	Other renewables	PJ	0	0	0
Direct uses of renewable energy   PJ   133   104   101			Non-renewable DH	PJ	0	0	0
Solar thermal - Buildings			Total direct uses of energy	PJ	438	530	511
Non-renewable - Industry		>	Direct uses of renewable energy	PJ	133	104	101
Non-renewable - Industry		ndustr	Solar thermal - Buildings	PJ	0	0	0
Non-renewable - Industry	S		Solar thermal - Industry	PJ	0	0	4
Non-renewable - Industry	Se	=	Geothermal	PJ	0	0	0
Non-renewable - Industry	ŧ	au	Bioenergy (traditional) - Buildings	PJ	39	28	0
Non-renewable - Industry	ē	gs	Bioenergy (modern) - Buildings	PJ	39	28	36
Non-renewable - Industry	<del>_</del> <del>_</del> <del>_</del> <del>_</del> <del>_</del> <del>_</del>	uildin	Bioenergy - Industry	PJ	55	48	61
Non-renewable - Industry	မွ		Non-renewable - Buildings	PJ	92	136	136
Biodiesel (conventional and advanced)	ž		Non-renewable - Industry	PJ	200	271	256
Biodiesel (conventional and advanced)	<u></u>		Non-renewable - BF/CO	PJ	13	18	18
Biodiesel (conventional and advanced)	ne		······································		364		
Biodiesel (conventional and advanced)	<u> </u>	끹.					
Biodiesel (conventional and advanced)	<u> </u>	od .					
Biomethane PJ 0 0 0 0 Non-renewable fuels PJ 347 685 614  Total final energy consumption (electricity, DH, direct uses) PJ 984 1551 1495  RE share in electricity generation 74% 64% 78% RE share in district heat generation 0% 0% 0% 0% RE share in Buildings - final energy use, direct uses (modern) 23% 15% 21% RE share in Industry - final energy use, direct uses 21% 15% 20% RE share in Transport fuels 5% 5% 5% 7% Share of modern RE in TFEC 3 25% 20% 27%	ш	SUE.					
Non-renewable fuels PJ 347 685 614  Total final energy consumption (electricity, DH, direct uses) 2 PJ 984 1 551 1 495  RE share in electricity generation 74% 64% 78%  RE share in district heat generation 0% 0% 0%  RE share in Buildings - final energy use, direct uses (modern) 23% 15% 21%  RE share in Industry - final energy use, direct uses 21% 15% 20%  RE share in Transport fuels 5% 5% 7%  Share of modern RE in TFEC 3 25% 20% 27%							
RE share in electricity generation RE share in district heat generation RE share in Buildings - final energy use, direct uses (modern) RE share in Industry - final energy use, direct uses RE share in Transport fuels Share of modern RE in TFEC 3  PJ 984 1551 1495 PJ 984 1551 149							
RE share in electricity generation 74% 64% 78% RE share in district heat generation 0% 0% 0% RE share in Buildings - final energy use, direct uses (modern) 23% 15% 21% RE share in Industry - final energy use, direct uses 21% 15% 20% RE share in Transport fuels 5% 5% 7% Share of modern RE in TFEC 3 25% 20% 27%	Tota	final o					
RE share in district heat generation 0% 0% 0%  RE share in Buildings - final energy use, direct uses (modern) 23% 15% 21%  RE share in Industry - final energy use, direct uses 21% 15% 20%  RE share in Transport fuels 5% 5% 7%  Share of modern RE in TFEC 3 25% 20% 27%	TOLA			PJ			
RE share in Buildings - final energy use, direct uses (modern)  RE share in Industry - final energy use, direct uses  RE share in Transport fuels  Share of modern RE in TFEC 3	S		, 5				
Share of modern RE in TFEC <sup>3</sup> 25% 20% 27%	ar e			dorn			
Share of modern RE in TFEC <sup>3</sup> 25% 20% 27%	she			uem)			
Share of modern RE in TFEC <sup>3</sup> 25% 20% 27%	ű						
			•				
RE investment needs [USD bln/yr (2010-2030)] N/A 1 2 Investment support for renewables [USD bln/yr in 2030] N/A N/A 1.3 Savings from reduced externalities - air pollution (average) N/A N/A 1.6 [USD bln/yr in 2030] Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) N/A N/A 0.7 [USD bln/yr in 2030] CO2 emissions from energy [Mt/yr] 54 98 84	S						
Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from energy [Mt/yr]  Savings from energy [Mt/yr]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from energy [Mt/yr]  Savings from energy [Mt/yr]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]	io						
Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030] Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO <sub>2</sub> ) [USD bln/yr in 2030] CO <sub>2</sub> emissions from energy [Mt/yr]  N/A  N/A  1.6  N/A  N/A  N/A  0.7	ca			01			
[USD bln/yr in 2030] Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030] CO2 emissions from energy [Mt/yr]  N/A  N/A  1.6  N/A  N/A  N/A  0.7	ibr						
Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO <sub>2</sub> )  N/A  N/A  N/A  0.7  CO <sub>2</sub> emissions from energy [Mt/yr]  54  98  84	iali	[USD	bln/yr in 2030]		N/A	N/A	1.6
CO2 emissions from energy [Mt/yr] 54 98 84	nanc		, , , ,	e CO2)	N/A	N/A	0.7
	证	со	2 emissions from energy [Mt/yr]		54	98	84

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

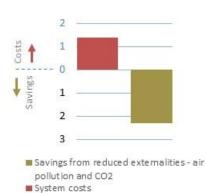


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Plan de Expansion de Referencia Generacion Transmision 2014-2028, UPME (2013).
- Integración de las energías renovables no convencionales en Colombia, UPME (2015).

















# **REmap Country Results - Cyprus**

						- /	
				2010	Reference	REmap	
			Unit	2010	Case 2030	2030	
		Total installed power generation capacity	GW	1.7	2.0	2.7	5 737 893 804 10 10 10 10
		Renewable capacity	GW	0.2	0.9	1.7	TFEC (EJ/yr) (left) and share of
		Hydropower (excl. pumped hydro)	GW	0.0	0.0	0.0	modern RE in TFEC (%) (right)
		Wind	GW	0.1	0.3	0.3	
		Biofuels (solid, liquid, gaseous)	GW	0.0	0.0	0.0	0.10 • RE share (%)
		Solar PV	GW	0.0	0.6	1.3	
₹		CSP	GW	0.0	0.1	0.1	20%
Energy generation and capacity		Geothermal	GW	0.0	0.0	0.0	0.05
<u>8</u>	Ď	Marine, other	GW	0.0	0.0	0.0	10%
3	ect	Non-renewable capacity	GW	1.5	1.1	0.9	
Ĕ	S T		TWh	4.9	6.1	6.6	0.00 0%
 _	Power sector	Total electricity generation	TWh	0.1		3.0	2010 2030 2030 Reference Remap
.00	Ъ.	Renewable generation			1.6		Reference Remap Case
<u> 5</u>		Hydropower	TWh	0.0	0.0	0.0	. Case
ne		Wind	TWh	0.0	0.4	0.5	
ge		Biofuels (solid, liquid, gaseous)	TWh	0.0	0.1	0.1	Final RE use by sector (%) and
≥		Solar PV	TWh	0.0	0.9	2.2	
ē		CSP	TWh	0.0	0.2	0.2	total (PJ/yr)
ᇤ		Geothermal	TWh	0.0	0.0	0.0	4 16 22
		Marine, other	TWh	0.0	0.0	0.0	100%
		Non-renewable generation	TWh	4.8	4.5	3.7	75%
		Total district heat generation	PJ	0.0	0.0	0.0	50% — — — — —
	I	Biofuels (solid, liquid, gaseous)	PJ	0.0	0.0	0.0	25%
	H	Other renewables	PJ	0.0	0.0	0.0	0%
		Non-renewable DH	PJ	0.0	0.0	0.0	2010 Reference REmap
		Total direct uses of energy	PJ	19.6	16.5	16.3	Case
		Direct uses of renewable energy	PJ	3.3	5.8	6.4	■ RE transport ■ Traditional biomass
	<u>.</u>	Solar thermal - Buildings	PJ	2.6	3.6	4.0	
₩.	Sing	Solar thermal - Industry	PJ	0.0	0.1	0.2	RE power
Ses	Buildings and Industry	Geothermal	PJ	0.0	0.1	0.1	
Š	힏	Bioenergy (traditional) - Buildings	PJ	0.0	0.0	0.0	
o Ct	S	Bioenergy (modern) - Buildings	PJ	0.3	1.0	1.0	CO2 emissions (Mt/yr)
Ë	ii.	Bioenergy - Industry	PJ	0.5	1.1	1.1	10
ĭ	흗	Non-renewable - Buildings	PJ	7.0	6.6	6.2	
se	Bu						5
<u> </u>		Non-renewable - Industry	PJ	9.3	4.0	3.7	. 3
Final energy use - direct uses $^{\mathrm{1}}$		Non-renewable - BF/CO	PJ	0.0	0.0	0.0	
ñ.		Total fuel consumption	PJ	43.7	51.3	46.0	0
<u>e</u>	t	Liquid biofuels	PJ	0.6	5.2	5.2	2010 Reference REmap
.⊑	nsport	Conventional biogasoline	PJ	0.2	1.7	1.7	Case
ш	Sur	Advanced biogasoline	PJ	0.0	0.5	0.5	■ CO2 emissions ■ Reductions
	Traı	Biodiesel (conventional and advanced)	PJ	0.5	3.0	3.0	
		Biomethane	PJ	0.0	0.0	0.0	
	<b>6</b>	Non-renewable fuels	PJ	43.1	46.1	40.9	Costs and savings (USD bln in 2030)
Iotal		y consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	81	88	85	r
		re in electricity generation		1%	26%	45%	0.10
RE shares		re in district heat generation		0%	0%	0%	0.10
<u>P</u>		re in Buildings - final energy use, direct uses (mo	odern)	29%	42%	45%	n 0.05
<u> </u>		re in Industry - final energy use, direct uses		5%	22%	26%	0.05
~		re in Transport fuels		1%	10%	11%	0.00
		of modern RE in TFEC <sup>3</sup>		5%	19%	26%	0.05 ————
rs	System	System costs [USD bln/yr in 2030]			N/A	0.05	♦ 0.05
t t	RE inve	estment needs [USD bln/yr (2010-2030)]		N/A	0.00	0.00	0.10
<u>:23</u>	Investr	nent support for renewables [USD bln/yr in 203	30]	N/A	N/A	0.04	5125
<u>pu</u>		s from reduced externalities - air pollution (aver		A1/A		0.10	0.15
<u></u>	[USD bln/	/yr in 2030]		N/A	N/A	0.10	20 32 82.0 1625
<u>Si</u>	Savings	s from reduced externalities - CO <sub>2</sub> (USD 50/tonn	ie CO2)	A1/A	N//A	0.04	Savings from reduced externalities - air
Financial indicators		/yr in 2030]		N/A	N/A	0.04	pollution and CO2
造	CO2 er	nissions from energy [Mt/yr]		9	6	5	System costs

- Renewable Energy Roadmap for the Republic of Cyprus, IRENA (2015).
- National Renewable Energy Action Plan (NREAP), Republic of Cyprus submitted to EC (2013).

















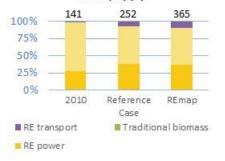
# **REmap Country Results - Denmark**

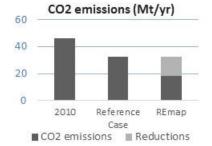
Total installed power generation capacity   GW   14   19   22				Unit	2010	Reference Case 2030	REmap 2030
Renewable capacity   GW   5			Total installed power generation capacity		14		
Hydropower (excl. pumped hydro)   GW   0   0   0							
Wind   Biofuels (solid, liquid, gaseous)   GW   1   2   3   3   3   3   3   3   3   3   3							
Biofuels (solid, liquid, gaseous)   GW   1   2   3							
Solar PV					1	2	3
CSP   GW   0   0   0   0   0   0   0   0   0					0	3	
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	₹						
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	aci	sector	Geothermal	GW	0	0	0
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	a D		Marine, other	GW	0	0	0
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	b		Non-renewable capacity	GW	9	6	5
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	an	ē		TWh	39	39	49
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   101   101   115	Ę	<b>§</b>	Renewable generation	TWh	13	29	43
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	ij	_	Hydropower	TWh	0	0	0
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	er		Wind	TWh	8	20	30
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   101   101   115	e.		Biofuels (solid, liquid, gaseous)	TWh	5	7	11
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	> >		Solar PV	TWh	0	2	2
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   101   101   115	<u>8</u>		CSP	TWh	0	0	0
Marine, other   TWh   0   0   0   0   Non-renewable generation   TWh   26   10   7   7   145   115	Ë		Geothermal	TWh	0	0	0
Total district heat generation			Marine, other	TWh	0	0	0
Biofuels (solid, liquid, gaseous)			Non-renewable generation	TWh	26	10	7
Other renewables			Total district heat generation	PJ	145	125	115
Non-renewable DH		I	Biofuels (solid, liquid, gaseous)	PJ	60	63	101
Total direct uses of energy   PJ   193   168   119		ቯ	Other renewables	PJ	0	1	11
Direct uses of renewable energy   PJ   54   82   94			Non-renewable DH	PJ	85	61	3
Solar thermal - Buildings			Total direct uses of energy	PJ	193	168	119
Non-renewable - Industry			Direct uses of renewable energy	PJ	54	82	94
Non-renewable - Industry		stry	Solar thermal - Buildings	PJ	1	1	1
Non-renewable - Industry	S 1	ą	Solar thermal - Industry	PJ	0	0	0
Non-renewable - Industry	Se	들	Geothermal	PJ	0	0	3
Non-renewable - Industry	t	anc	Bioenergy (traditional) - Buildings	PJ	0	0	0
Non-renewable - Industry	ē	Buildings	Bioenergy (modern) - Buildings	PJ	40	53	53
Non-renewable - Industry	ᇹ		Bioenergy - Industry	PJ	13	29	38
Non-renewable - Industry	بي		Non-renewable - Buildings	PJ	59	33	11
Biodiesel (conventional and advanced)   PJ   0   0   0   0	ns		Non-renewable - Industry	PJ	80	53	14
Biodiesel (conventional and advanced)   PJ   0   0   0   0	<u>ھ</u>		Non-renewable - BF/CO	PJ	0	0	0
Biodiesel (conventional and advanced)   PJ   0   0   0   0	ne		Total fuel consumption	PJ	207	243	216
Biodiesel (conventional and advanced)   PJ   0   0   0   0	<u>e</u>	. ب					
Biodiesel (conventional and advanced)   PJ   0   0   0   0	na	lod	<del>-</del>				
Biomethane PJ 0 0 0 0 0 0 Non-renewable fuels PJ 206 224 182  Total final energy consumption (electricity, DH, direct uses) PJ 647 664 614  RE share in electricity generation 34% 74% 86% RE share in district heat generation 42% 51% 97% RE share in Buildings - final energy use, direct uses (modern) 41% 62% 83% RE share in Industry - final energy use, direct uses 14% 35% 73% RE share in Transport fuels 14% 8% 16% Share of modern RE in TFEC 3 22% 38% 60%	证	sus					
Non-renewable fuels PJ 206 224 182  Total final energy consumption (electricity, DH, direct uses) 2 PJ 647 664 614  RE share in electricity generation 34% 74% 86%  RE share in district heat generation 42% 51% 97%  RE share in Buildings - final energy use, direct uses (modern) 41% 62% 83%  RE share in Industry - final energy use, direct uses 14% 35% 73%  RE share in Transport fuels 1% 8% 16%  Share of modern RE in TFEC 3 22% 38% 60%							
Total final energy consumption (electricity, DH, direct uses) <sup>2</sup> PJ 647 664 614  RE share in electricity generation 34% 74% 86%  RE share in district heat generation 42% 51% 97%  RE share in Buildings - final energy use, direct uses (modern) 41% 62% 83%  RE share in Industry - final energy use, direct uses 14% 35% 73%  RE share in Transport fuels 1% 8% 16%  Share of modern RE in TFEC <sup>3</sup> 22% 38% 60%							
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RE share in district heat generation 42% 51% 97% RE share in Buildings - final energy use, direct uses (modern) 41% 62% 83% RE share in Industry - final energy use, direct uses 14% 35% 73% RE share in Transport fuels 1% 8% 16% Share of modern RE in TFEC 3 22% 38% 60%	iotal			73			
Share of modern RE in TFEC <sup>3</sup> 22% 38% 60%	S		, 5				
Share of modern RE in TFEC <sup>3</sup> 22% 38% 60%	ē			odorn)			
Share of modern RE in TFEC <sup>3</sup> 22% 38% 60%	she		0, 1	Jueili)			
Share of modern RE in TFEC <sup>3</sup> 22% 38% 60%	Ä						
			•				
RE investment needs [USD bln/yr (2010-2030)] N/A 1 2 Investment support for renewables [USD bln/yr in 2030] N/A N/A 1.0 Savings from reduced externalities - air pollution (average)	S						
Investment support for renewables [USD bln/yr in 2030] N/A N/A 1.0  Savings from reduced externalities - air pollution (average)	ţ	1					
Savings from reduced externalities - air pollution (average)	g			กา			
= Savings nonneaded externances - an pondulon (average) N/A N/A 2.2	ibí			-	<del>.</del>	IV/A	1.0
[USD bln/yr in 2030]	. <u>=</u>	_		age)	N/A	N/A	2.2
Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO <sub>2</sub> )	cia		•	e CO2)			
[USD bln/yr in 2030]	an	_		552)	N/A	N/A	0.7
CO2 emissions from energy [Mt/yr] 46 33 18	Ë	-	•		46	33	18

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

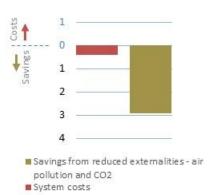


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- National Renewable Energy Action Plan (NREAP), Denmark submitted to EC (2013).
- Danish Energy Outlook, Energi Styrelsen (2011).
- Accelerating Green Energy Towards 2020, Danish Energy Agreement (2012).

















# **REmap Country Results – Dominican Republic**

					Reference	REmap
			Unit	2010	Case 2030	2030
		Total installed power generation capacity	GW	5	7	9
		Renewable capacity	GW	1	1	5
		Hydropower (excl. pumped hydro)	GW	1	1	1
		Wind	GW	0	0	3
		Biofuels (solid, liquid, gaseous)	GW	0	0	0
		Solar PV	GW	0	0	1
i₹		CSP	GW	0	0	0
Energy generation and capacity	_ ا	Geothermal	GW	0	0	0
Сар	Power sector	Marine, other	GW	0	0	0
ğ	Sec	Non-renewable capacity	GW	4	6	4
a	/er	Total electricity generation	TWh	14	30	30
o	ò	Renewable generation	TWh	2	3	11
ati	ъ.	Hydropower	TWh	2	2	2
ē		Wind	TWh	0	1	5
3e.		Biofuels (solid, liquid, gaseous)	TWh	0	0	2
≥ ≥		Solar PV	TWh	0	0	2
erg		CSP	TWh	0	0	0
E		Geothermal	TWh	0	0	0
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	12	27	19
		Total district heat generation	PJ	0	0	0
	품	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
		Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	76	93	85
	>	Direct uses of renewable energy	PJ	31	28	24
	ıstr	Solar thermal - Buildings	PJ	0	1	1
S 1	ρ J	Solar thermal - Industry	PJ	0	0	1
use	<del>-</del>	Geothermal	PJ	0	0	0
t	an	Bioenergy (traditional) - Buildings	PJ	18	10	0
i.	Buildings and Industry	Bioenergy (modern) - Buildings	PJ	3	3	7
<b>b</b> -		Bioenergy - Industry	PJ	9	13	15
Final energy use - direct uses <sup>1</sup>		Non-renewable - Buildings	PJ	25	36	35
ä		Non-renewable - Industry	PJ	20	29	26
<u></u>		Non-renewable - BF/CO	PJ	0	0	0
ne		Total fuel consumption	PJ	96	135	132
<u>e</u>	4	Liquid biofuels	PJ	0	1	5
ina	insport	Conventional biogasoline	PJ	0	1	1
ш	ans	Advanced biogasoline	PJ	0	0	0
	Tra	Biodiesel (conventional and advanced) Biomethane	PJ PJ	0	0	0
		Non-renewable fuels	PJ	95	134	126
Total	final energ	y consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	221	322	311
Total		e in electricity generation		13%	9%	37%
S		e in district heat generation		0%	0%	0%
RE shares		e in Buildings - final energy use, direct uses (mo	ndern)	7%	9%	19%
sh		e in Industry - final energy use, direct uses	, ,	32%	30%	38%
A.		e in Transport fuels		0%	1%	4%
		of modern RE in TFEC <sup>3</sup>		9%	8%	21%
δ		costs [USD bln/yr in 2030]		N/A	N/A	- 1
ţo		stment needs [USD bln/yr (2010-2030)]		N/A	0.1	0.4
<u>:</u>		nent support for renewables [USD bln/yr in 203	801	N/A	N/A	0.03
pu		from reduced externalities - air pollution (avera				
<u></u>	_	yr in 2030]	<i>5</i> ,	N/A	N/A	1.8
Financial indicators	_	from reduced externalities - CO <sub>2</sub> (USD 50/tonn	e CO2)	N1/A	N1/A	0.4
าลเ		yr in 2030]		N/A	N/A	0.4
這	CO2 en	nissions from energy [Mt/yr]		20	36	29

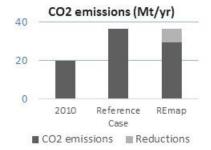
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



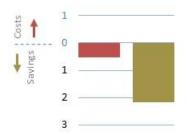
# Final RE use by sector (%) and total (PJ/yr)



■ RE transport
■ Traditional biomass
■ RE heat and other direct uses (modern)
■ RE power



### Costs and savings (USD bln in 2030)



Savings from reduced externalities - air pollution and CO2

- References for further consultation:
- Prospectiva demanda de la República Dominicana CNE (forthcomnig).
- Harnessing the Dominican Republic's Sustainable Energy Resources, WorldWatch Institute (2015).





System costs













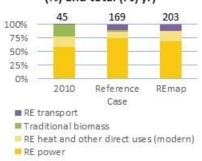
# **REmap Country Results – Ecuador**

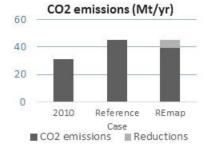
			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	5	14	14
		Renewable capacity	GW	2	10	11
		Hydropower (excl. pumped hydro)	GW	2	9	9
		Wind	GW	0	0	1
		Biofuels (solid, liquid, gaseous)	GW	0	0	0
		Solar PV	GW	0	0	1
<u>₹</u> .		CSP	GW	0	0	0
aci		Geothermal	GW	0	0	0
g	Ę	Marine, other	GW	0	0	0
b	sec	Non-renewable capacity	GW	3	4	3
an	Power sector	Total electricity generation	TWh	20	60	60
5	ŏ	Renewable generation	TWh	9	43	48
ij	_	Hydropower	TWh	9	42	44
er		Wind	TWh	0	1	2
Ę.		Biofuels (solid, liquid, gaseous)	TWh	0	0	1
Energy generation and capacity		Solar PV	TWh	0	1	1
50		CSP	TWh	0	0	0
Ë		Geothermal	TWh	0	0	1
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	11	17	12
		Total district heat generation	PJ	0	0	0
	Ŧ	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	ద	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	113	158	153
	>	Direct uses of renewable energy	PJ	19	26	39
	str	Solar thermal - Buildings	PJ	0	0	1
Final energy use - direct uses <sup>11</sup>	p	Solar thermal - Industry	PJ	0	0	5
ses	드	Geothermal	PJ	0	0	0
Š	anc	Bioenergy (traditional) - Buildings	PJ	10	7	0
ect	gs	Bioenergy (modern) - Buildings	PJ	0	7	9
흗	Buildings and Industry	Bioenergy - Industry	PJ	9	12	24
d)		Non-renewable - Buildings	PJ	43	60	59
nso		Non-renewable - Industry	PJ	51	72	55
≥0		Non-renewable - BF/CO	PJ	0	0	0
erg		Total fuel consumption	PJ	209	309	298
e	ų	Liquid biofuels	PJ	0	17	24
lal	oc	Conventional biogasoline	PJ	0	17	21
造	ansport	Advanced biogasoline	PJ	0	0	0
	Tra	Biodiesel (conventional and advanced)	PJ	0	0	2
		Biomethane	PJ	0	0	0
	6: 1	Non-renewable fuels	PJ	209	292	275
Total		gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	383	647	632
10		re in electricity generation		45%	72%	80%
ě		re in district heat generation	,	0%	0%	0%
RE shares		re in Buildings - final energy use, direct uses (mod	ern)	0%	9%	15%
ЕS		re in Industry - final energy use, direct uses		15%	15%	34%
~		re in Transport fuels		0%	5%	8%
10		of modern RE in TFEC <sup>3</sup>		9%	25%	32%
ors	_	costs [USD bln/yr in 2030]		N/A	N/A	- 1
at		estment needs [USD bln/yr (2010-2030)]		N/A	1	1
dic		ment support for renewables [USD bln/yr in 2030]		N/A	N/A	0.0
Financial indicators	_	s from reduced externalities - air pollution (averag /yr in 2030]	(e)	N/A	N/A	0.8
cia	_	s from reduced externalities - CO <sub>2</sub> (USD 50/tonne	CO2)			
an	_	/yr in 2030]	(02)	N/A	N/A	0.3
Fi		nissions from energy [Mt/yr]		31	45	39
	202 61					

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

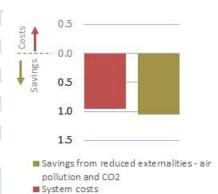


# Final RE consumption by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Plan Nacional para el buen vivir 2013-2017, Tomo I, Consejo Nacional de Planificación (2013).
- Plan Maestro de Electrificación (PME) 2013-2022, CONELEC (2013).
- Evaluación Rápida y Análisis de Brechas del Sector Energético, Roberto Gomelsky (2013).

















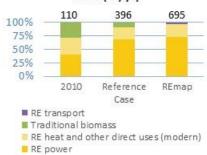
# REmap Country Results – Egypt

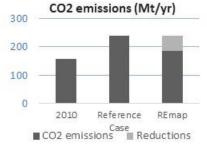
				2010	Reference	REmap
			Unit		Case 2030	2030
		Total installed power generation capacity	GW	25	56	78
		Renewable capacity	GW	3	25	59
		Hydropower (excl. pumped hydro)	GW	3	2	2
		Wind	GW	1	20	21
		Biofuels (solid, liquid, gaseous)	GW	0	0	1
		Solar PV	GW	0	1	21
Ë		CSP	GW	0	3	14
Эaс	Power sector	Geothermal	GW	0	0	0
g		Marine, other	GW	0	0	0
ō	Šē	Non-renewable capacity	GW	21	31	19
au	/er	Total electricity generation	TWh	147	285	289
o	ŏ	Renewable generation	TWh	15	86	158
aţi	_	Hydropower	TWh	13	9	9
er		Wind	TWh	1	69	71
Energy generation and capacity		Biofuels (solid, liquid, gaseous)	TWh	0	0	3
		Solar PV	TWh	0	1	37
ğ		CSP	TWh	0	7	38
ine.		Geothermal	TWh	0	0	0
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	132	199	131
		Total district heat generation	PJ	0	0	0
	_	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	777	1 061	981
		Direct uses of renewable energy	PJ	65	126	166
	Ę	Solar thermal - Buildings	PJ	0	4	9
1 1	Ins	Solar thermal - Industry	PJ	0	0	20
Final energy use - direct uses <sup>11</sup>	<u><u> </u></u>	Geothermal	PJ	0	0	0
nS	5	Bioenergy (traditional) - Buildings	PJ	32	38	1
ರ	Buildings and Industry	Bioenergy (modern) - Buildings	PJ	0	0	10
ire		Bioenergy - Industry	PJ	33	84	127
<b>b</b> -		Non-renewable - Buildings	PJ	246	377	343
se		Non-renewable - Industry	PJ	456	544	457
n /		Non-renewable - BF/CO	PJ	10	15	15
<b>6</b> 0			PJ PJ		921	896
ne		Total fuel consumption Liquid biofuels	PJ PJ	623	0	25
<u>e</u>	Ħ	Conventional biogasoline	PJ PJ	0	0	0
ina	sbc	Advanced biogasoline	PJ	0	0	25
ш	ransport	Biodiesel (conventional and advanced)	PJ	0	0	0
	Ĕ	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	623	921	871
Total	final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	1 947	2 882	2 797
Total		re in electricity generation		10%	30%	55%
S		re in district heat generation		0%	0%	0%
RE shares		re in Buildings - final energy use, direct uses (mo	dorn)	0%	1%	5%
she		re in Industry - final energy use, direct uses (ino	ueiii)	7%	13%	24%
Ψ̈́		re in Transport fuels		0%	0%	3%
œ		•				
ν,		of modern RE in TFEC 3		4%	12%	25%
or		costs [USD bln/yr in 2030]		N/A	N/A	2
ät		estment needs [USD bln/yr (2010-2030)]	01	N/A	3	8
di		ment support for renewables [USD bln/yr in 203	-	N/A	N/A	4.0
Financial indicators	_	s from reduced externalities - air pollution (avera	ige)	N/A	N/A	1.9
cia	_	/yr in 2030]	. (03)			
anc	_	s from reduced externalities - CO2 (USD 50/tonne /yr in 2030]	(02)	N/A	N/A	2.7
Ξ̈́		-		150	240	107
ш.	CO2 er	nissions from energy [Mt/yr]		159	240	187

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

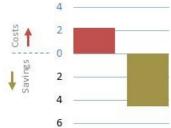


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



 Savings from reduced externalities - air pollution and CO2
 System costs

- Lahmeyer International; Fraunhofer ISI; Fraunhofer ISE (2013). Sub-task Reports 5.1, 5.6, 5.7, 6.1.
- L'Observatoire Méditerranéen de L'Energie (2011). 'Meditterranaen Energy Perspectives'. OME, Nanterre.

















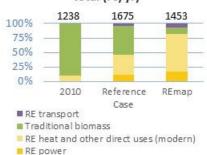
# **REmap Country Results – Ethiopia**

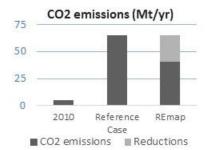
			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	2	31	33
		Renewable capacity	GW	2	28	30
		Hydropower (excl. pumped hydro)	GW	2	17	17
		Wind	GW	0	1	1
		Biofuels (solid, liquid, gaseous)	GW	0	0	2
		Solar PV	GW	0	9	9
₹		CSP	GW	0	0	0
aci		Geothermal	GW	0	1	1
ар	ţ	Marine, other	GW	0	0	0
Energy generation and capacity	Power sector	Non-renewable capacity	GW	0	4	3
auc	er s	Total electricity generation	TWh	5	105	117
<u></u>	Ň	Renewable generation	TWh	5	95	108
ţi	ڇ	Hydropower	TWh	5	73	73
era		Wind	TWh	0	4	4
en		Biofuels (solid, liquid, gaseous)	TWh	0	0	12
90		Solar PV	TWh	0	12	12
<u> </u>		CSP	TWh	0	0	0
ne		Geothermal	TWh	0	6	6
ш		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	0	10	9
		Total district heat generation	PJ	0	0	0
	_	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	1 253	1 724	1 344
		Direct uses of renewable energy	PJ	1 224	1 430	1 102
	St.	Solar thermal - Buildings	PJ	0	0	0
S 1	ğ	Solar thermal - Industry	PJ	0	0	0
se	드	Geothermal	PJ	0	0	0
יל ר	auc	Bioenergy (traditional) - Buildings	PJ	1 116	833	155
rec	gs	Bioenergy (modern) - Buildings	PJ	108	597	890
Ġ	Buildings and Industry	Bioenergy - Industry	PJ	0	0	57
e .		Non-renewable - Buildings	PJ	12	17	17
ns	Φ.	Non-renewable - Industry	PJ	17	277	224
β		Non-renewable - BF/CO	PJ	0	0	0
Final energy use - direct uses <sup>1</sup>		Total fuel consumption	PJ	37	458	246
ē		Liquid biofuels	PJ	0	60	97
na	ransport	Conventional biogasoline	PJ	0	60	64
证	lsu	Advanced biogasoline	PJ	0	0	3
	Tra	Biodiesel (conventional and advanced)	PJ	0	0	31
		Biomethane	PJ	0	0	0
	fine	Non-renewable fuels	PJ	37	398	148
ıotal		gy consumption (electricity, DH, direct uses) <sup>2</sup> re in electricity generation	PJ	1 304	2 386	1 864
S		, 0		99%	91%	93%
RE shares		re in district heat generation re in Buildings - final energy use, direct uses (mod	lorn)	0%	0%	0%
ha		0, ,	iem)	9%	41%	84%
Щ		re in Industry - final energy use, direct uses		0%	0%	20%
<u>~</u>		re in Transport fuels		0%	13%	40%
v)		of modern RE in TFEC 3		9%	35%	70%
Ö	1	costs [USD bln/yr in 2030] estment needs [USD bln/yr (2010-2030)]		N/A N/A	<i>N/A</i> 4	5
cat		nent support for renewables [USD bln/yr in 2030	1]			
ğ			•	N/A	N/A	3.3
al ii	"	s from reduced externalities - air pollution (avera (yr in 2030]	ge)	N/A	N/A	3.5
Financial indicators	Savings	from reduced externalities - $CO_2$ (USD 50/tonne /yr in 2030]	CO2)	N/A	N/A	1.2
Fin	_	nissions from energy [Mt/yr]		5	65	41

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

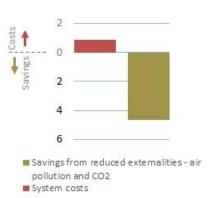


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



### References for further consultation:

 Ethiopian Climate Resilient Green Economy Strategy (CRGE), Ministry of Environment and Forest (MEF), 2015.

















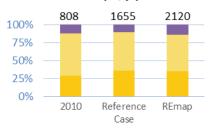
# **REmap Country Results – France**

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	119	147	167
		Renewable capacity	GW	33	94	121
		Hydropower (excl. pumped hydro)	GW	25	25	26
		Wind	GW	6	35	46
		Biofuels (solid, liquid, gaseous)	GW	1	3	5
		Solar PV	GW	1	32	44
₹		CSP	GW	0	0	0
aci		Geothermal	GW	0	0	0
ар	ţ	Marine, other	GW	0	0	0
Ъ	sec	Non-renewable capacity	GW	86	53	46
an	ē	Total electricity generation	TWh	569	529	532
Energy generation and capacity	Power sector	Renewable generation	TWh	85	224	284
atic	_	Hydropower	TWh	69	72	74
ē		Wind	TWh	10	91	121
je n		Biofuels (solid, liquid, gaseous)	TWh	5	20	30
≥		Solar PV	TWh	1	41	57
8		CSP	TWh	0	0	0
En		Geothermal	TWh	0	1	0
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	484	305	249
		Total district heat generation	PJ	153	248	293
	품	Biofuels (solid, liquid, gaseous)	PJ	23	49	94
	_	Other renewables	PJ	0	6	6
		Non-renewable DH	PJ	131	193	193
		Total direct uses of energy	PJ	2 631	1 668	1 569
	>	Direct uses of renewable energy	PJ	451	749	823
_	ıstı	Solar thermal - Buildings	PJ	2	39	69
S	Buildings and Industry	Solar thermal - Industry	PJ	0	0	14
nse	<del>-</del>	Geothermal	PJ	4	21	21
な	a	Bioenergy (traditional) - Buildings	PJ	0	0	0
ire	ngs	Bioenergy (modern) - Buildings	PJ	363	309	339
<del>ا</del> 0	ᅙ	Bioenergy - Industry	PJ	82	380	380
Se	Bui	Non-renewable - Buildings	PJ	1 347	284	127
n >		Non-renewable - Industry	PJ	723	523	508
Final energy use - direct uses <sup>1</sup>		Non-renewable - BF/CO	PJ	111	111	111
Suc.		Total fuel consumption	PJ PJ	1 808	1 444	<b>1 445</b> 300
<del> </del>	ŗ	Liquid biofuels  Conventional biogasoline	PJ PJ	101 17	165 25	44
<u>:</u>	Transport	Advanced biogasoline	PJ	0	15	45
	an	Biodiesel (conventional and advanced)	PJ	85	125	211
	F	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	1 707	1 279	1 145
Total	final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	6 164	5 188	5 150
		re in electricity generation		15%	42%	53%
es	RE sha	re in district heat generation		15%	22%	34%
RE shares	RE sha	re in Buildings - final energy use, direct uses (mod	ern)	22%	57%	77%
S	RE sha	re in Industry - final energy use, direct uses		10%	42%	44%
꼾		re in Transport fuels		6%	11%	21%
		of modern RE in TFEC <sup>3</sup>		13%	32%	41%
ors		costs [USD bln/yr in 2030]		N/A	N/A	2
atc		estment needs [USD bln/yr (2010-2030)]		N/A	11	14
dic		ment support for renewables [USD bln/yr in 2030	-	N/A	N/A	1.4
ial in	[USD bln,	s from reduced externalities - air pollution (averag /yr in 2030]	,	N/A	N/A	2.4
Financial indicators	[USD bln,	s from reduced externalities - $CO_2$ (USD 50/tonne /yr in 2030]	CO2)	N/A	N/A	1.4
证	CO2 er	missions from energy [Mt/yr]		316	191	162

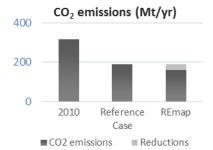
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



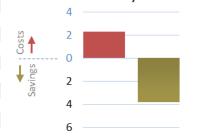
# Final RE use by sector (%) and total (PJ/yr)



- RF transport
- RE heat and other direct uses (modern)
- RE power



# Costs and savings (USD bln/yr in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- France Energy Transition Law, 2015.
- Vers un mix electrique 100% renouvelable en 2050, ADEME (2015).
- Roadmap for smart grid and electricity systems integrating renewable energy sources, ADEME (2013).

















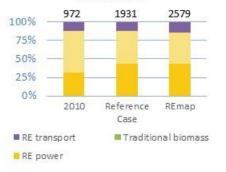
# **REmap Country Results – Germany**

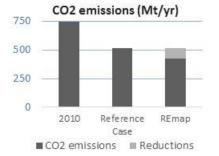
		-		2010	Reference	REmap
			Unit	2010	Case 2030	2030
		Total installed power generation capacity	GW	161	222	256
		Renewable capacity	GW	63	146	189
		Hydropower (excl. pumped hydro)	GW	5	5	5
		Wind	GW	27	59	88
		Biofuels (solid, liquid, gaseous)	GW	11	20	20
		Solar PV	GW	20	62	75
. <del>(</del> )		CSP	GW	0	0	0
ba	<u> </u>	Geothermal	GW	0	0	1
<u> </u>	技	Marine, other	GW	0	0	0
5	Se	Non-renewable capacity	_GW	98	76	66
Energy generation and capacity	Power sector	Total electricity generation	TWh	629	599	620
<u>.</u> 5	Po	Renewable generation	TWh	103	286	378
rat		Hydropower	TWh	21	19	23
Je		Wind	TWh	38	143	214
ge.		Biofuels (solid, liquid, gaseous)	TWh	33	67	67
≥		Solar PV	TWh	12	56	70
er.		CSP	TWh	0	0	0
ᇤ		Geothermal	TWh	0	1	4
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	525	313	242
		Total district heat generation	PJ	555	578	620
	품	Biofuels (solid, liquid, gaseous)	PJ	52	191	216
		Other renewables	PJ	0	0	84
		Non-renewable DH	PJ	504	387	320
		Total direct uses of energy	PJ	4 694	3 275	3 131
	>	Direct uses of renewable energy	PJ	495	741	878
_	ıstı	Solar thermal - Buildings	PJ	18	106	162
S	Buildings and Industry	Solar thermal - Industry	PJ	0	0	25
nse	_ _	Geothermal	PJ	19	86	86
せ	ä	Bioenergy (traditional) - Buildings	PJ	0	0	0
<u>i.</u>	sgu	Bioenergy (modern) - Buildings	PJ	318	375	431
ъ-	<u>=</u>	Bioenergy - Industry	PJ	140	174	174
Se	Bui	Non-renewable - Buildings	PJ	2 435	1 207	976
<u>ہ</u>		Non-renewable - Industry	PJ	1 510	1 242	1 193
Final energy use - direct uses <sup>1</sup>		Non-renewable - BF/CO	PJ	254	85	85
ne		Total fuel consumption	PJ	2 500	2 137	2 073
<del> </del>	ť	Liquid biofuels	PJ	121	228	368
.≌	nsport	Conventional biogasoline	PJ	33	49	49
ш.		Advanced biogasoline Biodiesel (conventional and advanced)	PJ PJ	0	46 122	50 260
	Tra	Biomethane	PJ	88	133 0	269 5
		Non-renewable fuels	PJ	2 379	1 909	1 700
Total	l final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	9 565	7 539	7 459
. Otal		re in electricity generation		16%	48%	61%
S		re in district heat generation		9%	33%	48%
are		re in Buildings - final energy use, direct uses (mode	ern)	13%	32%	41%
sh		re in Industry - final energy use, direct uses	,	8%	12%	14%
RE shares		re in Transport fuels		5%	11%	18%
		of modern RE in TFEC <sup>3</sup>		10%	26%	35%
ν		costs [USD bln/yr in 2030]		N/A	N/A	3
ţ		estment needs [USD bln/yr (2010-2030)]		N/A	15	23
ca		ment support for renewables [USD bln/yr in 2030]		N/A	N/A	2.9
pu		s from reduced externalities - air pollution (averag				
<u>.=</u>		/yr in 2030]	-1	N/A	N/A	6.0
Financial indicators		s from reduced externalities - CO <sub>2</sub> (USD 50/tonne o	CO2)	N/A	N1/A	4.0
nar	_	/yr in 2030]		N/A	N/A	4.8
遠	CO2 er	nissions from energy [Mt/yr]		746	518	421

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

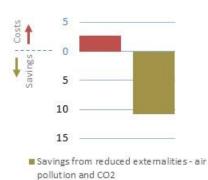


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



### References for further consultation:

- REmap: Renewable Energy Prospects, Germany, IRENA (2015).
- Projektionsbericht 2015, BMU (2015).
- Entwicklung der Energiemaerkte Energiereferenzprognose, BMWi (2014).





System costs













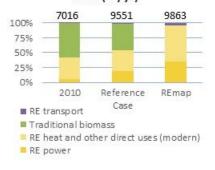
# REmap Country Results – India

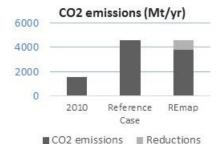
			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	174	663	854
		Renewable capacity	GW	56	252	521
		Hydropower (excl. pumped hydro)	GW	37	48	77
		Wind	GW	14	146	194
		Biofuels (solid, liquid, gaseous)	GW	3	11	28
		Solar PV	GW	1	48	209
₹		CSP	GW	0	0	11
aci		Geothermal	GW	0	0	2
Energy generation and capacity	Power sector	Marine, other	GW	0	0	0
b	sec	Non-renewable capacity	GW	118	411	333
an	ē	Total electricity generation	TWh	946	3 428	3 490
n C	NO N	Renewable generation	TWh	136	592	1 186
ij	Δ.	Hydropower	TWh	104	131	230
e		Wind	TWh	21	345	458
en		Biofuels (solid, liquid, gaseous)	TWh	10	35	108
8		Solar PV	TWh	1	82	346
50		CSP	TWh	0	0	28
ı.		Geothermal	TWh	0	0	16
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	810	2 835	2 304
		Total district heat generation	PJ	0	0	0
	_	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	13 055	27 567	25 256
	_ '	Direct uses of renewable energy	PJ	6 639	7 638	5 966
	it S	Solar thermal - Buildings	PJ	6	71	510
1	ñ	Solar thermal - Industry	PJ	0	1	151
Final energy use - direct uses <sup>1</sup>	Buildings and Industry	Geothermal	PJ	9	9	19
t u	D E	Bioenergy (traditional) - Buildings	PJ	4 063	4 259	0
- Sec	38 S	Bioenergy (modern) - Buildings	PJ	1 364	1 485	2 967
ij	ij	Bioenergy - Industry	PJ	1 196	1 813	2 319
e '	ij	Non-renewable - Buildings	PJ	1 023	4 740	4 740
ns	ā	Non-renewable - Industry	PJ	5 116	14 553	13 914
8		Non-renewable - BF/CO	PJ	278	636	636
je.		Total fuel consumption	PJ	2 214	5 718	3 351
e		Liquid biofuels	PJ	8	109	468
nal	ransport	Conventional biogasoline	PJ	7	42	108
证	dsu	Advanced biogasoline	PJ	0	1	37
	<u>r</u>	Biodiesel (conventional and advanced)	PJ	2	66	323
		Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	2 205	5 609	2 883
Tota		gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	18 222	44 055	38 695
		re in electricity generation		14%	17%	34%
res		re in district heat generation		0%	0%	0%
RE shares		re in Buildings - final energy use, direct uses (mod	ern)	21%	15%	42%
N N		re in Industry - final energy use, direct uses		19%	11%	15%
~		re in Transport fuels		0%	2%	14%
		of modern RE in TFEC <sup>3</sup>		16%	12%	25%
ors		costs [USD bln/yr in 2030]		N/A	N/A	17
ate		estment needs [USD bln/yr (2010-2030)]		N/A	25	51
dic		ment support for renewables [USD bln/yr in 2030		N/A	N/A	22.2
al ii		s from reduced externalities - air pollution (avera g/yr in 2030]	ge)	N/A	N/A	103.2
Financial indicators		s from reduced externalities - CO <sub>2</sub> (USD 50/tonne /yr in 2030]	CO2)	N/A	N/A	39.3
Ë	_	nissions from energy [Mt/yr]		1 560	4 570	3 783

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

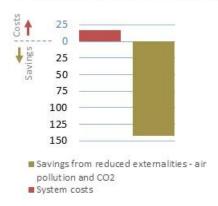


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Low Carbon Strategies for Inclusive Growth, Planning Commission of Government of India (2014).
- Report on India's Renewable Electricity Roadmap to 2030, NITI Aayog, Government of India (2015).
- Twelfth Five Year Plan (2012-2017), Planning Commission of Government of India (2013).

















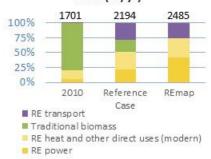
# **REmap Country Results – Indonesia**

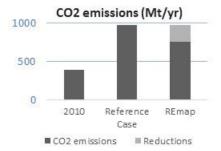
		nah ay				
			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	36	196	239
		Renewable capacity	GW	7	60	129
		Hydropower (excl. pumped hydro)	GW	4	16	25
		Wind	GW	0	2	11
		Biofuels (solid, liquid, gaseous)	GW	2	29	29
		Solar PV	GW	0	4	47
<u>₹</u>		CSP	GW	0	0	0
Energy generation and capacity		Geothermal	GW	1	9	14
ά	ţ	Marine, other	GW	0	0	3
9	Power sector	Non-renewable capacity	GW	29	136	110
ä	er	Total electricity generation	TWh	170	590	593
Ξ	8	Renewable generation	TWh	27	147	328
ij	مَ	Hydropower	TWh	18	37	76
er.		Wind	TWh	0	2	31
e		Biofuels (solid, liquid, gaseous)	TWh	0	61	61
<b>∞</b>		Solar PV	TWh	0	2	62
50		CSP	TWh	0	0	0
ne		Geothermal	TWh	9	45	84
ш		Marine, other	TWh	0	0	13
		Non-renewable generation	TWh	143	443	266
		Total district heat generation	PJ	0	0	0
	_	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	3 568	5 524	5 173
		Direct uses of renewable energy	PJ	1 608	1 110	791
	ŧ۲	Solar thermal - Buildings	PJ	0	0	0
₩.	Sing	Solar thermal - Industry	PJ	0	0	20
Ses	<u>=</u>	Geothermal	PJ	0	0	10
Š	p	Bioenergy (traditional) - Buildings	PJ	1 352	461	0
ect	S.	Bioenergy (modern) - Buildings	PJ	0	70	182
늘	Buildings and Industry	Bioenergy - Industry	PJ	255	579	579
1		Non-renewable - Buildings	PJ	317	654	654
Se	B	Non-renewable - Industry	PJ	1 644	3 760	3 727
2		Non-renewable - Hiddstry	PJ	0	0	0
Final energy use - direct uses $^{\mathrm{1}}$		Total fuel consumption	PJ	1 492	3 601	3 577
en		Liquid biofuels	PJ	8	617	651
<del>-</del>	ţ	Conventional biogasoline	PJ	1	417	433
뜶	nsport	Advanced biogasoline	PJ	0	0	0
	Tran	Biodiesel (conventional and advanced)	PJ	7	200	218
	F	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	1 483	2 985	2 925
Tota	l final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	5 590	11 289	10 923
		re in electricity generation		16%	25%	55%
S	RE sha	re in district heat generation		0%	0%	0%
are	RE sha	re in Buildings - final energy use, direct uses (mo	odern)	0%	6%	22%
sh		re in Industry - final energy use, direct uses	,	13%	13%	14%
RE shares		re in Transport fuels		1%	17%	18%
		Share of modern RE in TFEC <sup>3</sup>			16%	23%
Ñ		n costs [USD bln/yr in 2030]		6% N/A	N/A	4
to	,	estment needs [USD bln/yr (2010-2030)]		N/A	5	13
ica		ment support for renewables [USD bln/yr in 203	80]	N/A	N/A	4.2
bui le	Saving	s from reduced externalities - air pollution (aver /yr in 2030]	-	N/A	N/A	6.9
inancial indicators	Saving	s from reduced externalities - CO <sub>2</sub> (USD 50/tonn /yr in 2030]	e CO2)	N/A	N/A	10.5
:	CO2 or	nissions from anargy [Mt/yr]		301	971	761

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

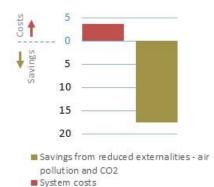


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



### References for further consultation:

CO2 emissions from energy [Mt/yr]

- Outlook Energi Indonesia, MEMR (2014).
- Outlook Energi Indonesia, BPPT (2015).
- Peer Review on Low Carbon Energy Policies in Indonesia (2013).



391

971

761















# **REmap Country Results – Iran (power sector)**

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	67	98	108
		Renewable capacity	GW	10	29	42
		Hydropower (excl. pumped hydro)	GW	10	21	21
		Wind	GW	0	6	12
ij		Biofuels (solid, liquid, gaseous)	GW	0	1	2
ac		Solar PV	GW	0	1	8
g		CSP	GW	0	0	0
ğ	sector	Geothermal	GW	0	0	0
au		Marine, other	GW	0	0	0
o		Non-renewable capacity	GW	57	69	66
Energy generation and capacity	Power	Total electricity generation	TWh	245	425	425
ē	ð	Renewable generation	TWh	13	63	93
ē	-	Hydropower	TWh	12	37	37
36		Wind	TWh	0	16	30
erg		Biofuels (solid, liquid, gaseous)	TWh	0	7	12
Ë		Solar PV	TWh	0	2	14
		CSP	TWh	0	0	0
		Geothermal	TWh	0	0	0
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	233	362	331
		PE chare in electricity generation		5%	15%	22%

RE share in electricity generation

### References for further consultation:

- Data provided by Iran Renewable Energy Organisation, based on output of the "MAED" and "MESSAGE" models.















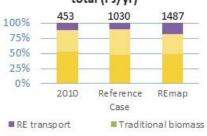
# **REmap Country Results – Italy**

		•				
				2010	Reference	REmap
			Unit		Case 2030	2030
		Total installed power generation capacity	GW	110	123	142
		Renewable capacity	GW	26	64	90
		Hydropower (excl. pumped hydro)	GW	14	14	17
		Wind	GW	6	19	20
		Biofuels (solid, liquid, gaseous)	GW	2	5	7
		Solar PV	GW	3	25	43
<u>:≥</u>		CSP	GW	0	1	1
ac		Geothermal	GW	1	1	2
<u>a</u>	ţ	Marine, other	GW	0	0	0
9	sec	Non-renewable capacity	GW	84	59	52
ä	er:	Total electricity generation	TWh	302	352	364
Energy generation and capacity	Power sector	Renewable generation	TWh	67	135	196
Ę	<u> </u>	Hydropower	TWh	41	39	49
<u> </u>		Wind	TWh	9	29	31
, a		Biofuels (solid, liquid, gaseous)	TWh	9	22	40
80		Solar PV	TWh	2	37	63
≥ 50						
Ē		CSP	TWh	0	2	0
ū		Geothermal	TWh	5	7	13
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	235	217	168
		Total district heat generation	PJ	205	126	126
	품	Biofuels (solid, liquid, gaseous)	PJ	15	24	24
		Other renewables	PJ	1	1	1
		Non-renewable DH	PJ	189	101	101
		Total direct uses of energy	PJ	2 166	2 142	2 116
	>	Direct uses of renewable energy	PJ	149	405	478
	str	Solar thermal - Buildings	PJ	5	44	90
S 1	Buildings and Industry	Solar thermal - Industry	PJ	0	0	20
se	트	Geothermal	PJ	3	18	18
יָּדָ ב	anc	Bioenergy (traditional) - Buildings	PJ	0	0	0
ē	gs (	Bioenergy (modern) - Buildings	PJ	131	304	304
흥	<u>:</u>	Bioenergy - Industry	PJ	9	39	45
o)	ij	Non-renewable - Buildings	PJ	1 317	1 000	949
nse	<b>B</b>	Non-renewable - Industry	PJ	700	736	690
>		Non-renewable - BF/CO	PJ	0	0	0
Final energy use - direct uses <sup>1</sup>		Total fuel consumption	PJ	1 703	1 677	1 590
en		Liquid biofuels	PJ	55	105	255
a	r.	Conventional biogasoline	PJ	0	14	54
뜶	ansport	Advanced biogasoline	PJ	0	25	64
	Tran	Biodiesel (conventional and advanced)	PJ	54	65	136
	F	Biomethane	PJ	0	0	8
		Non-renewable fuels	PJ	1 648	1 572	1 327
Tota	final energ	y consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	5 200	5 317	5 246
1000		e in electricity generation		22%	38%	54%
Ś		e in district heat generation		8%	19%	19%
a re		e in Buildings - final energy use, direct uses (mod	larn)	10%	27%	30%
RE shares		e in Industry - final energy use, direct uses	iciii)	1%	5%	9%
μ̈́		e in Transport fuels		3%	5% 6%	17%
12		·				
10		of modern RE in TFEC 3		9%	20%	29%
or		costs [USD bln/yr in 2030]		N/A	N/A	- 2
at		stment needs [USD bln/yr (2010-2030)]		N/A	5	9
dic		nent support for renewables [USD bln/yr in 2030		N/A	N/A	1.8
₽.		from reduced externalities - air pollution (averages	ge)	N/A	N/A	10.0
Financial indicators		yr in 2030]		-7		
nc	_	from reduced externalities - CO <sub>2</sub> (USD 50/tonne	CO2)	N/A	N/A	2.9
na	_	yr in 2030]				
正	CO2 en	nissions from energy [Mt/yr]		383	335	277

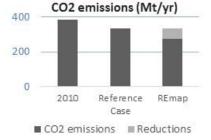
### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



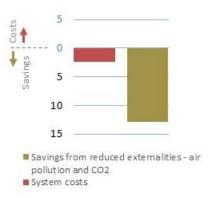
# Final RE use by sector (%) and total (PJ/yr)



■ RE transport ■ Traditional biomass ■ RE power



### Costs and savings (USD bln in 2030)



- Italy's National Energy Strategy, Italian Ministry for Economic Development (2010).
- Rapporto Energia E Ambiente, Scenari E Strategie, ENEA (2013).
- Italian National Renewable Energy Action Plan, Italian Ministry for Economic Development (2010).

















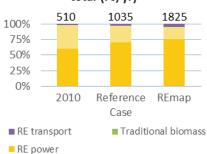
# **REmap Country Results – Japan**

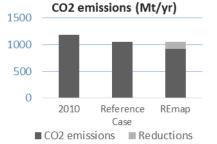
			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	262	266	388
		Renewable capacity	GW	31	105	250
		Hydropower (excl. pumped hydro)	GW	21	23	23
		Wind	GW	2	10	37
		Biofuels (solid, liquid, gaseous)	GW	3	7	7
		Solar PV	GW	4	64	179
₹		CSP	GW	0	0	0
aci		Geothermal	GW	1	2	2
ар	ţ	Marine, other	GW	0	0	2
b	sec	Non-renewable capacity	GW	231	161	139
Energy generation and capacity	Power sector	Total electricity generation	TWh	1 159	1 057	1 158
u o	8	Renewable generation	TWh	99	236	439
ă;	Δ.	Hydropower	TWh	76	88	90
ers		Wind	TWh	4	18	74
en		Biofuels (solid, liquid, gaseous)	TWh	12	44	49
8		Solar PV	TWh	4	75	212
9		CSP	TWh	0	0	0
ä		Geothermal	TWh	3	11	11
		Marine, other	TWh	0	0	4
		Non-renewable generation	TWh	1 060	821	719
		Total district heat generation	PJ	21	20	20
	_	Biofuels (solid, liquid, gaseous)	PJ	4	4	4
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	17	16	16
		Total direct uses of energy	PJ	7 153	7 162	6 072
	_	Direct uses of renewable energy	PJ	190	275	364
	stry	Solar thermal - Buildings	PJ	18	21	52
S 1	Buildings and Industry	Solar thermal - Industry	PJ	0	0	50
Final energy use - direct uses <sup>1</sup>	드	Geothermal	PJ	0	0	0
יל	anc	Bioenergy (traditional) - Buildings	PJ	0	0	0
ē	gs	Bioenergy (modern) - Buildings	PJ	0	0	0
₽	ä	Bioenergy - Industry	PJ	172	254	261
به	ij	Non-renewable - Buildings	PJ	2 596	2 475	1 384
ns	8	Non-renewable - Industry	PJ	3 566	3 611	3 523
8		Non-renewable - BF/CO	PJ	801	801	801
<u>اء</u> ا		Total fuel consumption	PJ	3 363	2 927	2 818
ē	4	Liquid biofuels	PJ	8	27	76
na	20.	Conventional biogasoline	PJ	8	27	76
证	ansport	Advanced biogasoline	PJ	0	0	0
	Tra	Biodiesel (conventional and advanced)	PJ	0	0	0
		Biomethane	PJ	0	0	1
		Non-renewable fuels	PJ	3 355	2 900	2 741
Tota		energy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	14 132	13 381	12 549
(0		share in electricity generation		9%	22%	38%
RE shares		share in district heat generation		20%	21%	21%
ha		share in Buildings - final energy use, direct uses (mode	ern)	1%	1%	4%
В		share in Industry - final energy use, direct uses		5%	7%	8%
~		share in Transport fuels		0%	1%	3%
40		are of modern RE in TFEC 3		4%	8%	15%
ors	•	stem costs [USD bln/yr in 2030]		N/A	N/A	1
ät		investment needs [USD bln/yr (2010-2030)]		N/A	21	36
ğ		restment support for renewables [USD bln/yr in 2030]		N/A	N/A	8.6
Financial indicators	[USD	vings from reduced externalities - air pollution (average bln/yr in 2030)		N/A	N/A	6.9
nanc	[USD	$vings$ from reduced externalities - $CO_2$ (USD 50/tonne 0 bln/yr in 2030]	LO2)	N/A	N/A	6.5
证	CO	2 emissions from energy [Mt/yr]		1 192	1 053	923

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

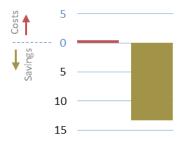


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Long-term energy supply and demand outlook, METI (2015).
- $\ Data \ Book \ on \ heat \ Pump \ \& \ Thermal \ Storage \ System \ 2013, \ Heat \ Pump \ \& \ Thermal \ Storage \ Technology \ Center \ of \ Japan \ (2013).$
- FY 2013 Energy Supply and Demand Report, METI (2015).





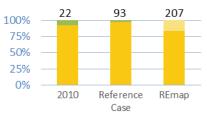
# REmap Country Results – Kazakhstan

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	20	34	41
		Renewable capacity	GW	2	9	19
		Hydropower (excl. pumped hydro)	GW	2	4	4
		Wind	GW	0	5	11
		Biofuels (solid, liquid, gaseous)	GW	0	0	1
		Solar PV	GW	0	1	4
Ë		CSP	GW	0	0	0
bac	<u> </u>	Geothermal	GW	0	0	0
g	ctc	Marine, other	GW	0	0	0
Energy generation and capacity	Power sector	Non-renewable capacity	GW	17	25	22
ē	We	Total electricity generation	TWh	83	145	145
. <u>ō</u>	Ро	Renewable generation	TWh	8	29	56
<u>ta</u>		Hydropower	TWh	8	15	15
ne		Wind Biofuels (solid, liquid, gaseous)	TWh TWh	0	14 0	32
ge		Solar PV	TWh	0	1	7
<u></u>		CSP	TWh	0	0	0
ne		Geothermal	TWh	0	0	0
ш		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	75	116	90
		Total district heat generation	PJ	402	1 120	1 127
	_	Biofuels (solid, liquid, gaseous)	PJ	0	0	39
	품	Other renewables	PJ	0	0	7
		Non-renewable DH	PJ	402	1 120	1 081
		Total direct uses of energy	PJ	1 145	3 082	3 072
	>	Direct uses of renewable energy	PJ	2	3	5
	str	Solar thermal - Buildings	PJ	0	0	0
S 1	npı	Solar thermal - Industry	PJ	0	0	0
Final energy use - direct uses <sup>1</sup>	Buildings and Industry	Geothermal	PJ	0	0	4
t	ä	Bioenergy (traditional) - Buildings	PJ	2	3	0
ire	sgı	Bioenergy (modern) - Buildings	PJ	0	0	1
<b>р</b> -	<u>6</u>	Bioenergy - Industry	PJ	0	0	0
se	Bui	Non-renewable - Buildings	PJ	220	958	951
n >		Non-renewable - Industry	PJ	833	1 919	1 915
g		Non-renewable - BF/CO	PJ	91	202	202
ene		Total fuel consumption Liquid biofuels	PJ PJ	<b>184</b> 0	<b>173</b> 0	<b>168</b> 0
a	r.	Conventional biogasoline	PJ	0	0	0
Ë	ransport	Advanced biogasoline	PJ	0	0	0
	ran	Biodiesel (conventional and advanced)	PJ	0	0	0
	-	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	184	173	168
Tota	l final energ	y consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	1 829	4 456	4 448
	RE shar	e in electricity generation		10%	20%	38%
'es		e in district heat generation		0%	0%	4%
RE shares		e in Buildings - final energy use, direct uses (mod	dern)	0%	0%	0%
E S		e in Industry - final energy use, direct uses		0%	0%	0%
~		e in Transport fuels		0%	0%	0%
		of modern RE in TFEC <sup>3</sup>		1%	2%	5%
ors		costs [USD bln/yr in 2030]		N/A	N/A	1
cat		stment needs [USD bln/yr (2010-2030)]	<b>N</b> 1	N/A	1	2
ğ		nent support for renewables [USD bln/yr in 2030	-	N/A	N/A	1.0
ial in	[USD bln/	from reduced externalities - air pollution (avera yr in 2030]		N/A	N/A	8.4
Financial indicators		from reduced externalities - CO₂ (USD 50/tonne yr in 2030]	CO2)	N/A	N/A	0.9
证	CO2 en	nissions from energy [Mt/yr]		179	777	759

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



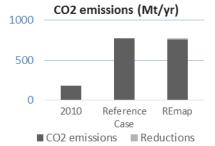
# Final RE use by sector (%) and total (PJ/yr)



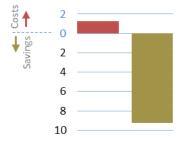
■ RE transport

■ Traditional biomass

RE heat and other direct uses (modern)



### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Concept for transition of the Republic of Kazakhstan to Green Economy, Republic of Kazakhstan (2013).
- Kerimray, A. et al. (2015), "TIMES Kazakhstan: from a national to a regional analysis and modelling", 1 June 2015, ETSAP Workshop. Abu Dhabi.

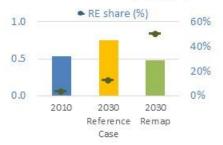




# REmap Country Results – Kenya

				2010	Reference	REmap
		Total installed power generation capacity	Unit GW	2	Case 2030 3	2030 4
		Renewable capacity	GW	1	2	3
		Hydropower (excl. pumped hydro)	GW	1	1	1
		Wind	GW	0	0	1
		Biofuels (solid, liquid, gaseous)	GW	0	0	0
		Solar PV	GW	0	0	0
≥		CSP	GW	0	0	0
ğ		Geothermal	GW	0	1	1
Energy generation and capacity	ō	Marine, other	GW	0	0	0
ŭ	ect	Non-renewable capacity	GW	1	1	1
nc Suc	Power sector	Total electricity generation	TWh	8	20	20
Ē	) W	Renewable generation	TWh	5	11	15
tio	P	Hydropower	TWh	3	3	3
ra		Wind	TWh	0	2	2
, ne		Biofuels (solid, liquid, gaseous)	TWh	0	0	0
g		Solar PV	TWh	0	0	1
<u></u>		CSP	TWh	0	0	0
nei		Geothermal	TWh	1	7	9
Ш		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	2	8	5
		Total district heat generation	PJ	0	0	<u>3</u>
		Biofuels (solid, liquid, gaseous)	PJ PJ	0	0	0
	吾	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	441	548	279
		Direct uses of renewable energy	PJ PJ	393	445	186
	Ę	Solar thermal - Buildings	PJ	0	2	3
н	ısı	Solar thermal - Industry	PJ	0	0	1
es	Buildings and Industry	Geothermal	PJ	0	0	0
Š	p	Bioenergy (traditional) - Buildings	PJ	393	391	0
ect	s S	Bioenergy (modern) - Buildings	PJ	0	51	171
di.	ing	Bioenergy - Industry	PJ	0	0	12
1	흹	Non-renewable - Buildings	PJ	14	44	44
JSE	Bu	Non-renewable - Industry	PJ	35	60	49
		Non-renewable - BF/CO	PJ	0	0	0
erg		Total fuel consumption	PJ	71	136	136
en		Liquid biofuels	PJ	0	1	3
a	ort	Conventional biogasoline	PJ	0	1	1
Final energy use - direct uses <sup>1</sup>	ransport	Advanced biogasoline	PJ	0	0	3
	ran	Biodiesel (conventional and advanced)	PJ	0	0	0
	-	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	71	135	133
Total	final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	535	755	485
		re in electricity generation		70%	57%	74%
es	RE sha	re in district heat generation		0%	0%	0%
RE shares	RE sha	re in Buildings - final energy use, direct uses (mo	dern)	0%	11%	80%
sh	RE sha	re in Industry - final energy use, direct uses		0%	0%	21%
RE	RE sha	re in Transport fuels		0%	0%	2%
	Share o	of modern RE in TFEC <sup>3</sup>		3%	12%	50%
S	System	costs [USD bln/yr in 2030]		N/A	N/A	0
ato	RE inve	estment needs [USD bln/yr (2010-2030)]		N/A	1	1
<u>i</u>	Investr	nent support for renewables [USD bln/yr in 203	0]	N/A	N/A	0.4
i	_	s from reduced externalities - air pollution (avera	ige)	N/A	N/A	1.3
Financial indicators	Savings	/yr in 2030] s from reduced externalities - CO₂ (USD 50/tonne from in 2020)	e CO2)	N/A	N/A	0.1
Fina		/yr in 2030] nissions from energy [Mt/yr]		11	21	19

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



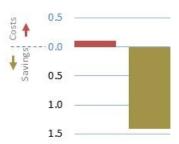
# Final RE use by sector (%) and total (PJ/yr)



- RE transport
- Traditional biomass
- RE heat and other direct uses (modern)
- RE power

# CO2 emissions (Mt/yr) 20 15 10 5 0 2010 Reference REmap Case CO2 emissions Reductions

### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Kenya Vision 2030, Government of Kenya, (2007).
- Updated Least Cost Power Development Plan Study Period: 2011-2031, Energy Regulatory Commission (2011)
- National Energy Policy (Draft), Ministry of Energy and Petroleum (2011).

















# REmap Country Results – Kuwait (power sector)

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	14.7	43.6	45.5
		Renewable capacity	GW	0.0	8.1	14.3
		Hydropower (excl. pumped hydro)	GW	0.0	0.0	0.0
_		Wind	GW	0.0	3.7	3.8
ؾ۬		Biofuels (solid, liquid, gaseous)	GW	0.0	0.0	0.0
Jac		Solar PV	GW	0.0	3.3	4.1
cap		CSP	GW	0.0	1.1	6.4
generation and capacity	sector	Geothermal	GW	0.0	0.0	0.0
a		Marine, other	GW	0.0	0.0	0.0
o		Non-renewable capacity	GW	14.7	35.5	31.3
ati	Power	Total electricity generation	TWh	57.0	146.1	146.1
ĕ	Š	Renewable generation	TWh	0.0	15.9	29.2
ger	-	Hydropower	TWh	0.0	0.0	0.0
		Wind	TWh	0.0	7.5	7.6
Energy		Biofuels (solid, liquid, gaseous)	TWh	0.0	0.0	0.0
E		Solar PV	TWh	0.0	5.2	6.2
		CSP	TWh	0.0	3.2	15.4
		Geothermal	TWh	0.0	0.0	0.0
		Marine, other	TWh	0.0	0.0	0.0
		Non-renewable generation	TWh	57.0	130.2	116.9
		RE share in electricity generation		0%	11%	20%

### References for further consultation:

- Clean Energy Options, Modeling of Possible Deployment Scenarios, KISR (2015).















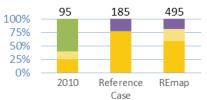
## **REmap Country Results – Malaysia**

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	27	60	69
		Renewable capacity	GW	3	14	29
		Hydropower (excl. pumped hydro)	GW	2	11	13
		Wind	GW	0	0	1
		Biofuels (solid, liquid, gaseous)	GW	1	2	6
		Solar PV	GW	0	0	9
نج		CSP	GW	0	0	0
bac	<u> </u>	Geothermal	GW	0	0	0
- E	ctc	Marine, other	GW	0	0	0
Da la	r se	Non-renewable capacity	GW	24	46	40
Energy generation and capacity	Power sector	Total electricity generation	TWh	125	181	187
. <u>ē</u>	Po	Renewable generation	TWh	8	45	93
rat		Hydropower	TWh	6	34	41
ne		Wind	TWh	0	0	2
ge		Biofuels (solid, liquid, gaseous)	TWh	2	11	33
<u></u> 60		Solar PV	TWh	0	1	15
Ē		CSP	TWh	0	0	0
ū		Geothermal	TWh	0	0	1
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	117	135	94
		Total district heat generation	PJ PJ	<b>0</b>	<b>0</b> 0	<b>0</b> 0
	품	Biofuels (solid, liquid, gaseous) Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ PJ	5 <b>27</b>	<b>740</b>	<b>742</b>
		Direct uses of renewable energy	PJ	71	2	115
	Ę	Solar thermal - Buildings	PJ	0	0	9
н	<u>.sn</u>	Solar thermal - Industry	PJ	0	0	20
ses	<u> </u>	Geothermal	PJ	0	0	0
Final energy use - direct uses $^{\mathrm{1}}$	pu	Bioenergy (traditional) - Buildings	PJ	57	1	0
ect	s a	Bioenergy (modern) - Buildings	PJ	14	0	1
ij	Buildings and Industry	Bioenergy - Industry	PJ	0	0	85
(I)		Non-renewable - Buildings	PJ	83	52	43
nse		Non-renewable - Industry	PJ	373	686	584
8		Non-renewable - BF/CO	PJ	0	0	0
er		Total fuel consumption	PJ	704	1 579	1 533
e		Liquid biofuels	PJ	0	42	91
lal	ansport	Conventional biogasoline	PJ	0	30	30
证	dsu	Advanced biogasoline	PJ	0	0	0
	Гrа	Biodiesel (conventional and advanced)	PJ	0	12	61
		Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	704	1 538	1 443
Tota		gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	1 651	2 933	2 911
10		re in electricity generation		6%	25%	50%
RE shares		re in district heat generation	,	0%	0%	0%
ha		re in Buildings - final energy use, direct uses (mod	ern)	9%	1%	18%
ы		re in Industry - final energy use, direct uses		0%	0%	15%
~		re in Transport fuels		0%	3%	6%
10		of modern RE in TFEC 3		2%	6%	17%
or;		costs [USD bln/yr in 2030]		N/A	N/A	2
cat		estment needs [USD bln/yr (2010-2030)]	,	N/A	2	3
ğ		nent support for renewables [USD bln/yr in 2030]	_	N/A	N/A	2.5
ial ir	[USD bln/	s from reduced externalities - air pollution (average //yr in 2030)	,	N/A	N/A	4.7
Financial indicators		s from reduced externalities - CO <sub>2</sub> (USD 50/tonne /yr in 2030]	CO2)	N/A	N/A	2.8
证	CO2 en	nissions from energy [Mt/yr]		179	263	206

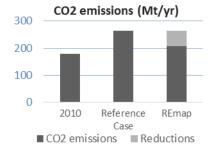
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



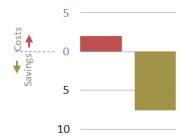
# Final RE use by sector (%) and total (PJ/yr)



- RE transport
- Traditional biomass
- RE heat and other direct uses (modern)
- RE power



### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- 4th ASEAN Energy Outlook (AEO4), ASEAN Centre for Energy (ACE) (2016).
- MALAYSIA COUNTRY PROFILES: ENERGY DATA AND POLICY, ACE (2015).
- Study on Asia potential of biofuel market, ERIA (2013).
- Technology roadmap, Solar Heating and Cooling, IEA (2012).

















# **REmap Country Results – Mexico**

Total installed power generation capacity GW 53 118 1  Renewable capacity GW 13 38 1  Hydropower (excl. pumped hydro) GW 12 19 3  Wind GW 0 11 3  Biofuels (solid, liquid, gaseous) GW 0 1	55 02 24 29 3 40 2 4 0
Hydropower (excl. pumped hydro) GW 12 19 Wind GW 0 11 Biofuels (solid, liquid, gaseous) GW 0 1	24 29 3 40 2 4
Wind GW 0 11 2 2 Biofuels (solid, liquid, gaseous) GW 0 1	29 3 40 2 4
Biofuels (solid, liquid, gaseous) GW 0 1	3 10 2 4 0
	10 2 4 0
Solar PV GW 0 6	2 4 0
	4 0
€ CSP GW 0 0	0
Geothermal GW 1 1	
Marine, other GW 0 0	53
Non-renewable capacity GW 40 80	
_	03
Renewable generation TWh 48 116 2	80
Hydropower TWh 37 52	72
Wind TWh 1 38 9	92
Biofuels (solid, liquid, gaseous)  TWh 3 4	15
Solar PV	56
CSP TWh 0 0	4
	32
	0
	24
Diefuel (askid kinnid assesse)	<b>0</b> 0
	0
	0
	1 <b>09</b>
Direct uses of renewable energy PI 302 375 5	83
Solar thermal - Buildings PJ 5 70 8	30
Solar thermal - Industry PJ 0 13	59
Geothermal PJ 0 0	14
Solar thermal - Buildings PJ 5 70 8 Solar thermal - Industry PJ 0 13 9 Solar thermal - Industry PJ 0 0 13 9 Solar thermal - Industry PJ 0 0 0 0 9 Solar thermal PJ 0 0 0 0 9 Solar thermal PJ 0 0 0 0 9 Solar thermal PJ 0 0 0 0 0 9 Solar thermal PJ 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	0
Bioenergy (modern) - Buildings PJ 0 216 2	30
Bioenergy - Industry PJ 38 25 2	00
Non-renewable - Buildings PJ 402 590 5	83
Non-renewable - Industry PJ 788 1 168 9	43
Non-renewable - BF/CO PJ 0 0	0
Solar thermal - Industry	258
Liquid biofuels PJ 17 75 1	28
Conventional biogasoline PJ 17 53  Advanced biogasoline PJ 0 0  Biodiesel (conventional and advanced) PJ 0 22	70
	17
E Diodese (conventional and davanced)	12
Biomethane PJ 0 0	0
	129
	354
, 9	5%
<u> </u>	1% - o/
RE share in Buildings - final energy use, direct uses (modern)  1% 31% 3:  RE share in Industry, final energy use, direct uses	5%
RE share in Industry - final energy use, direct uses 5% 3% 2:  RE share in Transport fuels 1% 2% 4	2%
	.% 1 <i>0</i> /
	1% 2
RE investment needs [USD bln/yr (2010-2030)]	2 10
Investment support for renewables [USD bln/yr in 2030] N/A N/A 2	.2
Savings from reduced externalities - air pollution (average)	
[USD bln/yr in 2030]  N/A N/A 2	.4
System costs [USD bln/yr in 2030]  RE investment needs [USD bln/yr (2010-2030)]  Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from energy [Mt/yr]  System costs [USD bln/yr in 2030]  N/A  N/A  N/A  Sovings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from energy [Mt/yr]  System costs [USD bln/yr in 2030]  N/A  N/A  N/A  Sovings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]	.2
CO2 emissions from energy [Mt/yr] 369 619 5	15

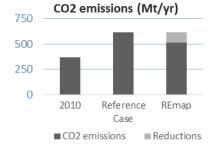
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



# Final RE use by sector (%) and total (PJ/yr)



- RE transport
- Traditional biomass
- RE heat and other direct uses (modern)
- RE power



### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Energy Demand and Supply Outlook 5th Edition, APEC (2014).
- Prospectiva de Energías Renovables 2012-2026 by the Mexican Energy Secretariat (SENER).

















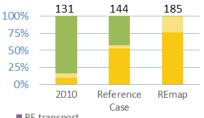
# **REmap Country Results – Morocco**

Total installed power generation capacity   GW   2.1   14.4   21.5				Unit	2010	Reference Case 2030	REmap 2030
Hydropower (excl. pumped hydro)   GW   1.8   3.3   3.4			Total installed power generation capacity		6.4		
Wind   GW   0.3   5.2   10.1			Renewable capacity	GW	2.1	14.4	21.5
Biofuels (solid, liquid, gaseous)   GW   0.0   0.0   0.5			Hydropower (excl. pumped hydro)	GW	1.8	3.3	3.4
Solar PV			Wind	GW	0.3	5.2	10.1
CSP   GW   0.0   3.1   3.1   3.1   Geothermal   GW   0.0			Biofuels (solid, liquid, gaseous)	GW	0.0	0.0	0.5
Marine, other   TWh   0.0   0.0   0.0   0.0			Solar PV	GW	0.0	2.7	4.4
Marine, other   TWh   0.0   0.0   0.0   0.0	Ë		CSP	GW	0.0	3.1	3.1
Marine, other   TWh   0.0   0.0   0.0   0.0	bac	<u> </u>					
Marine, other   TWh   0.0   0.0   0.0   0.0	g	ctc	Marine, other				
Marine, other   TWh   0.0   0.0   0.0   0.0	pu	r se					
Marine, other   TWh   0.0   0.0   0.0   0.0	ē	ě.					
Marine, other   TWh   0.0   0.0   0.0	<u>.</u>	Po					
Marine, other   TWh   0.0   0.0   0.0   0.0	rat						
Marine, other   TWh   0.0   0.0   0.0   0.0	ne						
Marine, other   TWh   0.0   0.0   0.0   0.0	ge						
Marine, other   TWh   0.0   0.0   0.0   0.0	<b>6</b> 6						
Marine, other   TWh   0.0   0.0   0.0   0.0	ē						
Non-renewable generation   TWh   20.9   52.3   38.9	교						
Total district heat generation							
Biofuels (solid, liquid, gaseous)							
Other renewables							
Non-renewable DH		폱					
Total direct uses of energy		_					
Direct uses of renewable energy							
Solar thermal - Buildings		ildings and Industry					
Non-renewable - Industry							
Non-renewable - Industry	7						
Non-renewable - Industry	es						
Non-renewable - Industry	ns						
Non-renewable - Industry	ct						
Non-renewable - Industry	i.						
Non-renewable - Industry							
Biodiesel (conventional and advanced)   PJ   0.0   0.0   0.0   0.0	ıse	Bu					
Biodiesel (conventional and advanced)   PJ   0.0   0.0   0.0   0.0	5						
Biodiesel (conventional and advanced)   PJ   0.0   0.0   0.0   0.0	erg						
Biodiesel (conventional and advanced)   PJ   0.0   0.0   0.0   0.0	en						
Biodiesel (conventional and advanced)   PJ   0.0   0.0   0.0   0.0	ā	ort.					
Biomethane	Ë	dsi	<del>-</del>				
Non-renewable fuels PJ 277 305 270  Total final energy consumption (electricity, DH, direct uses) 2 PJ 753 1 214 1 139  RE share in electricity generation 16% 34% 55%  RE share in district heat generation 0% 0% 0% 0%  RE share in Buildings - final energy use, direct uses (modern) 3% 1% 11%  RE share in Industry - final energy use, direct uses 2% 1% 6%  RE share in Transport fuels 0% 0% 0% 0%  Share of modern RE in TFEC 3 3% 7% 16%		rar	Biodiesel (conventional and advanced)	PJ	0.0	0.0	0.0
Total final energy consumption (electricity, DH, direct uses) <sup>2</sup> PJ 753 1 214 1 139  RE share in electricity generation 16% 34% 55%  RE share in district heat generation 0% 0% 0% 0%  RE share in Buildings - final energy use, direct uses (modern) 3% 1% 11%  RE share in Industry - final energy use, direct uses 2% 1% 6%  RE share in Transport fuels 0% 0% 0% 0%  Share of modern RE in TFEC <sup>3</sup> 3% 7% 16%			Biomethane	PJ	0.0	0.0	0.0
RE share in electricity generation 16% 34% 55%  RE share in district heat generation 0% 0% 0%  RE share in Buildings - final energy use, direct uses (modern) 3% 1% 11%  RE share in Industry - final energy use, direct uses 2% 1% 6%  RE share in Transport fuels 0% 0% 0%  Share of modern RE in TFEC 3 3% 7% 16%			Non-renewable fuels	PJ	277	305	270
RE share in district heat generation 0% 0% 0% 0% 0% RE share in Buildings - final energy use, direct uses (modern) 3% 1% 11% RE share in Industry - final energy use, direct uses 2% 1% 6% RE share in Transport fuels 0% 0% 0% 0% Share of modern RE in TFEC 3 3% 7% 16%	Tota	l final energ	y consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	753	1 214	1 139
Share of modern RE in TFEC <sup>3</sup> 3% 7% 16%		RE shar	e in electricity generation		16%	34%	55%
Share of modern RE in TFEC <sup>3</sup> 3% 7% 16%	es	RE shar	e in district heat generation		0%	0%	0%
Share of modern RE in TFEC <sup>3</sup> 3% 7% 16%	Jar	RE shar	e in Buildings - final energy use, direct uses (mod	dern)	3%	1%	11%
Share of modern RE in TFEC <sup>3</sup> 3% 7% 16%	s	RE shar	e in Industry - final energy use, direct uses		2%	1%	6%
	~	RE share in Transport fuels			0%	0%	0%
System costs [USD bln/yr in 2030] N/A N/A 1 2  RE investment needs [USD bln/yr (2010-2030)] N/A 1 2  Investment support for renewables [USD bln/yr in 2030] N/A N/A 0.4  Savings from reduced externalities - air pollution (average) N/A N/A 3.1  [USD bln/yr in 2030] N/A N/A 1.0  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) N/A N/A 1.0  [USD bln/yr in 2030] Savings from energy [Mt/yr] 56 97 76						7%	16%
RE investment needs [USD bln/yr (2010-2030)] N/A 1 2 Investment support for renewables [USD bln/yr in 2030] N/A N/A 0.4  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from energy [Mt/yr] 56 97 76	ors					N/A	-0.2
Investment support for renewables [USD bln/yr in 2030] N/A N/A 0.4  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO <sub>2</sub> ) [USD bln/yr in 2030]  CO <sub>2</sub> emissions from energy [Mt/yr]  Solution (average) N/A N/A 1.0  N/A N/A 1.0	atc					1	2
Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from energy [Mt/yr]  Solution (average)  N/A  N/A  1.0  76	dic			-	N/A	N/A	0.4
Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030] CO2 emissions from energy [Mt/yr]  Solve to the control of	al in		·	ge)	N/A	N/A	3.1
CO2 emissions from energy [Mt/yr] 56 97 76	nanci	_	· · · · · · · · · · · · · · · · · · ·	(CO2)	N/A	N/A	1.0
	造	CO2 en	nissions from energy [Mt/yr]		56	97	76

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



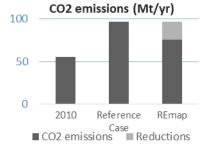
### Final RE use by sector (%) and total (PJ/yr)



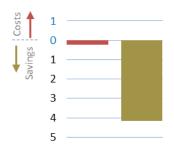
■ RE transport

■ Traditional biomass

RE heat and other direct uses (modern)



### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Etude Prospective de la Demande D'Energie a L'Horizon 2030, Ministry of Energy, Mines, Water and Environment (2013)
- Energie 2030: Quelles options pour le Maroc, Planning Commission.
- Intended Nationally Determined Contribution (INDC), Government of Morocco (2015).















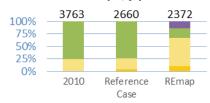
# **REmap Country Results – Nigeria**

				2010	Reference	REmap
			Unit		Case 2030	2030
		Total installed power generation capacity	GW	6	29	40
		Renewable capacity	GW	2	11	28
		Hydropower (excl. pumped hydro)	GW	2	8	10
		Wind	GW	0	0	1
		Biofuels (solid, liquid, gaseous)	GW	0	0	0
_		Solar PV	GW	0	4	16
city		CSP	GW	0	0	2
pa	<u> </u>	Geothermal	GW	0	0	0
ca	ğ	Marine, other	GW	0	0	0
þ	se.	Non-renewable capacity	GW	4	18	12
Energy generation and capacity	Power sector	Total electricity generation	TWh	21	141	141
Ö	9	Renewable generation	TWh	6	39	74
ati	_	Hydropower	TWh	5	33	43
Jer		Wind	TWh	0	0	3
ger		Biofuels (solid, liquid, gaseous)	TWh	0	0	0
 		Solar PV	TWh	1	6	24
erg		CSP	TWh	0	0	3
Ē		Geothermal	TWh	0	0	0
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	15	103	68
		Total district heat generation	PJ	0	0	0
	H	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	Δ	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	3 821	5 097	4 130
	>	Direct uses of renewable energy	PJ	3 746	2 531	1 800
	Buildings and Industry	Solar thermal - Buildings	PJ	0	159	170
S 1		Solar thermal - Industry	PJ	0	64	343
Se		Geothermal	PJ	0	0	0
י ב		Bioenergy (traditional) - Buildings	PJ	2 813	1 978	450
Э.		Bioenergy (modern) - Buildings	PJ	554	331	830
ë		Bioenergy - Industry	PJ	379	0	6
o)		Non-renewable - Buildings	PJ	26	546	609
nse		Non-renewable - Industry	PJ	50	2 020	1 721
<b>∑</b>		Non-renewable - BF/CO	PJ	0	0	0
Final energy use - direct uses <sup>1</sup>		Total fuel consumption	PJ	341	1 941	1 946
en		Liquid biofuels	PJ	0	0	327
Jal	ro t	Conventional biogasoline	PJ	0	0	194
Ë	ransport	Advanced biogasoline	PJ	0	0	0
	ra	Biodiesel (conventional and advanced)	PJ	0	0	132
	-	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	341	1 941	1 619
Total	final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	4 228	7 509	6 546
		re in electricity generation		27%	27%	52%
es	RE sha	re in district heat generation		19%	19%	19%
ar	RE sha	re in Buildings - final energy use, direct uses (mod	lern)	16%	16%	49%
RE shares	RE sha	re in Industry - final energy use, direct uses		88%	3%	17%
RE	RE sha	re in Transport fuels		0%	0%	17%
		of modern RE in TFEC <sup>3</sup>		22%	9%	29%
δ	System	costs [USD bln/yr in 2030]		N/A	N/A	- 3
ţ		estment needs [USD bln/yr (2010-2030)]		N/A	3	6
ica		ment support for renewables [USD bln/yr in 2030	)]	N/A	N/A	0.1
ndi		s from reduced externalities - air pollution (average	-			
: <u>=</u>	_	/yr in 2030]	۱- د	N/A	N/A	6.4
cie		s from reduced externalities - CO <sub>2</sub> (USD 50/tonne	CO2)			
Financial indicators	_	/yr in 2030]	,	N/A	N/A	2.5
ᇤ	-	missions from energy [Mt/yr]		40	361	312
D . (						

### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



### Final RE use by sector (%) and total (PJ/yr)



■ RE transport

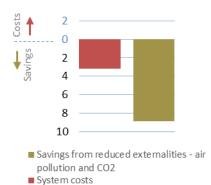
■ Traditional biomass

RE heat and other direct uses (modern)

RE power

### CO2 emissions (Mt/yr) 400 200 2010 Reference Case ■ CO2 emissions ■ Reductions

### Costs and savings (USD bln in 2030)



- Africa 2030: Roadmap for a Renewable Energy Future; Renewable Energy Zones for the Africa Clean Energy Corridor, IRENA (2015).
- The Nigerian Energy Sector, GIZ (2015).
- Sustainable Energy for All Action Agenda, ICREEE (2015).
- Draft National Renewable Energy and Energy Efficiency Policy, Energy Commission of Nigeria (2014).









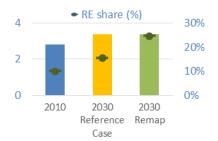




# **REmap Country Results – Poland**

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	36	54	63
		Renewable capacity	GW	5	16	31
		Hydropower (excl. pumped hydro)	GW	2	1	2
		Wind	GW	2	8	17
		Biofuels (solid, liquid, gaseous)	GW	0	5	8
		Solar PV	GW	0	3	5
Energy generation and capacity		CSP	GW	0	0	0
bac	<u> </u>	Geothermal	GW	0	0	0
g	Power sector	Marine, other	GW	0	0	0
P	r se	Non-renewable capacity	GW	31	38	32
ē	We	Total electricity generation	TWh	157	216	217
. <u>ē</u>	Po	Renewable generation	TWh	11	42	84
rat		Hydropower	TWh	3	3	5
ne		Wind	TWh	2	18	43
ge		Biofuels (solid, liquid, gaseous)	TWh	6	18 2	32 4
<u></u>		Solar PV CSP	TWh TWh	0	0	1
ne		Geothermal	TWh	0	0	0
ш		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	146	175	133
		Total district heat generation	PJ	344	513	471
	-	Biofuels (solid, liquid, gaseous)	PJ	13	41	93
	품	Other renewables	PJ	0	14	17
		Non-renewable DH	PJ	331	458	361
	Buildings and Industry	Total direct uses of energy	PJ	1 238	1 276	1 269
		Direct uses of renewable energy	PJ	184	253	356
		Solar thermal - Buildings	PJ	0	26	45
S 1		Solar thermal - Industry	PJ	0	0	10
Final energy use - direct uses <sup>1</sup>		Geothermal	PJ	1	0	0
t		Bioenergy (traditional) - Buildings	PJ	0	0	0
ē		Bioenergy (modern) - Buildings	PJ	122	155	170
- di		Bioenergy - Industry	PJ	61	72	130
Se.	3dil	Non-renewable - Buildings	PJ	627	428	375
ž		Non-renewable - Industry	PJ	342	491	434
<u></u>		Non-renewable - BF/CO	PJ	85	104	104
ne		Total fuel consumption	PJ	698	907	907
<u>=</u>	ţ	Liquid biofuels	PJ	37	71	103
ü	ransport	Conventional biogasoline Advanced biogasoline	PJ PJ	12 0	11 15	14 20
	än	Biodiesel (conventional and advanced)	PJ PJ	25	45	70
	F	Biomethane	PJ	0	0	6
		Non-renewable fuels	PJ	661	835	799
Tota	final energ	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	2 808	3 375	3 367
		e in electricity generation		7%	19%	39%
es	RE shar	e in district heat generation		4%	11%	23%
ar	RE shar	re in Buildings - final energy use, direct uses (mod	ern)	16%	30%	37%
RE shares	RE shar	e in Industry - final energy use, direct uses		15%	13%	24%
<b>&amp;</b>	RE share in Transport fuels			5%	8%	12%
	Share c	of modern RE in TFEC <sup>3</sup>		10%	15%	25%
ors	System	costs [USD bln/yr in 2030]		N/A	N/A	4
atc	RE inve	stment needs [USD bln/yr (2010-2030)]		N/A	2	4
dic		nent support for renewables [USD bln/yr in 2030]		N/A	N/A	2.9
al in		s from reduced externalities - air pollution (averag yr in 2030]	ge)	N/A	N/A	4.1
Financial indicators	_	from reduced externalities - CO <sub>2</sub> (USD 50/tonne /yr in 2030]	CO2)	N/A	N/A	2.7
证	CO2 en	nissions from energy [Mt/yr]		284	301	248

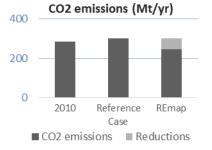
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



# Final RE use by sector (%) and total (PJ/yr)



■ RE transport ■ Traditional biomass ■ RE power



### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Ministry of Economy (2010), National Renewable Energy Action Plan (NREAP).
- Krajowa Agencja Poszanowania Energii (KAPE) (2013), Prognoza zapotrzebowania na paliwa i energię do 2050 roku (Forecast of fuels and energy demand until 2050), KAPE, Warsaw.

















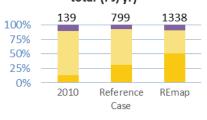
# **REmap Country Results – Republic of Korea**

			Unit	2010	Reference Case 2030	REmap
		Total installed power generation capacity	GW	73	138	2030 181
		Renewable capacity	GW	73 7	41	101
		Hydropower (excl. pumped hydro)	GW	6	7	7
		Wind	GW	0	13	27
					5	5
		Biofuels (solid, liquid, gaseous) Solar PV	GW GW	0	17	61
>		CSP	GW		0	0
ċ				0		0
ed	ō	Geothermal	GW GW	0	0	1
<u> </u>	ect	Marine, other  Non-renewable capacity		67	97	79
Energy generation and capacity	Power sector		GW			
e _	Ňe	Total electricity generation	TWh	480	738	748
Ö	Ъ.	Renewable generation	TWh	6 4	76 5	207 5
<u>r</u> a		Hydropower	TWh			
ne		Wind	TWh	1	27	89
ge		Biofuels (solid, liquid, gaseous)	TWh	1	23	23
8A		Solar PV	TWh	1	20	82
Je.		CSP	TWh	0	0	0
ш		Geothermal	TWh	0	0	3
		Marine, other	TWh	0	2	6
		Non-renewable generation	TWh	475	662	541
		Total district heat generation	PJ	172	305	305
	품	Biofuels (solid, liquid, gaseous)	PJ	20	22	22
		Other renewables	PJ	0	20	20
		Non-renewable DH	PJ	152	263	263
		Total direct uses of energy	PJ	2 526	2 889	2 809
	5	Direct uses of renewable energy	PJ	97	477	517
_	Buildings and Industry	Solar thermal - Buildings	PJ	1	57	57
S		Solar thermal - Industry	PJ	0	19	38
Final energy use - direct uses <sup>1</sup>		Geothermal	PJ	2	85	107
t		Bioenergy (traditional) - Buildings	PJ	0	0	0
i.		Bioenergy (modern) - Buildings	PJ	3	11	11
<u>5</u>		Bioenergy - Industry	PJ	91	306	306
ė		Non-renewable - Buildings	PJ	831	912	843
ž		Non-renewable - Industry	PJ	1 136	1 037	987
<u></u>		Non-renewable - BF/CO	PJ	462	462	462
nei		Total fuel consumption	PJ	1 539	1 436	1 409
ē	4	Liquid biofuels	PJ	15	59	132
na	ransport	Conventional biogasoline	PJ	1	0	13
正	lsu	Advanced biogasoline	PJ	0	0	0
	<u>E</u>	Biodiesel (conventional and advanced)	PJ	14	59	119
		Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	1 524	1 378	1 277
Total		gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	5 787	6 910	6 839
		re in electricity generation		1%	10%	28%
es		re in district heat generation		11%	14%	14%
hai		re in Buildings - final energy use, direct uses (mod	dern)	1%	13%	13%
RE shares		re in Industry - final energy use, direct uses		7%	25%	28%
~		re in Transport fuels	1%	4%	9%	
		of modern RE in TFEC <sup>3</sup>		3%	12%	20%
ors	System costs [USD bln/yr in 2030]			N/A	N/A	0
atc	RE investment needs [USD bln/yr (2010-2030)]			N/A	6	14
ica	Investment support for renewables [USD bln/yr in 2030]			N/A	N/A	2.3
al inc	_	s from reduced externalities - air pollution (avera /yr in 2030]	ge)	N/A	N/A	4.9
Financial indicators	Savings	s from reduced externalities - CO <sub>2</sub> (USD 50/tonne	(CO2)	N/A	N/A	5.7
ina	-	/yr in 2030]				270
	CO2 er	nissions from energy [Mt/yr]		504	493	378

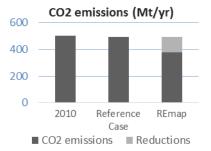
### TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



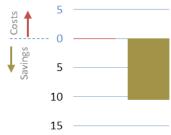
# Final RE use by sector (%) and total (PJ/yr)







### Costs and savings (USD bln in 2030)



Savings from reduced externalities - air pollution and CO2System costs

- Korea 2nd Energy Master Plan, Outlook & Policies to 2035, MOTIE (2014).
- The 4th Renewable Energy Scheme, MOTIE (2014).
- An Analysis of Long-term Scenarios for the Transition to Renewable Energy in the Korean Electricity Sector, Park, Yun, and Jeon (2013).





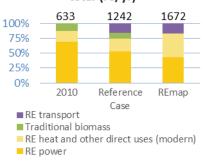
# **REmap Country Results – Russian Federation**

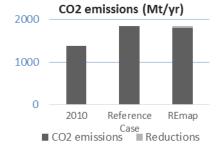
			l lait	2010	Reference Case 2030	REmap
		Total installed newer generation canacity	Unit GW	231	285	2030 294
		Total installed power generation capacity				
		Renewable capacity	GW	47	66	76
		Hydropower (excl. pumped hydro)	GW	47	58	58
		Wind	GW	0	4	5
		Biofuels (solid, liquid, gaseous)	GW	0	2	7
>		Solar PV	GW	0	2	5
Ė		CSP	GW	0	0	0
pa	≿	Geothermal	GW	0	0	1
g	ğ	Marine, other	GW	0	0	0
P	S	Non-renewable capacity	GW	183	220	218
Energy generation and capacity	Power sector	Total electricity generation	TWh	1 036	1 352	1 379
<u>.</u> 5	Po	Renewable generation	TWh	170	243	276
äţ	_	Hydropower	TWh	166	227	227
آور اور		Wind	TWh	0	8	11
gei		Biofuels (solid, liquid, gaseous)	TWh	3	6	28
 ≥2		Solar PV	TWh	0	2	5
er.		CSP	TWh	0	0	0
Ē		Geothermal	TWh	1	1	6
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	866	1 109	1 103
		Total district heat generation	PJ	5 674	7 305	7 305
	I	Biofuels (solid, liquid, gaseous)	PJ	120	162	395
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	5 554	7 143	6 910
		Total direct uses of energy	PJ	5 426	8 807	8 782
		Direct uses of renewable energy	PJ	91	248	318
	dustry	Solar thermal - Buildings	PJ	0	0	0
4		Solar thermal - Industry	PJ	0	0	0
Ses	<u> </u>	Geothermal	PJ	0	0	0
ב	Buildings and Industry	Bioenergy (traditional) - Buildings	PJ	76	120	0
Se		Bioenergy (modern) - Buildings	PJ	0	0	190
흉		Bioenergy - Industry	PJ	15	128	128
(1)		Non-renewable - Buildings	PJ	2 255	3 034	2 939
use		Non-renewable - Industry	PJ	2 233	3 386	3 386
> >		Non-renewable - BF/CO	PJ	846	2 138	2 138
Final energy use - direct uses <sup>1</sup>		Total fuel consumption	PJ	3 733	5 401	5 400
en		Liquid biofuels	PJ	0	200	288
<del>e</del>	r.	Conventional biogasoline	PJ	0	200	200
뜶	ransport	Advanced biogasoline	PJ	0	0	0
	. au	Biodiesel (conventional and advanced)	PJ	0	0	88
	F	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	3 733	5 201	5 112
Total	final energ	gy consumption (electricity, DH, direct uses) 2	PJ	16 932	24 336	24 311
		re in electricity generation		16%	18%	20%
S		re in district heat generation		2%	2%	5%
are		re in Buildings - final energy use, direct uses (mod	dern)	0%	0%	6%
sh		re in Industry - final energy use, direct uses	,	1%	4%	4%
RE shares		re in Transport fuels		0%	4%	5%
		of modern RE in TFEC <sup>3</sup>		3%	5%	7%
S		costs [USD bln/yr in 2030]		N/A	N/A	- 1
ΙŌ	_	estment needs [USD bln/yr (2010-2030)]		N/A	13	14
cat			าไ			
ğ		nent support for renewables [USD bln/yr in 2030	-	N/A	N/A	2.2
Financial indicators		s from reduced externalities - air pollution (avera /yr in 2030]	ge)	N/A	N/A	1.5
cia		s from reduced externalities - CO2 (USD 50/tonne	CO2)			
an	_	yr in 2030]	202)	N/A	N/A	1.7
Ξ		nissions from energy [Mt/yr]		1 384	1 843	1 810
	CO2 61	mosions nom cherby [ivid yi]		± 20 <del>+</del>	I 040	1 010

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

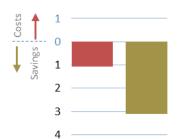


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Energy Strategy of Russia for the period up to 2035, Ministry of Energy of the Russian Federation (2010).
- Draft results of the Energy Strategy of Russia for the period up to 2030 (2016).

















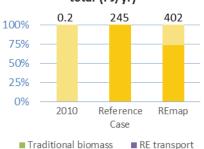
# **REmap Country Results – Saudi Arabia**

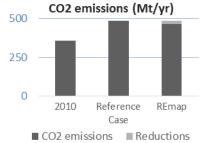
				2010	Reference	REmap
			Unit		Case 2030	2030
		Total installed power generation capacity	GW	55	137	140
		Renewable capacity	GW	0	27	37
		Hydropower (excl. pumped hydro) Wind	GW	0	0	0
			GW GW	0	5 2	5 2
		Biofuels (solid, liquid, gaseous) Solar PV	GW	0	8	16
≥		CSP	GW	0	13	14
acit		Geothermal	GW	0	1	1
аb	ţor	Marine, other	GW	0	0	0
o p	sec	Non-renewable capacity	GW	55	110	104
Energy generation and capacity	Power sector	Total electricity generation	TWh	240	601	601
E C	NO N	Renewable generation	TWh	0	85	106
aţic		Hydropower	TWh	0	0	0
ē		Wind	TWh	0	15	16
gen		Biofuels (solid, liquid, gaseous)	TWh	0	11	12
₩ <b>&gt;</b>		Solar PV	TWh	0	14	28
erg		CSP	TWh	0	42	46
En		Geothermal	TWh	0	4	4
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	240	516	495
		Total district heat generation	PJ	0	0	0
	품	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
		Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	824	1 020	1 073
	Buildings and Industry	Direct uses of renewable energy Solar thermal - Buildings	PJ PJ	0	0	107 59
₽		Solar thermal - Industry	PJ PJ	0	0	38
ses		Geothermal	PJ	0	0	10
ž		Bioenergy (traditional) - Buildings	PJ	0	0	0
ect		Bioenergy (modern) - Buildings	PJ	0	0	0
ġ		Bioenergy - Industry	PJ	0	0	0
ď		Non-renewable - Buildings	PJ	63	69	69
Final energy use - direct uses <sup>1</sup>	ā	Non-renewable - Industry	PJ	761	951	897
8		Non-renewable - BF/CO	PJ	0	0	0
Jer		Total fuel consumption	PJ	1 476	2 629	2 594
ē	ر ب	Liquid biofuels	PJ	0	0	0
na	por	Conventional biogasoline	PJ	0	0	0
证	ansport	Advanced biogasoline	PJ	0	0	0
	Tr.	Biodiesel (conventional and advanced)	PJ	0	0	0
		Biomethane  Non-renewable fuels	PJ PJ	0 1 476	0 2 629	0 2 594
Tota	l final onor	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	2 990	5 376	<b>5 332</b>
Tota		re in electricity generation		0%	14%	18%
S		re in district heat generation		0%	0%	0%
RE shares		re in Buildings - final energy use, direct uses (mod	ern)	0%	0%	46%
sh		re in Industry - final energy use, direct uses	,	0%	0%	5%
R E		re in Transport fuels		0%	0%	0%
	Share of modern RE in TFEC <sup>3</sup>			0%	5%	8%
รา		costs [USD bln/yr in 2030]		N/A	N/A	- 8
at o	RE investment needs [USD bln/yr (2010-2030)]			N/A	4	6
ica		nent support for renewables [USD bln/yr in 2030	]	N/A	N/A	0.3
ino	Savings	from reduced externalities - air pollution (averag	ge)	N/A	N/A	4.3
<u>=</u>	_	yr in 2030]		IV/A	IV/A	4.3
Financial indicators		s from reduced externalities - CO <sub>2</sub> (USD 50/tonne	CO2)	N/A	N/A	1.1
ina	-	(yr in 2030]				
т.	L CO2 en	nissions from energy [Mt/yr]		360	488	465

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

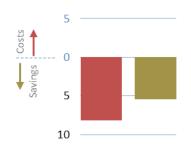


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



 Savings from reduced externalities - air pollution and CO2
 System costs

- Saudi Arabia's Renewable Energy Strategy and Solar Energy Deployment Roadmap, KACARE (2013).
- Geothermal Development Roadmap for the Kingdom of Saudi Arabia, Hashem (2012).
- Prospects of Renewable Energy to Promoto Zero-Energy Residential Buildings in the KSA, Alrashed and Asif















# **REmap Country Results – South Africa**

		·		2010	Reference	REmap
			Unit		Case 2030	2030
		Total installed power generation capacity	GW	37	75	92
		Renewable capacity	GW	1	19	43
		Hydropower (excl. pumped hydro)	GW	1	1	1
		Wind	GW	0	4	8
		Biofuels (solid, liquid, gaseous)	GW	0	1	3
_		Solar PV	GW	0	10	25
Energy generation and capacity		CSP	GW	0	3	5
pa	5	Geothermal	GW	0	0	0
2	Power sector	Marine, other	GW	0	0	0
힏	r se	Non-renewable capacity	GW	36	57	50
ā	Še.	Total electricity generation	TWh	259	438	440
<u>.</u>	Po	Renewable generation	TWh	4	48	98
<u>a</u> t		Hydropower	TWh	4	4	4
ne		Wind	TWh	0	11	22
ge		Biofuels (solid, liquid, gaseous)	TWh	0	5	16
≥		Solar PV	TWh	0	17	39
ē		CSP	TWh	0	11	18
ᇤ		Geothermal	TWh	0	0	0
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	255	390	341
		Total district heat generation	PJ	0	0	0
	품	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	۵	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	1 189	1 427	1 277
	>	Direct uses of renewable energy	PJ	451	445	487
	ıstı	Solar thermal - Buildings	PJ	3	4	75
S	op.	Solar thermal - Industry	PJ	0	0	26
Se	= 5	Geothermal (Buildings and Industry)	PJ	0	0	0
ŧ	Buildings and Industry	Bioenergy (traditional) - Buildings	PJ	237	219	33
ē		Bioenergy (modern) - Buildings	PJ	133	123	170
ਚ		Bioenergy - Industry	PJ	78	99	184
ė	Ē	Non-renewable - Buildings	PJ	175	153	70
Sn		Non-renewable - Industry	PJ	587	829	720
Final energy use - direct uses <sup>1</sup>		Non-renewable - BF/CO	PJ	- 24	0	0
Je		Total fuel consumption	PJ	740	1 524	1 497
<u> </u>	ب	Liquid biofuels	PJ	0	0	31
na	ansport	Conventional biogasoline	PJ	0	0	16
iΞ	lsu	Advanced biogasoline	PJ	0	0	0
	Tra	Biodiesel (conventional and advanced)	PJ	0	0	15
		Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	740	1 524	1 466
Tota		rgy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	2 682	4 490	4 239
10		e in electricity generation		2%	11%	22%
<u>re</u>		e in district heat generation		N/A	N/A	N/A
RE shares		re in Buildings - final energy use, direct uses (mod	lern)	25%	25%	70%
E S		re in Industry - final energy use, direct uses		12%	11%	23%
~		e in Transport fuels		0%	0%	2%
		of modern RE in TFEC <sup>3</sup>		8%	9%	19%
ors	,	costs [USD bln/yr in 2030]		N/A	N/A	0
ate		stment needs [USD bln/yr (2010-2030)]		N/A	2	5
dic		nent support for renewables [USD bln/yr in 2030		N/A	N/A	3.5
ial in	[USD bln/	from reduced externalities - air pollution (avera yr in 2030]		N/A	N/A	16.6
Financial indicators	_	from reduced externalities - $CO_2$ (USD 50/tonne yr in 2030]	CO2)	N/A	N/A	3.1
证	CO2 en	nissions from energy [Mt/yr]		361	509	447

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



# Final RE use by sector (%) and total (PJ/yr)

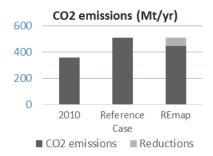


■ RE transport

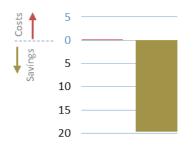
■ Traditional biomass

RE heat and other direct uses (modern)

RE power



### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

### $\label{lem:References} \textbf{References for further consultation:}$

- Draft 2012 on Integrated Energy Planning (2012).
- IRP 2010-2030, update report, DOE (2013).

















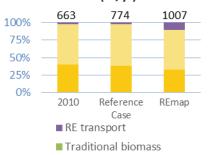
# REmap Country Results – Sweden

Total installed power generation capacity   GIV   28   42   44     Renewable capacity   GIV   18   29   33     Hydropower (excl. pumped hydro)   GIV   16   17   20     Wind   GIV   2   7   7     Biofucles (solid, liquid, gaseous)   GIV   0   0   0     Solar PV   GIV   0   0   0   0     CSP   GIV   0   0   0   0     Geothermal   GIV   0   0   0   0     Marine, other   TWh   148   194   198   198     Renewable generation   TWh   83   120   136   136     Hydropower   TWh   66   69   82     Wind   TWh   4   12   12   12     Biofucles (solid, liquid, gaseous)   TWh   13   39   42     Solar PV   TWh   0   0   0   0     Geothermal   TWh   0   0   0   0     Marine, other   TWh   0   0   0   0     Bioles (solid, liquid, gaseous)   PJ   150   157   186     Other renewable generation   PJ   204   170   194     Bioles (solid, liquid, gaseous)   PJ   150   157   186     Other renewable energy   PJ   225   304   382     Solar thermal - Industry   PJ   0   0   0     Geothermal   Montrelevable energy   PJ   205   37   8     Biolenergy (modern) - Buildings   PJ   31   55   55     Biolenergy (modern) - Buildings   PJ   31   55   55     Bionethane   Disposoline   PJ   31   52   72     Bionethane   Disposoline   PJ   31   52   72     Bionethane   Disposoline   PJ   31   52   72     B				Unit	2010	Reference Case 2030	REmap 2030
Hydropower (excl. pumped hydro)   GW   16   17   20			Total installed power generation capacity		28		
Wind   GW   2   7   7   7   8   15   15   15   15   15   15   15			Renewable capacity	GW	18	29	33
Biofuels (solid, liquid, gaseous)   GW   0   5   6			Hydropower (excl. pumped hydro)	GW	16	17	20
Solar PV   GW   0   0   0   0			Wind	GW	2	7	7
CSP   GW   0   0   0   0   0   0   0   0   0			Biofuels (solid, liquid, gaseous)	GW	0	5	6
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186			Solar PV	GW	0	0	0
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	Ë		CSP	GW	0	0	0
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	bac	<u> </u>					
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	g	ctc					0
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	P	r se					
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	ā	Wei					
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	Ö	Po					
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	rat						
Marine, other   TWh   0   0   0   0   0   Non-renewable generation   TWh   655   74   662     170   194   194   194   195   150   157   186	ne						
Marine, other   TWh   0   0   0   0	ge						
Marine, other   TWh   0   0   0   0	g.						
Marine, other   TWh   0   0   0   0	Jer						
Non-renewable generation   TWh   65   74   62	ū						
Total district heat generation			i				
Biofuels (solid, liquid, gaseous)							
Other renewables							
Non-renewable DH		품					
Total direct uses of energy							
Direct uses of renewable energy							
Solar thermal - Buildings							
Non-renewable - Industry		ings and Industry					
Non-renewable - Industry	↔						
Non-renewable - Industry	ses		· · · · · · · · · · · · · · · · · · ·				
Non-renewable - Industry	Š						
Non-renewable - Industry	ect						
Non-renewable - Industry	흉						
Non-renewable - Industry	o)	톋					
Biodiesel (conventional and advanced)   PJ   14   5   72	use	盈					
Biodiesel (conventional and advanced)   PJ   14   5   72	26						
Biodiesel (conventional and advanced)   PJ   14   5   72	erg						
Biodiesel (conventional and advanced)   PJ   14   5   72	e			PJ	17	10	99
Biodiesel (conventional and advanced)   PJ   14   5   72	la	L O	Conventional biogasoline	PJ	3	2	2
Biomethane Non-renewable fuels PJ 0 5 8 Non-renewable fuels PJ 302 282 190  Total final energy consumption (electricity, DH, direct uses) 2 PJ 1400 1423 1417  RE share in electricity generation RE share in district heat generation RE share in Buildings - final energy use, direct uses (modern) RE share in Industry - final energy use, direct uses RE share in Transport fuels Share of modern RE in TFEC 3 47% 54% 70%	虚	dsu	Advanced biogasoline	PJ	0	3	25
Non-renewable fuels PJ 302 282 190  Total final energy consumption (electricity, DH, direct uses) 2 PJ 1400 1423 1417  RE share in electricity generation 56% 62% 69%  RE share in district heat generation 74% 93% 96%  RE share in Buildings - final energy use, direct uses (modern) 46% 60% 87%  RE share in Industry - final energy use, direct uses 67% 64% 84%  RE share in Transport fuels 5% 5% 37%  Share of modern RE in TFEC 3 47% 54% 70%			Biodiesel (conventional and advanced)	PJ	14	5	72
Total final energy consumption (electricity, DH, direct uses) <sup>2</sup> PJ 1 400 1 423 1 417  RE share in electricity generation 56% 62% 69%  RE share in district heat generation 74% 93% 96%  RE share in Buildings - final energy use, direct uses (modern) 46% 60% 87%  RE share in Industry - final energy use, direct uses 67% 64% 84%  RE share in Transport fuels 5% 5% 37%  Share of modern RE in TFEC <sup>3</sup> 47% 54% 70%							
RE share in electricity generation 56% 62% 69%  RE share in district heat generation 74% 93% 96%  RE share in Buildings - final energy use, direct uses (modern) 46% 60% 87%  RE share in Industry - final energy use, direct uses 67% 64% 84%  RE share in Transport fuels 5% 5% 37%  Share of modern RE in TFEC 3 47% 54% 70%							
RE share in district heat generation 74% 93% 96% RE share in Buildings - final energy use, direct uses (modern) 46% 60% 87% RE share in Industry - final energy use, direct uses 67% 64% 84% RE share in Transport fuels 5% 5% 37% Share of modern RE in TFEC 3 47% 54% 70%	Tota			PJ			
Share of modern RE in TFEC <sup>3</sup> 47% 54% 70%	10						
Share of modern RE in TFEC <sup>3</sup> 47% 54% 70%	E		<u> </u>	,			
Share of modern RE in TFEC <sup>3</sup> 47% 54% 70%	ha		0, ,	ern)			
Share of modern RE in TFEC <sup>3</sup> 47% 54% 70%	ШS						
	~		•				
RE investment needs [USD bln/yr (2010-2030)] Investment support for renewables [USD bln/yr in 2030] Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  N/A  N/A  1.  1.  2.  3.  N/A  N/A  0.4  0.4  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]	10						
Investment needs [OSD bin/yr (2010-2030)] N/A 2 3  Investment support for renewables [USD bln/yr in 2030] N/A N/A 0.4  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030] N/A N/A 0.3	or.	, , , , , , , , , , , , , , , , , , , ,					
Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  N/A  N/A  0.4  0.3	cat			1			
[USD bln/yr in 2030] N/A N/A 0.3	di				N/A	N/A	0.4
	ial in	[USD bln/	/yr in 2030]		N/A	N/A	0.3
Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2)  N/A  N/A  0.8	nanc		s from reduced externalities - CO <sub>2</sub> (USD 50/tonne /yr in 2030]	CO2)	N/A	N/A	0.8
CO2 emissions from energy [Mt/yr] 41 38 22	证	CO2 er	nissions from energy [Mt/yr]		41	38	22

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



# Final RE use by sector (%) and total (PJ/yr)



25 CO2 emissions (Mt/yr)
25 2010 Reference REmap

### Costs and savings (USD bln in 2030)

Case ■ CO2 emissions ■ Reductions



- Savings from reduced externalities air pollution and CO2
- System costs

- Energy in Sweden 2015, Swedish Energy Agency (2015).
- The Advanced Energy [r]evolution, Greenpeace International, European Renewable Energy Council (2011).
- National Renewable Energy Action Plan (NREAP), Sweden submitted to EC (2012).

















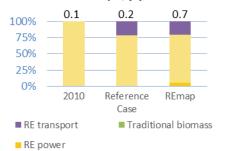
# **REmap Country Results – Tonga**

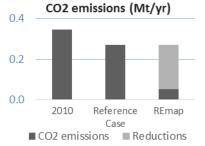
			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	0.01	0.03	0.09
		Renewable capacity	GW	0.00	0.01	0.12
		Hydropower (excl. pumped hydro)	GW	0.00	0.00	0.00
		Wind	GW	0.00	0.00	0.00
		Biofuels (solid, liquid, gaseous)	GW	0.00	0.00	0.00
		Solar PV	GW	0.00	0.01	0.12
ؾؘ		CSP	GW	0.00	0.00	0.00
Jac	_	Geothermal	GW	0.00	0.00	0.00
Energy generation and capacity	Power sector	Marine, other	GW	0.00	0.00	0.00
٦	Se	Non-renewable capacity	GW	0.01	0.03	-0.03
ā	Ver	Total electricity generation	TWh	0.06	0.12	0.36
<u>.</u> 0	Po	Renewable generation	TWh	0.00	0.01	0.14
rat	_	Hydropower	TWh	0.00	0.00	0.00
Je.		Wind	TWh	0.00	0.00	0.00
ge		Biofuels (solid, liquid, gaseous)	TWh	0.00	0.00	0.00
≥		Solar PV	TWh	0.00	0.01	0.14
ē		CSP	TWh	0.00	0.00	0.00
n n		Geothermal	TWh	0.00	0.00	0.00
		Marine, other	TWh	0.00	0.00	0.00
		Non-renewable generation	TWh	0.06	0.11	0.22
		Total district heat generation	PJ	0.00	0.00	0.00
	품	Biofuels (solid, liquid, gaseous)	PJ	0.00	0.00	0.00
	<u> </u>	Other renewables	PJ	0.00	0.00	0.00
		Non-renewable DH	PJ	0.00	0.00	0.00
	Buildings and Industry	Total direct uses of energy	PJ	2.60	2.65	2.59
		Direct uses of renewable energy	PJ	0.10	0.15	0.50
_		Solar thermal - Buildings	PJ	0.00	0.00	0.25
es		Solar thermal - Industry	PJ	0.00	0.00	0.10
Final energy use - direct uses <sup>1</sup>		Geothermal	PJ	0.00	0.00	0.00
せ		Bioenergy (traditional) - Buildings	PJ	0.00	0.00	0.00
ire		Bioenergy (modern) - Buildings	PJ	0.05	0.07	0.07
7		Bioenergy - Industry	PJ	0.05	0.08	0.08
se		Non-renewable - Buildings	PJ	1.50	1.50	1.21
n >		Non-renewable - Industry	PJ	1.00	1.00	0.88
er B		Non-renewable - BF/CO	PJ PJ	0.00	0.00	0.00 <b>0.97</b>
ene		Total fuel consumption Liquid biofuels	PJ PJ	<b>2.00</b> 0.00	<b>2.04</b> 0.04	0.97
<del>a</del>	r.	Conventional biogasoline	PJ PJ	0.00	0.04	0.14
Ë	ransport	Advanced biogasoline	PJ	0.00	0.00	0.00
	gu	Biodiesel (conventional and advanced)	PJ	0.00	0.00	0.10
	F	Biomethane	PJ	0.00	0.00	0.00
		Non-renewable fuels	PJ	2.00	2.00	0.83
Tota	final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	4.60	4.69	3.66
		re in electricity generation		3%	7%	39%
S		re in district heat generation		0%	0%	0%
are	RE sha	re in Buildings - final energy use, direct uses (mo	dern)	3%	4%	21%
RE shares	RE sha	re in Industry - final energy use, direct uses		5%	8%	17%
R.	RE sha	re in Transport fuels		0%	2%	14%
	Share o	of modern RE in TFEC <sup>3</sup>		2%	4%	19%
S	System	n costs [USD bln/yr in 2030]		N/A	N/A	0
to	RE inve	estment needs [USD bln/yr (2010-2030)]		N/A	0	0
<u>:</u>		ment support for renewables [USD bln/yr in 203	0]	N/A	N/A	0.0
l ind		s from reduced externalities - air pollution (avera /vr in 20301	ige)	N/A	N/A	0.0
Financial indicators	[USD bln/yr in 2030] Savings from reduced externalities - CO₂ (USD 50/tonne CO2 [USD bln/yr in 2030]		e CO2)	N/A	N/A	0.0
Fi	_	missions from energy [Mt/yr]		0	0	0

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

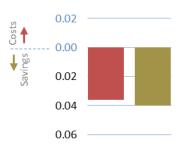


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



Savings from reduced externalities - air pollution and CO2

■ System costs

- Pacific Lighthouses, Tonga, IRENA (2013).
- Tonga Energy Road Map 2010-2020, Kingdom of Tonga (2010).

















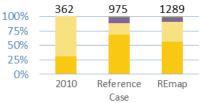
# **REmap Country Results – Turkey**

			Unit	2010	Reference Case 2030	REmap 2030
		Total installed power generation capacity	GW	45	144	146
		Renewable capacity	GW	16	89	95
		Hydropower (excl. pumped hydro)	GW	15	44	44
		Wind	GW	1	33	33
		Biofuels (solid, liquid, gaseous)	GW	0	1	4
		Solar PV	GW	0	9	11
. <u>₹</u> .	Ĺ	CSP	GW	0	0	0
ac		Geothermal	GW	0	1	3
g	cto	Marine, other	GW	0	0	0
Energy generation and capacity	Power sector	Non-renewable capacity	GW	29	55	51
a	/er	Total electricity generation	TWh	187	543	544
<u> </u>	ŏ	Renewable generation	TWh	38	229	251
aţi	_	Hydropower	TWh	36	119	119
er		Wind	TWh	1	82	82
e.		Biofuels (solid, liquid, gaseous)	TWh	0	7	18
SO >		Solar PV	TWh	0	14	18
<u> </u>		CSP	TWh	0	0	0
ı.		Geothermal	TWh	0	8	13
		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	149	313	293
		Total district heat generation	PJ	0	0	0
	-	Biofuels (solid, liquid, gaseous)	PJ	0	0	0
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	0	0	0
		Total direct uses of energy	PJ	1 456	1 598	1 630
		Direct uses of renewable energy	PJ	252	210	461
	ř.	Solar thermal - Buildings	PJ	13	37	54
Η.	snp	Solar thermal - Industry	PJ	5	0	23
Ses	Ĕ	Geothermal	PJ	40	24	102
, T	Buildings and Industry	Bioenergy (traditional) - Buildings	PJ	0	16	16
e.	SS	Bioenergy (modern) - Buildings	PJ	192	124	244
흉	<u>:</u>	Bioenergy - Industry	PJ	2	8	23
ı,	텵	Non-renewable - Buildings	PJ	620	712	548
use	五	Non-renewable - Industry	PJ	488	573	518
>		Non-renewable - BF/CO	PJ	96	103	103
Final energy use - direct uses <sup>1</sup>		Total fuel consumption	PJ	623	1 220	1 205
en		Liquid biofuels	PJ	0	100	100
a	ansport	Conventional biogasoline	PJ	0	9	9
뜶	dsı	Advanced biogasoline	PJ	0	0	0
	ran	Biodiesel (conventional and advanced)	PJ	0	91	91
	Ĕ	Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	623	1 120	1 105
Total	final ener	gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	2 663	4 441	4 463
	RE sha	re in electricity generation		20%	42%	46%
es	RE sha	re in district heat generation		0%	0%	0%
RE shares	RE sha	re in Buildings - final energy use, direct uses (mod	ern)	28%	20%	41%
-R	RE sha	re in Industry - final energy use, direct uses		2%	1%	11%
Æ	RE sha	re in Transport fuels		0%	8%	8%
	Share o	of modern RE in TFEC <sup>3</sup>		14%	22%	29%
S		costs [USD bln/yr in 2030]		N/A	N/A	0
to	•	estment needs [USD bln/yr (2010-2030)]		N/A	10	12
<u>:</u>		ment support for renewables [USD bln/yr in 2030	]	N/A	N/A	1.4
l ind	Savings	s from reduced externalities - air pollution (average /yr in 2030]		N/A	N/A	4.3
Financial indicators	Savings	s from reduced externalities - CO <sub>2</sub> (USD 50/tonne (yr in 2030]	CO2)	N/A	N/A	1.3
Fin		nissions from energy [Mt/yr]		235	316	290
	202 61				510	-50

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



# Final RE use by sector (%) and total (PJ/yr)



■ Traditional biomass

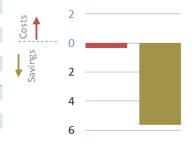
■ RE transport

RE heat and other direct uses (modern)

RE power

# CO2 emissions (Mt/yr) 200 2010 Reference REmap Case CO2 emissions Reductions

### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

### References for further consultation:

- National Renewable Energy Action Plan for Turkey, Ministry of Energy and Natural Resources (2014).

















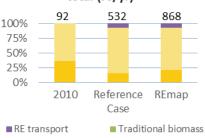
# **REmap Country Results – Ukraine**

			11	2010	Reference	REmap
		Total installed power generation capacity	Unit GW	54	Case 2030 80	2030 <b>85</b>
		Renewable capacity	GW	6	11	<b>27</b>
		Hydropower (excl. pumped hydro)	GW	5	6	6
		Wind	GW	0	0	9
		Biofuels (solid, liquid, gaseous)	GW	0	3	4
		Solar PV	GW	0	3	8
>		CSP	GW	0	0	0
ci		Geothermal	GW	0	0	0
ape	ō	Marine, other	GW	0	0	0
<u>ა</u>	ect	Non-renewable capacity	GW	48	69	58
Energy generation and capacity	Power sector	Total electricity generation	TWh	189	<b>284</b>	284
u L	Š	Renewable generation	TWh	13	32	71
tio	Pc	Hydropower	TWh	13	15	15
ra		Wind	TWh	0	8	35
sue.		Biofuels (solid, liquid, gaseous)	TWh	0	7	13
g		Solar PV	TWh	0	3	8
رو و		CSP	TWh	0	0	0
nei		Geothermal	TWh	0	0	0
Ш		Marine, other	TWh	0	0	0
		Non-renewable generation	TWh	175	252	213
		Total district heat generation	PJ	619	678	678
	_	Biofuels (solid, liquid, gaseous)	PJ	11	116	137
	품	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	607	562	541
		Total direct uses of energy	PJ	1 687	2 085	2 099
		Direct uses of renewable energy	PJ	48	312	502
	it Z	Solar thermal - Buildings	PJ	0	15	36
н.	sng	Solar thermal - Industry	PJ	0	0	5
ses	Buildings and Industry	Geothermal	PJ	0	4	10
Ţ		Bioenergy (traditional) - Buildings	PJ	0	0	0
e.		Bioenergy (modern) - Buildings	PJ	47	126	186
ij	Ξ	Bioenergy - Industry	PJ	2	167	264
a)	븚	Non-renewable - Buildings	PJ	636	689	611
Final energy use - direct uses <sup>1</sup>	ā	Non-renewable - Industry	PJ	628	679	581
g		Non-renewable - BF/CO	PJ	375	406	406
Jer		Total fuel consumption	PJ	455	557	557
e		Liquid biofuels	PJ	0	37	63
nal	oc	Conventional biogasoline	PJ	0	25	30
Ξ	ransport	Advanced biogasoline	PJ	0	0	5
	Tra	Biodiesel (conventional and advanced)	PJ	0	12	27
		Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	455	520	495
Total		gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	3 207	4 039	4 053
10		re in electricity generation		7%	11%	25%
RE shares		re in district heat generation		2%	17%	20%
ha		re in Buildings - final energy use, direct uses (mod	lern)	7%	17%	27%
Щ. S		re in Industry - final energy use, direct uses		0%	20%	32%
~		re in Transport fuels		0%	7%	11%
ιΔ.		of modern RE in TFEC 3		3%	13%	22%
or.		costs [USD bln/yr in 2030]		N/A	N/A	0
cat		estment needs [USD bln/yr (2010-2030)]	1	N/A	2	4
di		ment support for renewables [USD bln/yr in 2030	•	N/A	N/A	0.7
. <u>⊑</u>	_	s from reduced externalities - air pollution (averag /yr in 2030]	ge)	N/A	N/A	1.6
cia		s from reduced externalities - CO2 (USD 50/tonne	CO3)			
an	_	yr in 2030]	CO2)	N/A	N/A	2.6
Financial indicators		nissions from energy [Mt/yr]		236	284	231
		5, 5, 7, 3				

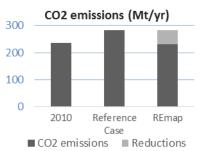
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



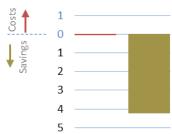
# Final RE use by sector (%) and total (PJ/yr)



RE power



### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

### References for further consultation:

 National Renewable Energy Action Plan (NREAP) through 2020 DRAFT, State Agency on Energy Efficiency and Energy Saving of Ukraine (2012).

















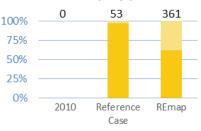
# **REmap Country Results – United Arab Emirates**

Total installed power generation capacity   GW   0   0   8   34				Unit	2010	Reference Case 2030	REmap 2030
Hydropower (excl. pumped hydro)   GW   0   0   0   0			Total installed power generation capacity		23		
Wind   GW   O   O   1			Renewable capacity	GW	0	8	34
Solar PV   GW   O   O   O   O			Hydropower (excl. pumped hydro)	GW	0	0	0
Solar PV			Wind	GW	0	0	1
CSP   Geothermal   GW   O   O   O   O   O   O   O   O   O			Biofuels (solid, liquid, gaseous)	GW	0	0	0
Marine, other   TWh   0			Solar PV	GW	0	6	29
Marine, other   TWh   0	Ë		CSP	GW	0	1	3
Marine, other   TWh   0	Jac	_	Geothermal	GW	0	0	0
Marine, other   TWh   0	cak	ct	Marine, other	GW	0	0	0
Marine, other   TWh   0	Þ	se	Non-renewable capacity	GW	23	48	42
Marine, other   TWh   0	ā	/er	Total electricity generation	TWh	98	233	242
Marine, other   TWh   0	io	90	Renewable generation	TWh	0	15	66
Marine, other   TWh   0	ati	_	Hydropower	TWh	0	0	0
Marine, other   TWh   0	Je.			TWh	0		
Marine, other   TWh   0	geı		Biofuels (solid, liquid, gaseous)	TWh	0	1	3
Marine, other   TWh   0	<u>}</u>			TWh	0	10	49
Marine, other   TWh   0	er.			TWh	0	3	12
Non-renewable generation   TWh   98   218   176	En		Geothermal	TWh	0	0	
Total district heat generation			Marine, other	TWh	0	0	0
Biofuels (solid, liquid, gaseous)						218	
Other renewables							
Non-renewable DH		Ξ					
Total direct uses of energy   PJ   1149   1876   1915							
Direct uses of renewable energy							
Solar thermal - Buildings			——————————————————————————————————————				
Non-renewable - Industry		>					
Non-renewable - Industry	_	ıst					
Non-renewable - Industry	S	ng .	· · · · · · · · · · · · · · · · · · ·				
Non-renewable - Industry	use	- <del>-</del>					
Non-renewable - Industry	な	a					
Non-renewable - Industry	ire	νgυ					
Non-renewable - Industry	р <u>-</u>	펼					
Biodiesel (conventional and advanced)   PJ   0   0   0   0	se	Bui					
Biodiesel (conventional and advanced)   PJ   0   0   0   0	л >						
Biodiesel (conventional and advanced)   PJ   0   0   0   0	50						
Biodiesel (conventional and advanced)   PJ   0   0   0   0	, ne						
Biodiesel (conventional and advanced)   PJ   0   0   0   0	al e	Ę					
Biodiesel (conventional and advanced)   PJ   0   0   0   0	<u>ii</u>	sbc					
Biomethane		an					
Non-renewable fuels		F					
RE share in electricity generation   O%   6%   27%							
RE share in electricity generation   0%   6%   27%	Total	final energ					
RE share in district heat generation   0%   0%   0%   0%     RE share in Buildings - final energy use, direct uses (modern)   0%   11%   94%     RE share in Industry - final energy use, direct uses   0%   0%   0%     RE share in Transport fuels   0%   0%   0%     Share of modern RE in TFEC 3   0%   2%   11%     System costs [USD bln/yr in 2030]   N/A   N/A   1   4     Investment needs [USD bln/yr (2010-2030)]   N/A   N/A   1.8     Savings from reduced externalities - air pollution (average)     [USD bln/yr in 2030]   N/A   N/A   1.6     Savings from reduced externalities - CO2 (USD 50/tonne CO2)   N/A   N/A   1.6     N/A   N/A   1.6							
Share of modern RE in TFEC <sup>3</sup> System costs [USD bln/yr in 2030]  RE investment needs [USD bln/yr (2010-2030)]  Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  N/A  N/A  1.6	S	-					
Share of modern RE in TFEC <sup>3</sup> System costs [USD bln/yr in 2030]  RE investment needs [USD bln/yr (2010-2030)]  Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  N/A  N/A  1.6	are			dern)			
Share of modern RE in TFEC <sup>3</sup> System costs [USD bln/yr in 2030]  RE investment needs [USD bln/yr (2010-2030)]  Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  N/A  N/A  1.6	sh			,			4%
Share of modern RE in TFEC <sup>3</sup> System costs [USD bln/yr in 2030]  RE investment needs [USD bln/yr (2010-2030)]  Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  N/A  N/A  1.6	RE	·			0%	0%	0%
System costs [USD bln/yr in 2030]		•					
RE investment needs [USD bln/yr (2010-2030)]  Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - air pollution (average)  [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2)  [USD bln/yr in 2030]  [USD bln/yr in 2030]  CO2 emissions from pageray [Mt/yr]  152  371  340	ก						
Investment support for renewables [USD bln/yr in 2030] N/A N/A 1.8  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  [USD bln/yr in 2030]  CO2 emissions from pageray [Mt/yr]  152 271 240	ţ						4
Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from pagers [Mt/yr]  152  240	<u>:</u>	Investment support for renewables [USD bln/yr in 2030]				N/A	1.8
[USD bln/yr in 2030] Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]	nd				<del>.</del>		2.2
[USD bln/yr in 2030]  (CO2 emissions from energy [Mt/yr]	cial i	[USD bln/yr in 2030]			N/A	N/A	2.3
$\Box$ CO2 emissions from energy [Mt/yr] 1E2 274 240	nanc	_		(02)	N/A	N/A	1.6
CO2 emissions from energy [wit/yr] 155 2/1 240	证	CO2 en	nissions from energy [Mt/yr]		153	271	240

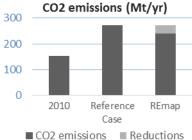
# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



# Final RE use by sector (%) and total (PJ/yr)







### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- REmap: Renewable Energy Prospects, United Arab Emirates, IRENA (2015).
- UAE State of Energy Report 2015, Ministry of Energy (2015).
- Renewable Energy Market Analysis: The GCC Region (2016).

















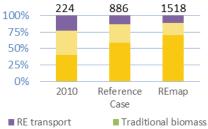
# **REmap Country Results – United Kingdom**

				2010	Reference	REmap
			Unit		Case 2030	2030
		Total installed power generation capacity	GW	91	109	141
		Renewable capacity	GW	9	50	98
		Hydropower (excl. pumped hydro)	GW	2	2	4
		Wind	GW	5	27	60
		Biofuels (solid, liquid, gaseous)	GW	2	6	6
>		Solar PV	GW	0	16	24
cit		CSP	GW	0	0	0
ра	ō	Geothermal	GW	0	0	3
<u>8</u>	ect	Marine, other	GW	0 82		43
ınd	s r	Non-renewable capacity  Total electricity generation	GW TWh	366	58 <b>346</b>	397
Energy generation and capacity	Power sector	Renewable generation	TWh	28	142	298
tio	Po	Hydropower	TWh	5	6	14
ra		Wind	TWh	11	82	195
ene		Biofuels (solid, liquid, gaseous)	TWh	12	39	39
8		Solar PV	TWh	0	15	25
rg S		CSP	TWh	0	0	0
ne		Geothermal	TWh	0	0	19
ш		Marine, other	TWh	0	0	4
		Non-renewable generation	TWh	338	203	99
		Total district heat generation	PJ	231	165	165
	_	Biofuels (solid, liquid, gaseous)	PJ	8	25	48
	ᆷ	Other renewables	PJ	0	0	0
		Non-renewable DH	PJ	224	140	117
		Total direct uses of energy	PJ	2 976	2 418	1 881
		Direct uses of renewable energy	PJ	82	246	281
	it T	Solar thermal - Buildings	PJ	0	0	23
1	gns	Solar thermal - Industry	PJ	0	0	3
Final energy use - direct uses <sup>1</sup>	Buildings and Industry	Geothermal	PJ	0	0	0
t u		Bioenergy (traditional) - Buildings	PJ	0	0	0
Ģ		Bioenergy (modern) - Buildings	PJ	61	133	133
d.		Bioenergy - Industry	PJ	20	114	122
a) I		Non-renewable - Buildings	PJ	2 059	1 593	1 034
ns		Non-renewable - Industry	PJ	726	480	467
8		Non-renewable - BF/CO	PJ	110	99	99
Jer		Total fuel consumption	PJ	1 753	1 605	1 514
e	ب	Liquid biofuels	PJ	52	119	165
nal	insport	Conventional biogasoline	PJ	17	90	100
证	usk	Advanced biogasoline	PJ	0	1	36
	Tra	Biodiesel (conventional and advanced)	PJ	34	29	29
		Biomethane	PJ	0	0	0
		Non-renewable fuels	PJ	1 701	1 485	1 349
Total		gy consumption (electricity, DH, direct uses) <sup>2</sup>	PJ	5 936	5 330	4 871
10		re in electricity generation		8%	41%	75%
ě	RE share in district heat generation			3%	15%	29%
RE shares	RE share in Buildings - final energy use, direct uses (modern)			3%	8%	13%
S П	RE share in Industry - final energy use, direct uses			3%	19%	21%
~	RE share in Transport fuels			3%	7%	11%
(0	Share of modern RE in TFEC <sup>3</sup>			4%	17%	32%
ors	System costs [USD bln/yr in 2030]			N/A	N/A	- 3
at	RE investment needs [USD bln/yr (2010-2030)]			N/A	7	16
dic	Investment support for renewables [USD bln/yr in 2030]			N/A	N/A	1.6
Financial indicators	Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]			N/A	N/A	2.0
ıcia	Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2)			N//	N1/A	2.2
nan	[USD bln/yr in 2030]			N/A	N/A	3.2
证	CO2 emissions from energy [Mt/yr]			516	300	237

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



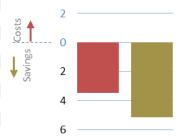
# Final RE use by sector (%) and total (PJ/yr)



■ RE transport ■ Traditional biomass ■ RE power

# CO2 emissions (Mt/yr) 400 200 2010 Reference REmap Case CO2 emissions Reductions

### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- 2015 energy and emissions projections: projections of greenhouse gas emissions and energy demand from 2015 to 2035, DECC (2015).
- Delivering UK Energy Investment, DECC (2014).
- UK Renewable Energy Roadmap Update 2013, DECC (2013).

















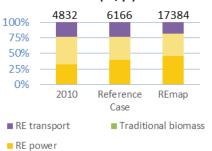
# **REmap Country Results – United States**

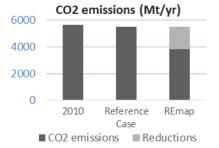
Unit 20	Reference REmap Case 2030 2030
	983 1 106 1 435
	133 227 792
	78 80 115
	39 87 343
	10 13 66
Solar PV GW	2 37 237
	1 2 6
Geothermal GW	2 7 25
Marine, other GW	0 0 0
Non-renewable capacity GW 8	350 880 643
Total electricity generation TWh 4	129 4 679 4 887
	170 756 2 450
Hydropower TWh 2	260 295 429
Wind	96 245 1 099
Biofuels (solid, liquid, gaseous) TWh	95 94 348
Solar PV TWh	4 68 368
CSP	1 3 16
Geothermal TWh	15 52 189
Marine, other TWh	0 0 0
	659 3 923 2 437
	155 516 516
Diefriele (selid lieuid seesens)	91 154 154
Other renewables  Other renewables	0 0 0
	363 363 363
	098 24 802 23 763
Direct uses of renewable energy P1 2	114 2 228 6 065
Solar thermal - Buildings PJ	96 113 692
Solar thermal - Industry PJ	0 0 241
Solar thermal - Buildings PJ  Solar thermal - Industry PJ  Geothermal PJ  Bioenergy (traditional) - Buildings PJ  Bioenergy (modern) - Buildings PJ  Bioenergy - Industry PJ  Non-renewable - Buildings PJ  Non-renewable - Buildings PJ  9	11 29 59
Bioenergy (traditional) - Buildings PJ	0 0 0
Bioenergy (modern) - Buildings PJ 5	550 501 704
Bioenergy - Industry PJ 1	456 1585 4370
Non-renewable - Buildings PJ 9	556 8 789 6 644
Non-renewable - Industry PJ 11	090 13 481 10 750
Non-renewable - BF/CO PJ 3	339 304 304
	264 26 196 25 462
Liquid biofuels PJ 1	125 1 422 2 965
Conventional biogasoline PJ 1	060 1 227 1 465
Conventional biogasoline PJ 1  Advanced biogasoline PJ  Biodiscal (conventional and advanced) PJ	0 44 1350
Biodiesel (conventional and advanced) PJ	
Biomethane PJ	65 150 150
Non-renewable fuels PJ 26	65 150 150 0 0 261
Total final energy consumption (electricity, DH, direct uses) <sup>2</sup> PJ 64	
RE share in electricity generation 1	0 0 261
RE share in district heat generation 2	0 0 261 139 24 775 22 236
RE share in Buildings - final energy use, direct uses (modern)	0 0 261 139 24 775 22 236 150 66 370 65 462
RE share in Industry - final energy use, direct uses 1	0 0 261 139 24 775 22 236 150 66 370 65 462 1% 16% 50%
RE share in industry - linal energy use, direct uses	0 0 261 139 24 775 22 236 <b>150 66 370 65 462</b> 1% 16% 50% 0% 30% 30%
u ·	0 0 261 139 24 775 22 236 150 66 370 65 462 1% 16% 50% 0% 30% 30% 5% 7% 18%
The state of the s	0         0         261           139         24 775         22 236           150         66 370         65 462           1%         16%         50%           0%         30%         30%           5%         7%         18%           2%         11%         30%
Share of modern RE in TFEC <sup>3</sup>	0         0         261           139         24 775         22 236           150         66 370         65 462           1%         16%         50%           0%         30%         30%           5%         7%         18%           2%         11%         30%           14%         5%         12%
Share of modern RE in TFEC <sup>3</sup>	0         0         261           139         24 775         22 236           150         66 370         65 462           1%         16%         50%           0%         30%         30%           5%         7%         18%           2%         11%         30%           4%         5%         12%           3%         9%         27%
Share of modern RE in TFEC <sup>3</sup>	0         0         261           139         24 775         22 236           150         66 370         65 462           1%         16%         50%           0%         30%         30%           5%         7%         18%           2%         11%         30%           4%         5%         12%           3%         9%         27%           1/A         N/A         20
Share of modern RE in TFEC <sup>3</sup>	0         0         261           139         24 775         22 236           150         66 370         65 462           1%         16%         50%           0%         30%         30%           5%         7%         18%           2%         11%         30%           4%         5%         12%           3%         9%         27%           1/A         N/A         20           1/A         13         96
Share of modern RE in TFEC <sup>3</sup> System costs [USD bln/yr in 2030]  RE investment needs [USD bln/yr (2010-2030)]  Investment support for renewables [USD bln/yr in 2030]  Savings from reduced externalities - GO <sub>2</sub> (USD 50/tonne CO2)	0     0     261       139     24 775     22 236       150     66 370     65 462       1%     16%     50%       0%     30%     30%       5%     7%     18%       2%     11%     30%       4%     5%     12%       3%     9%     27%       1/A     N/A     20       1/A     N/A     41.5

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)

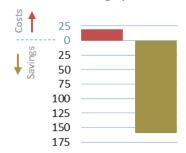


# Final RE use by sector (%) and total (PJ/yr)





### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

- Annual Energy Outlook 2015, US Energy Information Agency (2015).
- Clean Power Plan, US Environmental Protection Agency (2015).
- Transportation Energy Futures, National Renewable Energy Laboratory (2014).
- Renewable Electricity Futures Study, National Renewable Energy Laboratory (2012).

















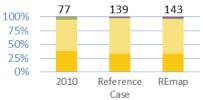
# **REmap Country Results – Uruguay**

Total installed power generation capacity   GW   2				Unit	2010	Reference Case 2030	REmap 2030
Renewable capacity   GW   2			Total installed power generation capacity		3		
Wind   Biofuels (solid, liquid, gaseous)   GW   0				GW	2	4	4
Biofuels (solid, liquid, gaseous)   GW   0			Hydropower (excl. pumped hydro)	GW	2	2	2
Solar PV   GW   0   0   0   0   0   0   0   0   0			Wind	GW	0	2	2
CSP   GW   0   0   0   0   0   0   0   0   0			Biofuels (solid, liquid, gaseous)	GW	0	1	1
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1			Solar PV	GW	0	0	0
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	ij		CSP	GW	0	0	0
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	Jac	_	Geothermal	GW	0	0	0
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	cap	ct	Marine, other	GW	0	0	0
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	ğ	/er se	Non-renewable capacity	GW	1	1	1
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	ar		Total electricity generation	TWh	11	16	16
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	Ö	Š	Renewable generation	TWh	10	15	15
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	ati	_	Hydropower	TWh	8	10	10
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	Jer		Wind	TWh	0	3	3
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	ger		Biofuels (solid, liquid, gaseous)	TWh	1	2	2
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	<u>}</u>		Solar PV	TWh	0	1	1
Marine, other   TWh   0   0   0   0   1   1   1   1   1   1	erg		CSP	TWh	0	0	0
Non-renewable generation   TWh   1   1   1   1   1   1   1   1   1	En		Geothermal				
Total district heat generation			Marine, other	TWh	0	0	0
Biofuels (solid, liquid, gaseous)					1	1	1
Other renewables			Total district heat generation				0
Non-renewable DH		Ξ					
Total direct uses of energy   PJ   64   116   116							
Direct uses of renewable energy							
Solar thermal - Buildings			—				
Non-renewable - Industry		≥					
Non-renewable - Industry	н	ust					
Non-renewable - Industry	es	pu					
Non-renewable - Industry	ns	_ _					
Non-renewable - Industry	ţ	ar					
Non-renewable - Industry	lire	ngs					
Non-renewable - Industry	0	i					
Biodiesel (conventional and advanced)   PJ   0   1   2	Ise	Bu					
Biodiesel (conventional and advanced)   PJ   0   1   2	n >						
Biodiesel (conventional and advanced)   PJ   0   1   2	erg						
Biodiesel (conventional and advanced)   PJ   0   1   2	en(						
Biodiesel (conventional and advanced)   PJ   0   1   2	a (	r.					
Biodiesel (conventional and advanced)   PJ   0   1   2	Fin	sbc	<del>-</del>				
Biomethane PJ 0 0 0 0 0 Non-renewable fuels PJ 43 80 77  Total final energy consumption (electricity, DH, direct uses) 2 PJ 148 260 259  RE share in electricity generation 89% 94% 94% RE share in district heat generation 0% 0% 0% 0% RE share in Buildings - final energy use, direct uses (modern) 44% 46% 47% RE share in Industry - final energy use, direct uses 83% 85% 87% RE share in Transport fuels 1% 2% 5% Share of modern RE in TFEC 3 51% 54% 56%		ran	5				
Total final energy consumption (electricity, DH, direct uses) <sup>2</sup> PJ 148 260 259  RE share in electricity generation 89% 94% 94%  RE share in district heat generation 0% 0% 0%  RE share in Buildings - final energy use, direct uses (modern) 44% 46% 47%  RE share in Industry - final energy use, direct uses 83% 85% 87%  RE share in Transport fuels 1% 2% 5%  Share of modern RE in TFEC <sup>3</sup> 51% 54% 56%		F					
Total final energy consumption (electricity, DH, direct uses) <sup>2</sup> PJ 148 260 259  RE share in electricity generation 89% 94% 94%  RE share in district heat generation 0% 0% 0%  RE share in Buildings - final energy use, direct uses (modern) 44% 46% 47%  RE share in Industry - final energy use, direct uses 83% 85% 87%  RE share in Transport fuels 1% 2% 5%  Share of modern RE in TFEC <sup>3</sup> 51% 54% 56%			Non-renewable fuels	PJ	43	80	77
RE share in district heat generation 0% 0% 0% 0% RE share in Buildings - final energy use, direct uses (modern) 44% 46% 47% RE share in Industry - final energy use, direct uses 83% 85% 87% RE share in Transport fuels 1% 2% 5% Share of modern RE in TFEC 3 51% 54% 56%	Total	final ener		PJ	148	260	259
Share of modern RE in TFEC <sup>3</sup> 51% 54% 56%		RE sha	re in electricity generation		89%	94%	94%
Share of modern RE in TFEC <sup>3</sup> 51% 54% 56%	es	RE sha	re in district heat generation		0%	0%	0%
Share of modern RE in TFEC <sup>3</sup> 51% 54% 56%	shar	RE share in Buildings - final energy use, direct uses (modern)			44%	46%	47%
Share of modern RE in TFEC <sup>3</sup> 51% 54% 56%		RE share in Industry - final energy use, direct uses			83%	85%	87%
	2	RE share in Transport fuels			1%	2%	5%
System costs [USD bln/yr in 2030]   N/A   N/A   0.02     RE investment needs [USD bln/yr (2010-2030)]   N/A   0.3   0.3     Investment support for renewables [USD bln/yr in 2030]   N/A   N/A   0.05     Savings from reduced externalities - air pollution (average)   N/A   N/A   0.1     USD bln/yr in 2030]   Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2)   N/A   N/A   0.02     [USD bln/yr in 2030]   CO2 emissions from energy [Mt/yr]   5   10   9					51%	54%	56%
RE investment needs [USD bln/yr (2010-2030)] $N/A$ 0.3 0.3 Investment support for renewables [USD bln/yr in 2030] $N/A$ $N/A$ 0.05 Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030] $N/A$ $N/A$ 0.1 Savings from reduced externalities - $N/A$ $N/A$ 0.1 [USD bln/yr in 2030] $N/A$ $N/A$ 0.02 [USD bln/yr in 2030] $N/A$ $N/A$ 0.02 CO2 emissions from energy [Mt/yr] $N/A$ 0.09	ors				N/A	N/A	0.02
Investment support for renewables [USD bln/yr in 2030] N/A N/A 0.05  Savings from reduced externalities - air pollution (average) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO2 emissions from energy [Mt/yr]  Savings from reduced externalities - CO <sub>2</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  CO3 emissions from energy [Mt/yr]  Savings from reduced externalities - CO <sub>3</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>4</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>5</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>5</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>5</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>5</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]  Savings from reduced externalities - CO <sub>5</sub> (USD 50/tonne CO2) [USD bln/yr in 2030]	atc						
Savings from reduced externalities - air pollution (average) N/A N/A 0.1 [USD bln/yr in 2030] Savings from reduced externalities - $CO_2$ (USD 50/tonne CO2) N/A N/A 0.02 [USD bln/yr in 2030] CO2 emissions from energy [Mt/yr] 5 10 9	<u> </u>				N/A	N/A	0.05
Savings from reduced externalities - $CO_2$ (USD 50/tonne CO2) N/A N/A 0.02 [USD bln/yr in 2030] CO2 emissions from energy [Mt/yr] 5 10 9	al inc	, , , , ,			N/A	N/A	0.1
CO2 emissions from energy [Mt/yr] 5 10 9	nanci				N/A	N/A	0.02
	遣	CO2 emissions from energy [Mt/yr]				10	9

# TFEC (EJ/yr) (left) and share of modern RE in TFEC (%) (right)



# Final RE use by sector (%) and total (PJ/yr)



■ RE transport

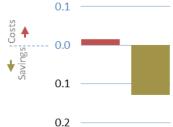
■ Traditional biomass

RE heat and other direct uses (modern)

RE power

# CO2 emissions (Mt/yr) 5 0 2010 Reference REmap Case CO2 emissions Reductions

### Costs and savings (USD bln in 2030)



- Savings from reduced externalities air pollution and CO2
- System costs

### References for further consultation:

- Estudio de Demanda 2012-2035, MIEM (2014).

















### **NOTES**:

- <sup>1</sup> Final energy use/consumption from direct uses excludes electricity and district heat consumption.
- <sup>2</sup> Total final energy consumption (TFEC) is the energy delivered to consumers, whether as electricity, heat or fuels that can be used directly as a source of energy. This consumption is usually sub-divided into that used in: transport; industry; residential, commercial and public buildings; and agriculture; and it excludes non-energy uses of fuels.
- <sup>3</sup> Modern renewable energy (RE) excludes traditional uses of bioenergy (in countries that use traditional bioenergy); the share of modern RE in TFEC is equal to total modern RE consumption in end-use sectors (including consumption of renewable electricity and district heat and direct uses of renewables), divided by TFEC:

Share of modern RE in TFEC = 
$$\frac{Total\ modern\ RE\ use}{TFEC}$$















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