REmap
A Renewable Energy Roadmap

IRENA
International Renewable Energy Agency

#REmap

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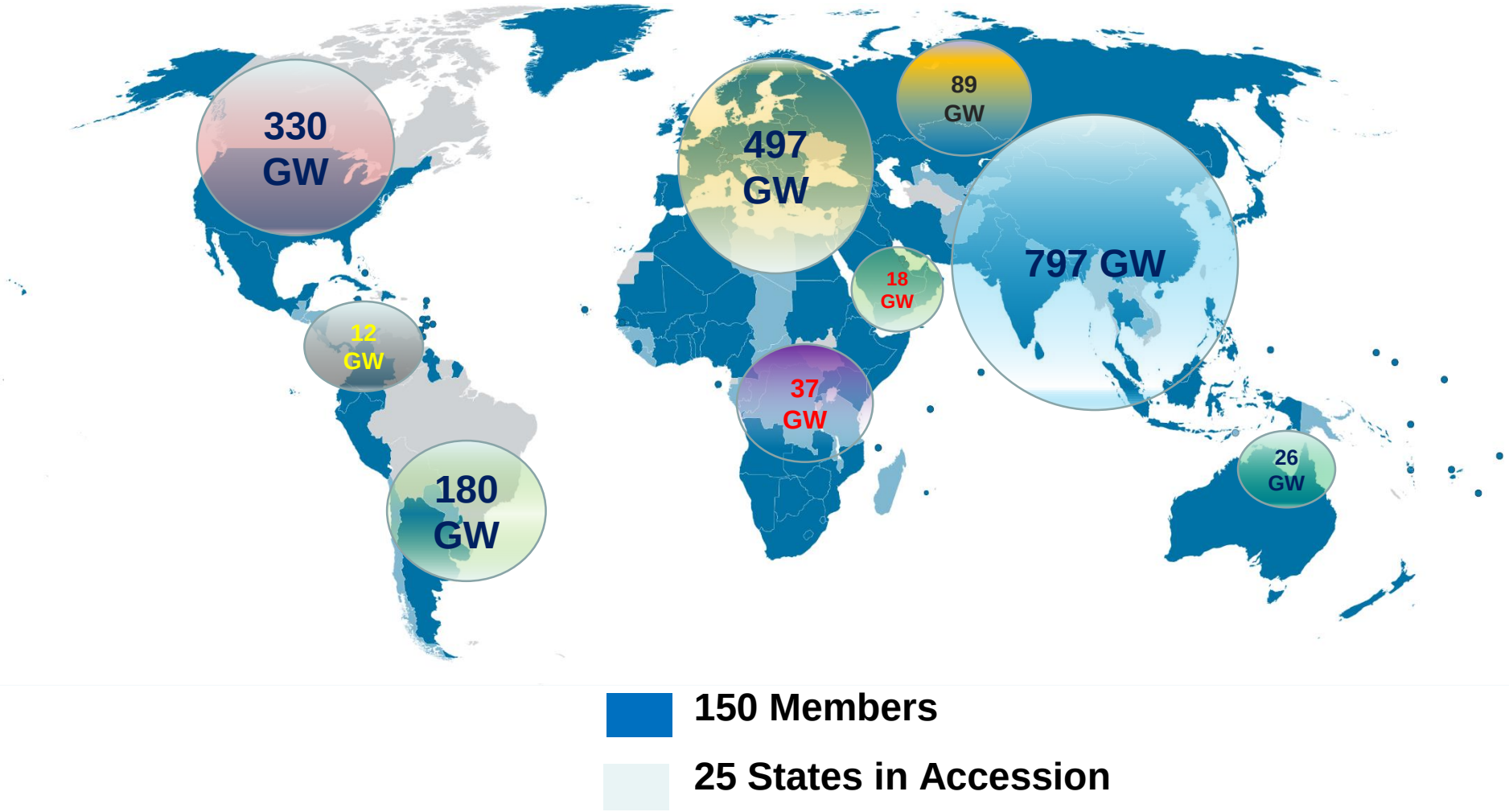
APEC EGNRET, Jeju Republic of Korea, 27-30 March 2017

Outline

- Brief introduction of IRENA and REmap program
- Overview REmap methodology
- Overview REmap tool
- Demonstration of REmap tool (on the Excel file)

IRENA and REmap program

IRENA's Global Coverage

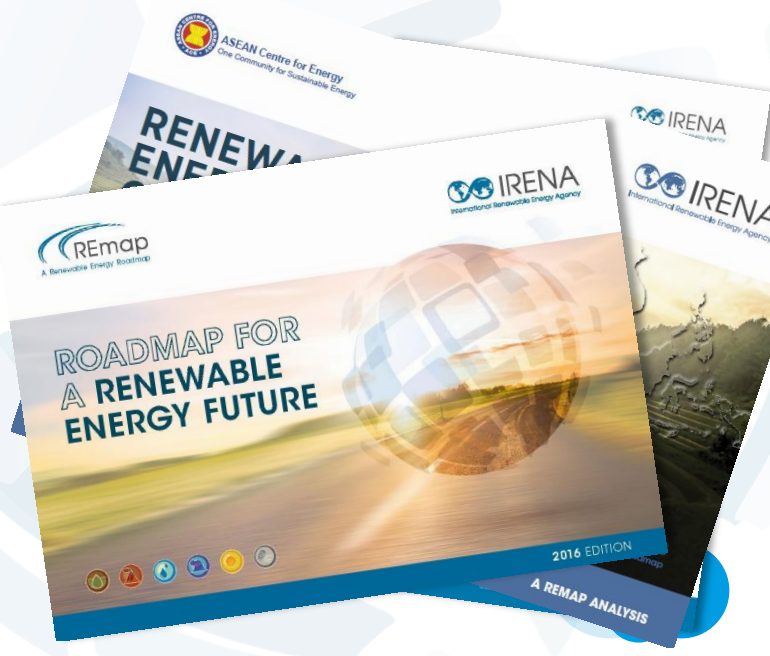


Representing (2016):

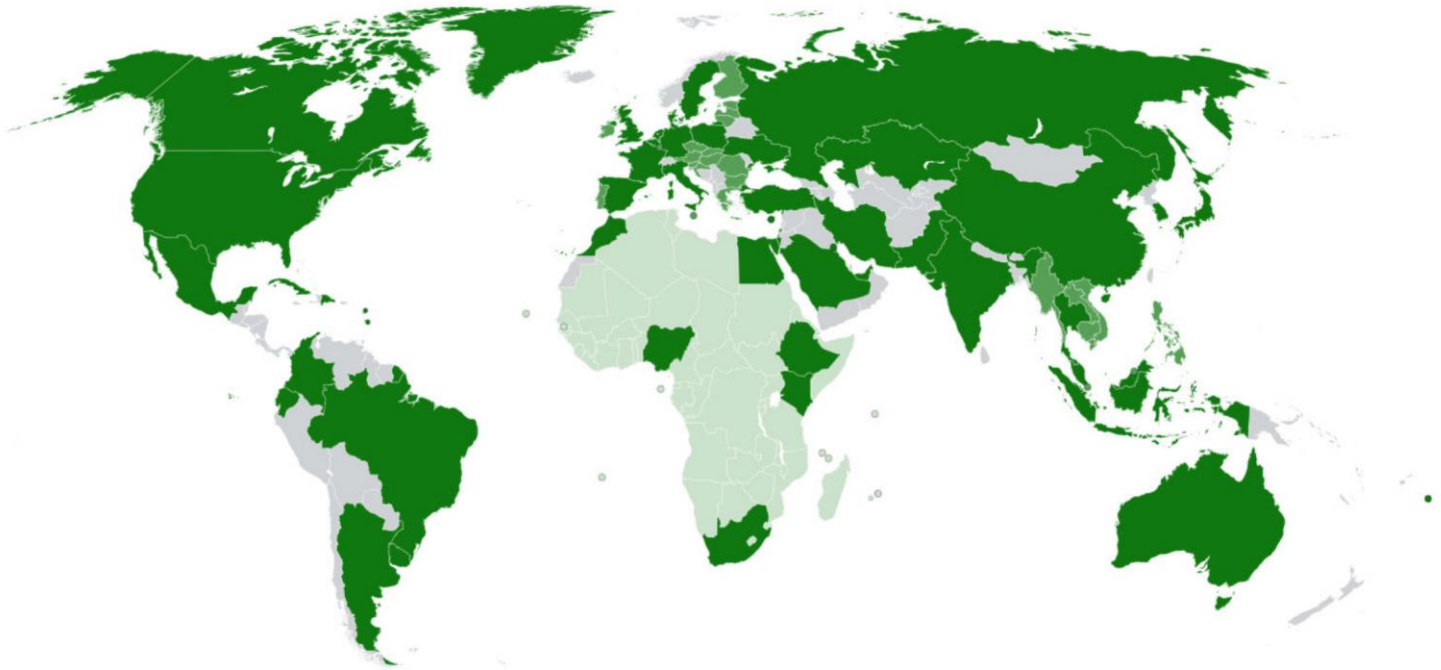
- ❑ 87% of the global installed renewable electricity generation capacity
- ❑ 80% of the global renewable electricity generation output

Remap Program

- IRENA's Global Renewable Energy Roadmap
- Shows feasible, cost-effective ways to increase renewable energy deployment in world's energy mix by 2030 in line with UN SDG7
- Support the G20 in determining pathways for operationalising Paris Agreement with decarbonisation scenarios analysis to 2050, report released in March 2017
- REmap 3.0 report coming in early 2018
- Identifies concrete technology options for countries and sectors
- Assesses policy and investment implications
- Outlines benefits (economic, social, environmental)
- 30 publications to date and datasets



REmap Countries and regional efforts



- Applied to **70 countries**, covering more than 90% of the global energy demand
- **Dark green**: REmap countries
- **Middle green**: Countries covered under the REmap regional analyses for the EU and ASEAN
- **Light green**: Countries covered under the REmap regional analysis and IRENA power pools projects for Africa

REmap Methodology

The REmap approach

- IRENA's REmap programme explores how to operationalize a doubling of the global renewable energy share by 2030 and put the world on a <2C climate pathway by 2050 in line with Paris Agreement
- Technology Options:
  - This is no a target setting exercise
  - Each technology option is characterized by its cost and potentials
  - Technology options can be combined into roadmaps or plans and translated into policy action
- Includes power and end-uses (industry, buildings, transport)
  - Including sector coupling and power systems aspects
- Developed together with and validated by country experts

REmap engagement process

- Joint work of countries and IRENA
- Three parallel tracks:
  - Country analysis (for all countries included in REmap program)
  - Regional analysis (ASEAN, Africa, EU)
  - REmap comprehensive country reports or working papers (with interested countries)
- IRENA works with country experts to conduct analysis
  - Approximately 1-3 man-weeks of work required by country expert
  - Country report based on close collaboration, longer process
- An established “REmap tool”

Regional and country engagement options

- **Regional analysis**
  - Lower level of technology options assessment and regional disaggregation
  - Identify key technologies and trends, and cross-country opportunities
- **Country Efforts**
  - Renewable Readiness Assessment (RRAs) – institutional frameworks, capacity, planning
  - REmap/RRA (Thailand and Egypt) – frameworks, capacity and planning with technology view
  - REmap full report (e.g. Indonesia, China, Germany, the US, and Russia) – In-depth technology options analysis, costing/benefits assessment and possible policy suggestions
  - REmap working paper (e.gi. Poland, Japan and Pakistan) – Specific sector technology focus with limited/no policy discussion
  - REmap/Power/District Heating and Cooling/Bioenergy/Transportation– In-depth technology options analyses with sector focus

REmap country analyses
Collaboration of IRENA and country experts

What is the RE outlook by 2030 in government plans?

- Overall energy demand forecast
- Sectoral breakdowns
- Government targets for RE
- Share of RE in energy mix (in SE4ALL definition)

What are the costs and benefits of the RE options?

- Accounting for forecast energy prices, discount rates, technology costs
- Derive set of metrics, e.g. investment needs, substitution cost (per technology), net system costs

What are the additional RE deployment options?

- Accounting for RE resources in the country; realistic deployment potential
- Includes large number of technology options across sectors (power, DH, buildings, industry, transport)

REmap Tool

The REmap tool

- REmap is an excel based accounting framework to develop technology options:

  In REmap **tool**:

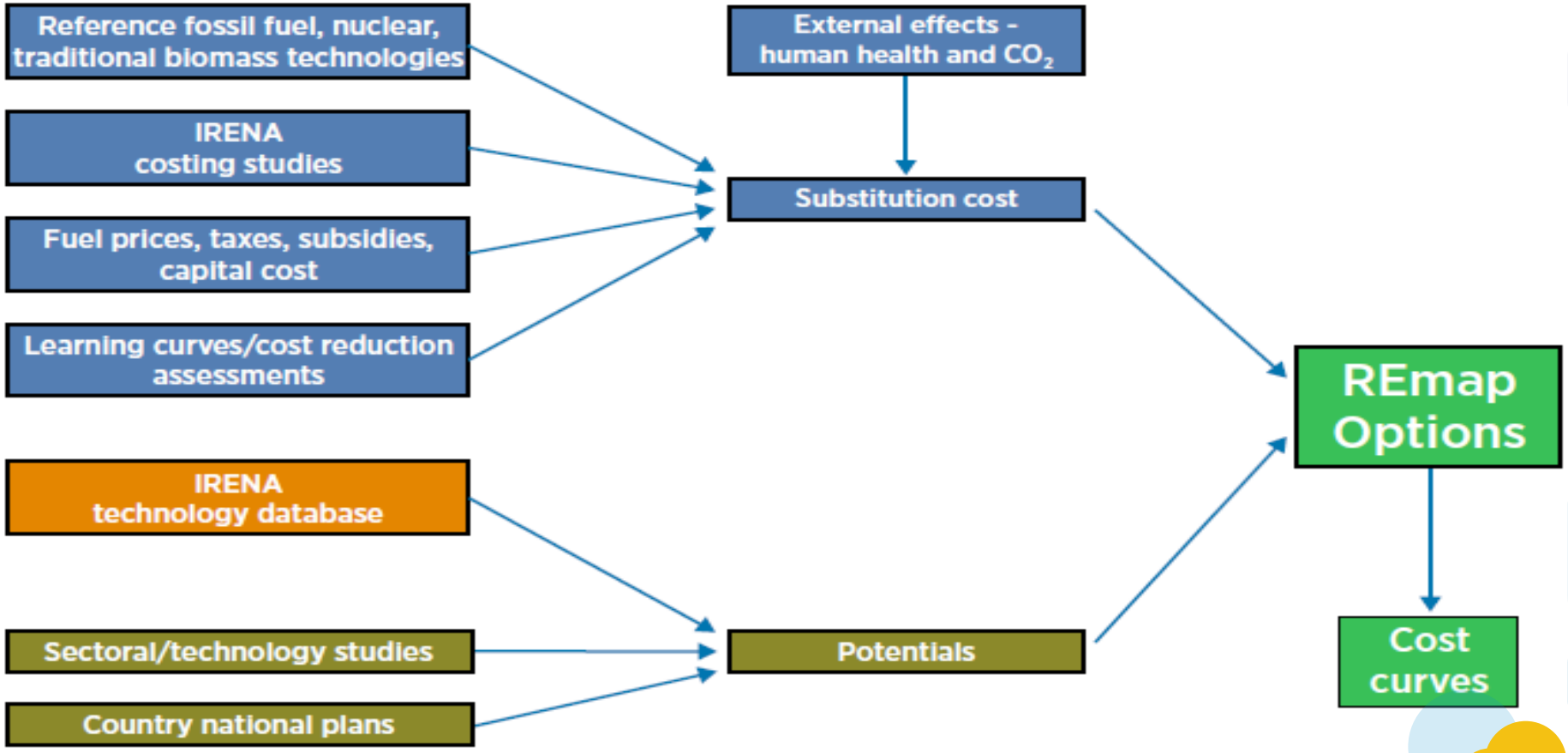
  - interpret energy system developments in uniform methodology with similar system boundaries
  - Renewable Options analysis based on technology list and uniform approach to substitution
  - Costs/benefits/investments framework for cross sector/country/technology assessment

  Additional co-analysis (not part of this study)

  - System aspects (power system)
  - Macro-economic benefits

REmap tool

- Excel based tool allowing a comparable and transparent framework



REmap Options - realistic potential of renewables

- **REmap (= Reference Case + REmap Options)** – additional potential of renewables beyond the Reference Case for an accelerated RE deployment for years 2030, and 2050 or specific policy target year(e.g. 2036 for Thailand's case)

- Estimation of **REmap Options**, sector and technical indicators approach (% share of each technology within each sector and annual uptake)
  - Demand growth
  - Age of existing capital stock
  - Costs of technologies in 2030 or 2050
  - Resource availability
  - Access to finance, human resource needs and supply
  - Manufacturing capacity

→Reference case analysis based also on IRENA renewables readiness assessment

→Technical workshop(s) for feedback & expert consultation – analysis will be revised and updated for final report

REmap analysis data needs

- Statistics on energy consumption by end-use sector (industry, transport, buildings) and energy generation (2014, or the defined reference year)
- Energy demand projections
- Power sector generation projections and system development (transmission, distribution, DSM and overall energy management)
- Data or literature on: renewable energy potential for future development (for all sectors); high renewable energy scenarios
- Energy commodity prices (today and future)
- Technology costs and performance factors (today and future)

Financial metrics of REmap Options

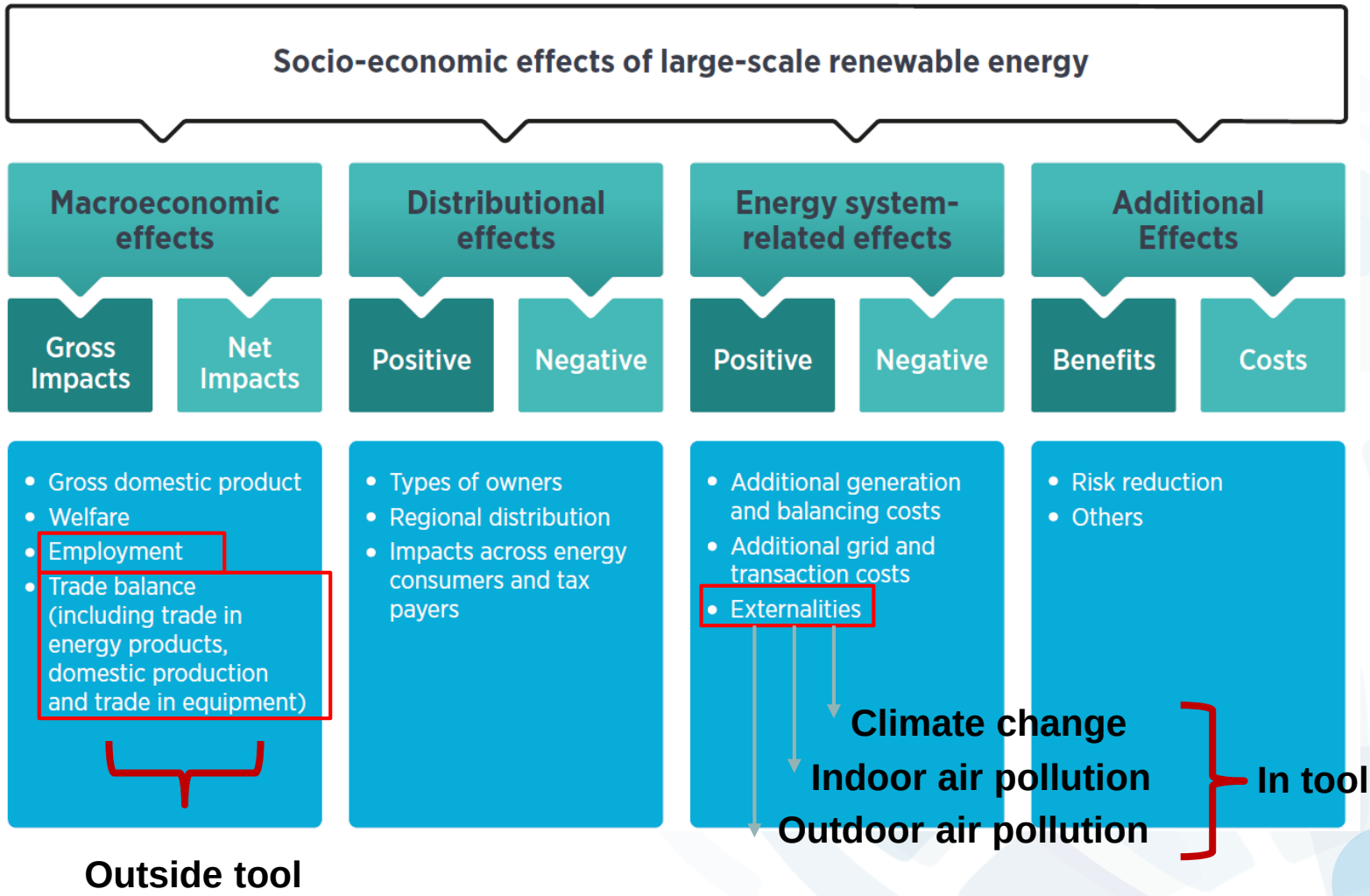
- Costs – substitution costs, incremental system costs
- Investments – incremental for RE, total for RE and Fossil Subsidies
- External costs relating to air pollution and CO2

Benefits of REmap Options

- **Air pollution**
  - Five pollutants (SO_2, NO_x, VOC, NH_3, $PM_{2.5}$)
  - Indoor air pollution (traditional uses of biomass)
  - Outdoor air pollution (power generation, transport, industry, buildings)
  - Emissions from each sector by technology
  - Damages of each pollutant by region based on ExternE adjusted by GDP for each country
  - Unit external costs (USD per tonne of pollutant)

- **Climate change**
  - For carbon dioxide (CO_2) emissions only
  - Assuming a carbon price in 2030 of USD 17-80 per tonne CO_2

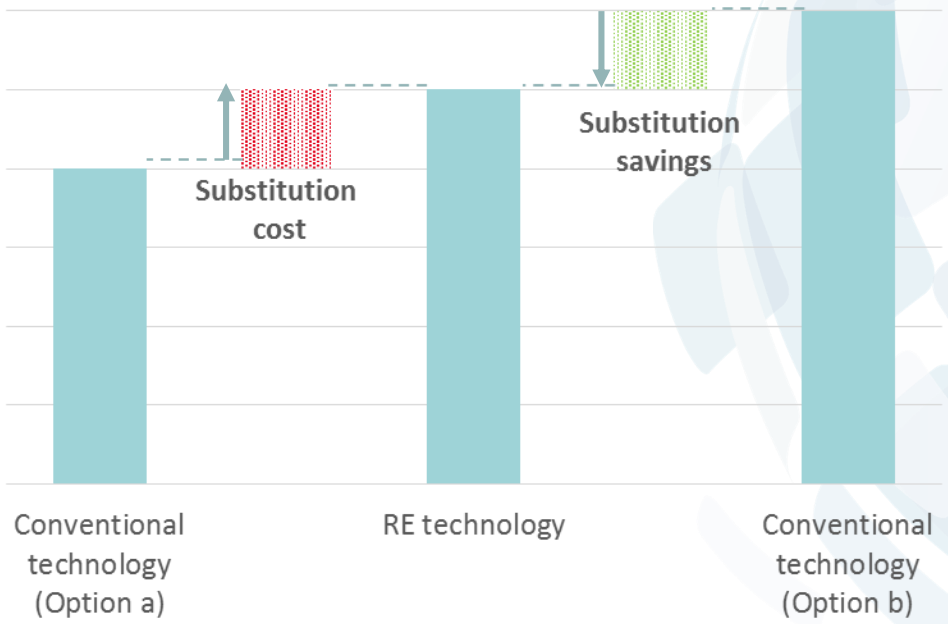
Renewables have various socio-economic benefits



Costs of REmap Options

- **Costs**
  - Based on levelised cost of electricity generation, heat and transport
  - For each REmap Option relative non-RE counterpart

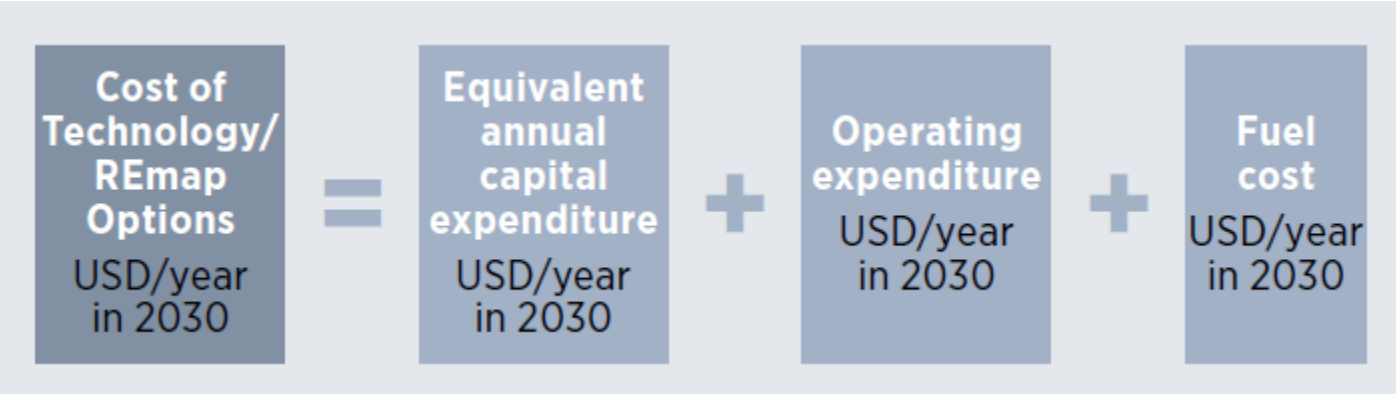
REmap Option substitution and costs



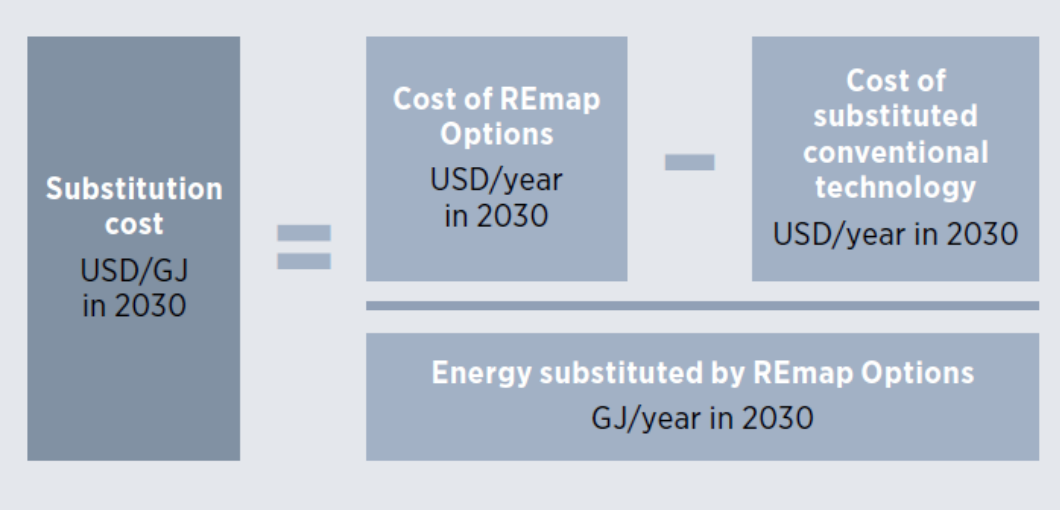
1. **REmap Option**: energy contribution of selected RE technology
2. Substitution of equivalent energy consumption from a conventional technology

Costs of REmap Options

- **Cost**

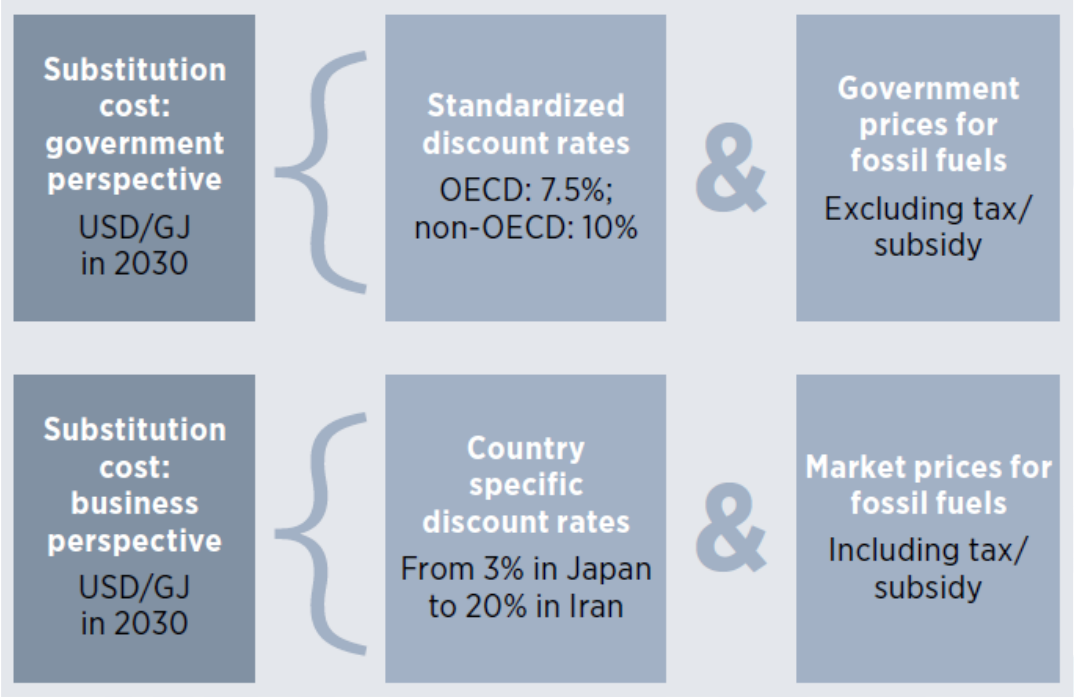


- **Substitution cost**



Government vs Business perspective

- **Government or "societal" perspective**
  - Perspective used to assess policy options
  - Used for cross-country comparison
- **Business or "investors" perspective**
  - Perspective for the marketplace

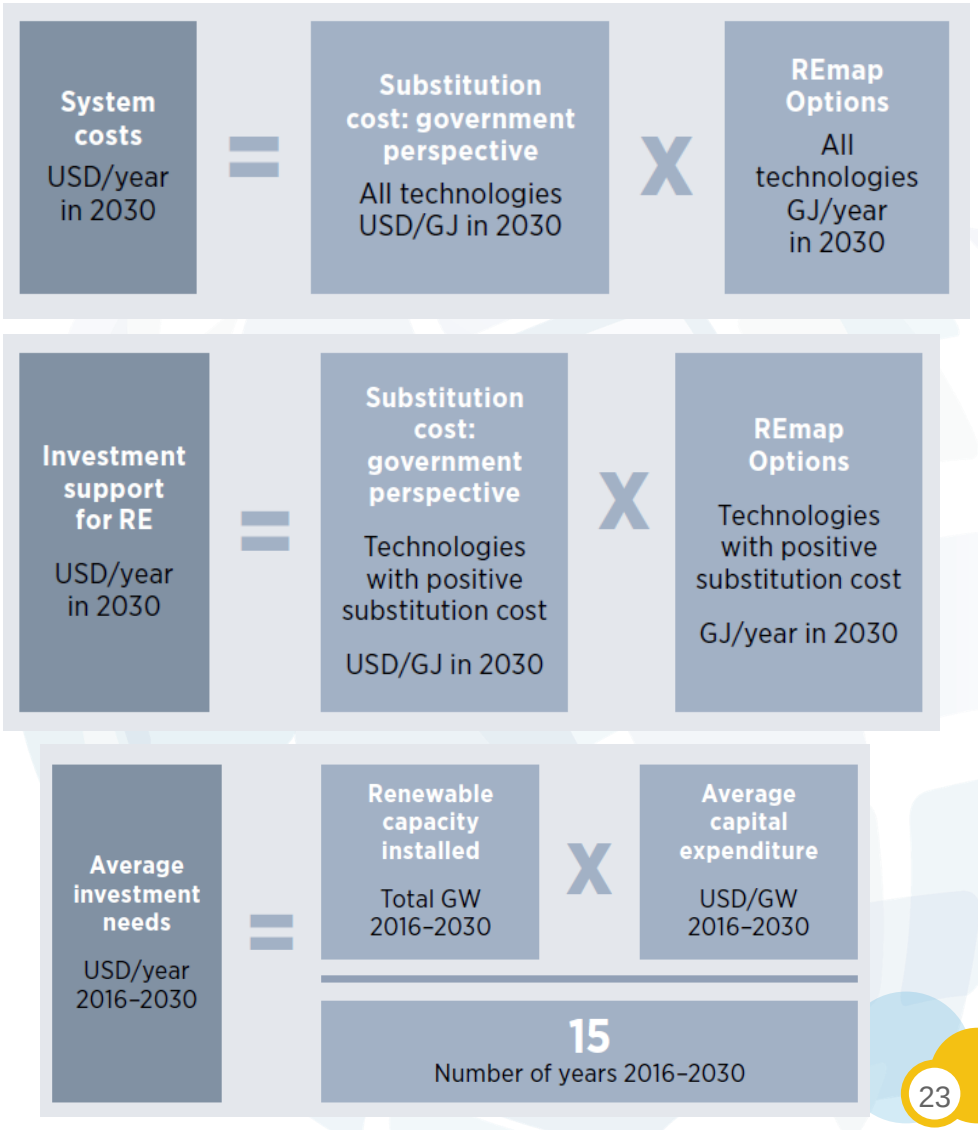


System, Subsidy and Investments

- System cost – metric for general competitiveness of Options on country or sector level

(Excludes infrastructure, externalities)

- Investment support (subsidy)
- Investment needs – for capacity



REmap tool analysis steps

1. Build the 2014 and Reference Case energy balance (**WS0 EB**)
2. Reference Case and commodity prices ONLY for those used in the sector tables (**WS1**)
3. Review technology list options ONLY for techs used in sector tables, update cost, performance and fuel (**WS2**)
4. Identify potential of accelerated renewable energy uptake and input into the sector tabs, select fuel that is substituted (**WS 3-6**)
   - Industry, Buildings (residential, commercial, public), Transport, Power and District Heat
5. Input macro-economic indicators (consistent with Review results (**WS8 and Summary tables**)

Energy balance (WS0)

2030 Energy Balance (PJ/yr) (Reference case)	Coal	Oil and oil products	Natural gas	Nuclear	Hydro	Geothermal	Solar photovoltaics	CSP	Wind	Solid biomass	of which	Liquid & Gaseous Biofuels	of which	Solar thermal	Electricity	Heat	Total
	TOT	TOT	TOT	TOT	TOT	TOT	TOT	TOT	TOT	TOT	Traditional	TOT	Biogas	TOT			
Production	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Imports	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Exports	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Intl. Bunkers	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Stock Changes	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TPES	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Power generation	**-1,418**	**-36**	**-357**	**0**	**-45**	**0**	**-5**	**0**	**-84**	**-44**	**0**	**-45**	**0**	**0**	**859**		**-1,175**
Electricity: Main activity	-1,417	-13	-318	0	-45	0	0	0	-84	-44	0	-45	0	0	824		-1,143
Electricity: Autoproducer	-1	-23	-38	0	0	0	-5	0	0	0	0	0	0	0	35		-33
CHP	**-59**	**0**	**-56**	**0**	**0**	**0**	**0**	**0**	**0**	**-261**	**0**	**-2**	**0**	**0**	**83**		**-295**
Heat generation	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		**0**	**0**
Heat: Main activity																	
Heat: Autoproducer																	
Other energy sectors	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Refineries (including own use)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
BF & CO (including own use)	-80	-1	-3	0	0	0	0	0	0	0	0	0	0	0	0	0	-84
Liquefaction Plants (incl. Own use)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Others	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Own Use (excl. Refineries & BF & CO)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Distribution Losses	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TFC	**113**	**1,572**	**577**	**0**	**0**	**0**	**0**	**0**	**0**	**175**	**0**	**13**	**0**	**11**	**910**	**0**	**3,371**
Industry (excl. Feedstocks)	**106**	**197**	**360**	**0**	**0**	**0**	**0**	**0**	**0**	**114**	**0**	**0**	**0**	**0**	**320**		**1,098**
Iron and Steel	26	1	23	0	0	0	0	0	0	0	0	0	0	0	16	0	66
Chem. & Petroch	7	11	79	0	0	0	0	0	0	12	0	0	0	0	21	0	128
of which: Feedstocks	0	106	43	0	0	0	0	0	0	0	0	0	0	0	0	0	149
Non-ferrous Metals	37	64	125	0	0	0	0	0	0	2	0	0	0	0	164	0	391
Non-metallic mineral	22	16	62	0	0	0	0	0	0	1	0	0	0	0	19	0	120
Food and tobacco	11	3	31	0	0	0	0	0	0	55	0	0	0	0	23	0	124
Paper, Pulp, Printing	2	0	22	0	0	0	0	0	0	24	0	0	0	0	17	0	66
Textile and leather	0	1	5	0	0	0	0	0	0	0	0	0	0	0	3	0	10
Others	1	101	13	0	0	0	0	0	0	20	0	0	0	0	57	0	192
Transport	**5**	**1,324**	**21**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**17**	**0**	**1,379**
Intl. civil aviat	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Dom. aviat	0	107	0	0	0	0	0	0	0	0	0	0	0	0	0	0	107
Road	0	1,136	2	0	0	0	0	0	0	0	0	12	0	0	0	0	1,150
Rail	0	40	0	0	0	0	0	0	0	0	0	0	0	0	10	0	50
Pipeline Transport	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0	17
Internal Navigation	5	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38
Non-specified & other	0	8	1	0	0	0	0	0	0	0	0	0	0	0	6	0	16
Buildings	**2**	**50**	**196**	**0**	**0**	**0**	**0**	**0**	**0**	**61**	**0**	**1**	**0**	**11**	**574**		**894**
space cooling	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86	0	86
space heating	1	36	139	0	0	0	0	0	0	31	0	1	0	6	0	0	213
water heating	0	5	21	0	0	0	0	0	0	21	0	0	0	4	0	0	50
cooking	0	1	2	0	0	0	0	0	0	2	0	0	0	0	0	0	5
lighting	0	0	0	0	0	0	0	0	0	0	0	0	0	0	67	0	67
appliances	0	0	0	0	0	0	0	0	0	0	0	0	0	0	191	0	191
others	0	9	34	0	0	0	0	0	0	7	0	0	0	1	229	0	281
Other sectors	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Agriculture	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Non energy use	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**
Electricity Gen. - TWh	**152**	**3**	**41**	**0**	**12**	**0**	**4**	**0**	**20**	**2**	**0**	**4**	**0**	**0**			**239**
Electricity: Main activity	151	1	38	0	12	0	0	0	20	2	0	4	0	0			229
Electricity: Autoproducer	0	2	4	0	0	0	4	0	0	0	0	0	0	0			10
CHP (electricity)- TWh	**5**	**0**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**12**	**0**	**0**	**0**	**0**			**23**
CHP (heat)- PJ																	**0**
Heat generation- PJ																	**0**
Heat: Main activity																	
Heat: Autoproducer																	
Power Capacity - GW	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

- Populate 2014 baseyear) and Reference Case 2030
- REmap is automatically adjusted based on sectoral table substitution

Sector substitution tables (WS3-6)

Renewable Energy Technology														Conventional Fossil Fuel & Nuclear Technology			
2020	Power production: new capacity	Renewable energy capacity installed	Main fuel type (excl. Electricity)	Capacity factor	Lifetime	Total capacity	Overnight Cap. Cost	O&M Costs	Fuel demand	Power demand	Conversion efficiency	Total annualized costs	Production cost	2020	Total substituted fossil fuel	Total substituted electricity	Fossil fuel capacity substituted
POWER SECTOR														POWER			
	(PJ/yr)	(MW)	(-)	(%, cap)	(years)	(MW)	(USD/kW)	(USD/kW/yr)	(GJf/kW/yr)	(GJe/kW/yr)	(%)	(USD/yr)	(USD/GJe)		(PJ/yr)	(PJ/yr)	(MW)
A) Main activity														A) Main activity			
Hydro (Small)		0	0	50	40	0	4000	80	0.000	0.013	100	24487	31	Coal	0	0.000	0.0
Hydro (Large)		0	0	50	60	100	1500	30	0.000	0.013	100	18119426	11	Coal	0	0.000	0.0
Wind onshore		0	0	38	30	100	1840	74	0.000	0.013	100	26948582	22	Coal	0	0.000	0.0
Wind efficient		0	0	42	30	100	2200	99	0.000	0.013	100	33307435	25	Coal	0	0.000	0.0
Wind offshore		0	0	48	30	50	2870	158	0.000	0.013	100	23149872	31	Coal	0	0.000	0.0
Solar PV (Residential/Commercial)		0	0	16	30	0	1400	14	0.000	0.013	100	16321	32	Coal	0	0.000	0.0
Solar PV (Utility)		0	0	18	30	1	1000	10	0.000	0.013	100	116779	21	Coal	0	0.000	0.0
Solar CSP PT no storage		0	0	35	35	50	6250	63	0.000	0.013	100	35563033	64	Coal	0	0.000	0.0
Solar CSP PT storage		0	0	40	35	50	8150	245	0.000	0.013	100	54513555	86	Coal	0	0.000	0.0
Solar CSP ST storage		0	0	70	30	20	10000	100	0.000	0.013	100	23229850	53	Coal	0	0.000	0.0
Biomass co-firing (retrofit)		0	rimary_biomass	70	40	200	500	13	58.093	0.054	38	152748257	35	Coal	0	0.000	0.0
Biomass steam cycle		0	rimary_biomass	80	25	50	2750	69	66.392	0.054	38	58570557	46	Coal	0	0.000	0.0
Biomass (gasification CC)		0	rimary_biomass	85	25	15	3500	88	67.014	0.054	40	19203844	48	Coal	0	0.000	0.0

- In the tool blue cells indicate user inputs, yellow are calculated
- Complete for Industry, Buildings, Transport and Power tables
- Select from list RE technology, input potential (fuel demand in end-use sectors, or generation in power)
- Pick substituted fossil technology

AH	AI	AJ
Annualized total costs: REMAP	Annualized total costs: substituted fossil fuels	Average incremental cost of substitution
(USD/yr)	(USD/yr)	(USD/GJ)
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0
0	0	0.0

→ See REmap Tool Manual for detailed description of each sector substitute table, or ask IRENA staff

Technology cost and performance in 2030 (example from power sector) (WS2)

	Capacity Factor	Lifetime	Reference capacity or annual mileage	Overnight capital cost	O&M costs	Conversion efficiency
POWER SECTOR	(%)	(years)	(kW)	(USD/kW)	(USD/kW/yr)	(%)
Hydro (Small)	50	40	0.1	2500	50	100
Hydro (Large)	50	60	100	1500	30	100
Wind onshore	34	30	100	1500	60	100
Wind offshore	45	30	50	2870	158	100
Solar PV (Rooftop)	16	30	0.1	1400	14	100
Solar PV (Utility)	18	30	1.0	1000	10	100
Solar CSP PT no storage	25	35	50	2250	23	33
Solar CSP PT storage	38	35	50	4000	120	33
Biomass power	70	25	50	2750	69	38
Landfill gas power	70	25	0.5	1800	45	32
Geothermal	80	50	25	2500	100	10
Tide, wave, ocean	50	25	5.0	3500	35	100
Coal (non-OECD)	80	60	650	1300	52	30
Natural gas	60	30	650	1000	40	55
Oil	30	50	400	1200	18	40
Nuclear (non-OECD)	84	60	1200	5500	138	33
Diesel (Gen-set)	40	20	0.1	1500	38	42

RE techs

Non-RE techs

- A complete dataset of technology costs for power gen, heating/cooling and transport
- Technologies can be added
- “Localise” values for capacity factor, capital cost, conversion efficiency

Energy commodity prices today and 2030 (WS1)

Energy commodities prices (excl. VAT, but including CO2 tax, annual average)					Emission factors (based on IPCC, if		Additional fuel prices due to CO2 price			Energy Commodities Prices (excluding CO2 Tax)		
							2010	2020	2030	2010	2020	2030
Crude_oil	(USD/GJ)	15.313	16.466	20.4685	(kg CO2/TJ)	73300	(USD/GJ) 0.733	1.466	3.2985	14.58	15	17.17
Steam_coal	(USD/GJ)	3.661	5.422	8.8245	(kg CO2/TJ)	96100	(USD/GJ) 0.961	1.922	4.3245	2.7	3.5	4.5
Electricity_Household	(USD/kWh)	0.1	0.2	0.25	(kg CO2/TJ)		(USD/GJ)	0	0	0.1	0.2	0.25
Electricity_Industry	(USD/kWh)	0.1	0.2	0.25	(kg CO2/TJ)		(USD/GJ)	0	0	0.1	0.2	0.25
Natural_gas_Household	(USD/GJ)	5.561	8.122	12.0245	(kg CO2/TJ)	56100	(USD/GJ) 0.561	1.122	2.5245	5	7	9.5
Natural_gas_Industry	(USD/GJ)	5.561	8.122	12.0245	(kg CO2/TJ)	56100	(USD/GJ) 0.561	1.122	2.5245	5	7	9.5
Petroleum_products	(USD/GJ)	12.774	19.548	28.483	(kg CO2/TJ)	77400	(USD/GJ) 0.774	1.548	3.483	12	18	25
Diesel	(USD/GJ)	21.741	31.482	38.3345	(kg CO2/TJ)	74100	(USD/GJ) 0.741	1.482	3.3345	21	30	35
Gasoline	(USD/GJ)	21.693	31.386	38.1185	(kg CO2/TJ)	69300	(USD/GJ) 0.693	1.386	3.1185	21	30	35
Kerosene	(USD/GJ)	25.7	36.4	43.15	(kg CO2/TJ)	70000	(USD/GJ) 0.7	1.4	3.15	25	35	40
Biodiesel	(USD/GJ)	25	25	27	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	25	25	27
Biofuel	(USD/GJ)	21	30	35	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	21	30	35
First_generation_bioethanol	(USD/GJ)	18	22	25	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	18	22	25
Second_generation_bioethanol	(USD/GJ)	32	32	33	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	32	32	33
Biomethane	(USD/GJ)	20	20	22	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	20	20	22
Biokerosene	(USD/GJ)	35	45	55	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	35	45	55
Hydrogen	(USD/GJ)	20	25	30	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	20	25	30
Primary_biomass_1	(USD/GJ)	11.4	12	15.8	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	11.4	12	15.8
Primary_biomass_2	(USD/GJ)	11.4	12	15.8	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	11.4	12	15.8
Primary_biomass_3	(USD/GJ)	11.4	12	15.8	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	11.4	12	15.8
Biomass_residues_1	(USD/GJ)	4	5	6	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	4	5	6
Biomass_residues_2	(USD/GJ)	4	5	6	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	4	5	6
Biomass_residues_3	(USD/GJ)	4	5	6	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	4	5	6
Traditional_biomass_1	(USD/GJ)	5	4	3	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	5	4	3
Traditional_biomass_2	(USD/GJ)	5	4	3	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	5	4	3
Municipal_waste	(USD/GJ)	1	1	2	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	1	1	2
Nuclear_fuel	(USD/GJ)	2.5	3.5	5	(kg CO2/TJ)	0	(USD/GJ) 0	0	0	2.5	3.5	5
Carbon_price	(USD/t CO2)									10	20	45

- Input values in USD/GJ for commodities used as fuel in the technology list
- Input price of electricity in USD/kWh

-> If future years unavailable input in 2014

Government perspective – prices excluding effects of taxation or subsidy

Business perspective – prices include effect of taxation or subsidy

- Discount rate – WACC
- Check macro-economic indicators: population, GDP, others

Review results

- Summary table tab has results overview showing key renewable energy technology, shares and other indicators
- For 2014, Reference Case and REmap 2030
  - Power capacity and generation
  - End-use renewable energy (heating, transport, other direct uses)
  - TFEC/TPES totals and shares
  - Financial indictors
- Results general for year 2030

- Extended summary table shows energy carrier level consumption by sector, and more detail on substitution costs, externalities, emissions, investments

Cost-supply curves

Macro plots REmap Options in cost-supply curve

- X-axis = RE share
- Y-axis = substitution cost
- A perspective on competitiveness and potential of the REmap Options

- Once values are final, another REmap tool can be used to enhance presentation with bars, colors and labelling