

ENERGY TRANSFORMATION

REST OF ASIA

Regional analysis covers 16 countries:

West Asia

- Armenia
- Azerbaijan
- Turkey

Central Asia:

- Kazakhstan
- Kyrgyz Republic
- Tajikistan
- Turkmenistan
- Uzbekistan

South Asia:

- Afghanistan
- Bangladesh
- Bhutan
- India
- Maldives
- Nepal
- Pakistan
- Sri Lanka

STATUS/CHARACTERISTICS AND NEEDS:

Population (millions)



Current: **27% of global population**, mainly in India (68%) followed by Pakistan (11%), Bangladesh (8%) and Turkey (4%).

2050 outlook: Average **0.7% per year increase** to **2 602 million**, or 28% of global population.

IRENA analysis based on E3ME.

GDP per capita (thousand USD 2015)

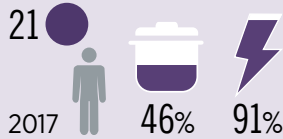


Current: **Well below the global average** (10.9).

2050 outlook: **Rapid development;** **► PES: CAGR = 4.9%**

IRENA analysis based on E3ME.

Energy consumption (GJ/capita) and energy access (%)



Energy consumption per capita:

Current: well below the global average (51 GJ/year)..

Electricity access:

Over 91% (2017) up from 75% (2010). Still, 178 million people in the region lack electricity access (IEA, IRENA, UNSD, WB, WHO, 2019).

Clean cooking access:

Available to less than 50% of region's population (2017), with especially large access deficit in India (IEA, IRENA, UNSD, WB, WHO, 2019).

Source: Access to electricity, 2017 values (World Bank Group, 2019a), access to clean cooking, 2016 values (World Bank Group, 2019b), TFEC, 2017 values (IEA, 2019).

Fossil fuel net import



Current status:

West and South Asian countries are net importers, while Central Asian countries are net exporters (mainly oil and gas).

2050 outlook:

Rising air pollution and resource challenges; Large untapped renewable energy potential.

▶ **PES:** The total generation (est. 7514 TWh) represents **23%** of overall renewable power potential.

Note: Current status, IRENA analysis based on proportion of net imports of fossil fuels in TPES, 2017 values (IEA, 2019). 2050 outlook, IRENA analysis and potential based on Deng *et al.* (2015).

Energy-intensive industries (% in global consumption)



Current status:

Accounts for **14% of global energy demand for iron and steel** and around **9% for non-ferrous metals and non-metallic minerals** industries.

2050 outlook:

Increasing output of iron and steel, metals, chemicals and petrochemicals; **India and Pakistan require concentrated effort and specific decarbonisation solutions.**

Source: IRENA analysis based on 2017 values (IEA, 2019).

Energy-related CO₂ emissions per capita (tCO₂/capita)



Recent:

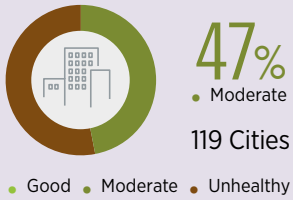
Region's annual emissions: 3.8 Gt (2018). 11% of global energy-related CO₂ emissions.

2050 outlook:

▶ **PES: Almost doubling to 7.2 Gt** with enabling policies. CO₂ emissions from transport are poised to triple to 1.4 Gt propelled by population growth and urbanization.

Note: 2050 values based on IRENA analysis and historical data based on Global Carbon Atlas (2019).

Urban air quality (%)



South Asia currently has the world's most toxic air, with 18 of the planet's 20 most-polluted cities found in India (15), Pakistan (2) and Bangladesh (1).

Record-high air pollution has periodically shut down regular activities and caused serious health issues in Delhi, India.

IRENA analysis based on PM 2.5 concentration, 2016 and 2017 values (WHO, 2019).

Electricity prices and renewables costs

Electricity price:

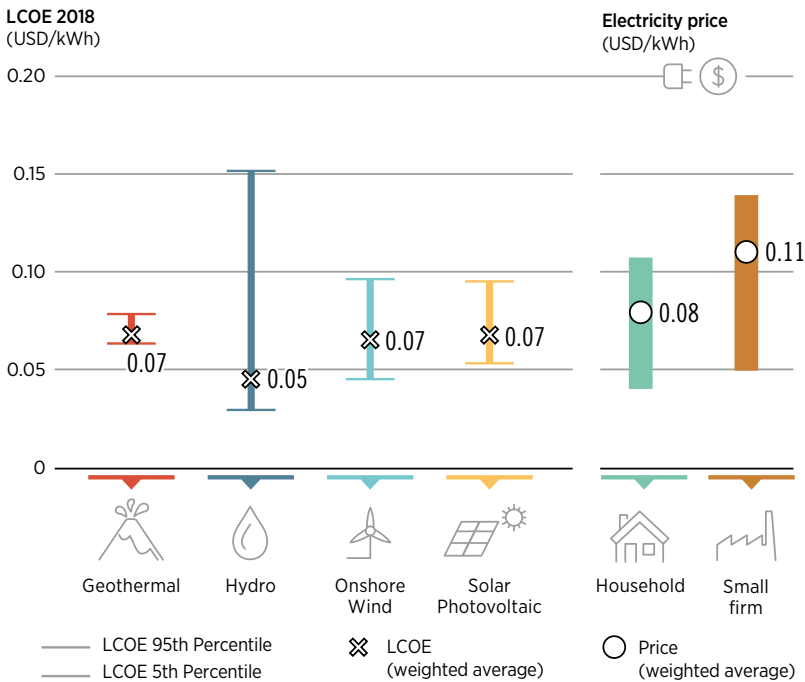
Among the lowest in the world, only in MENA is lower. Similar to Rest of Europe.

Renewables cost and auctions:

Onshore wind: Similar to G20 average levels of USD 0.05/kWh (weighted average LCOE);
Solar PV: Below G20 average (USD 0.096/kWh);

India: Solar PV cost-competitive compared to thermal power generation (USD 0.068/kWh for coal and USD 0.093/kWh for combined-cycle gas).

Rest of Asia



LCOE based on IRENA (2019a) and electricity prices based on Global Petrol Prices (2019).
 Note: The LCOE data is for projects commissioned in 2018. Real weighted average cost of capital (WACC) is 7.5% for OECD countries and China and 10% for the rest of the world.

ENERGY TRANSFORMATION: KEY BENEFITS

1

REDUCED EMISSIONS

- ▶ Clean local air
- ▶ Lower CO₂ output
- ▶ Improved health and well-being



2

ENERGY INDEPENDENCE AND ACCESS

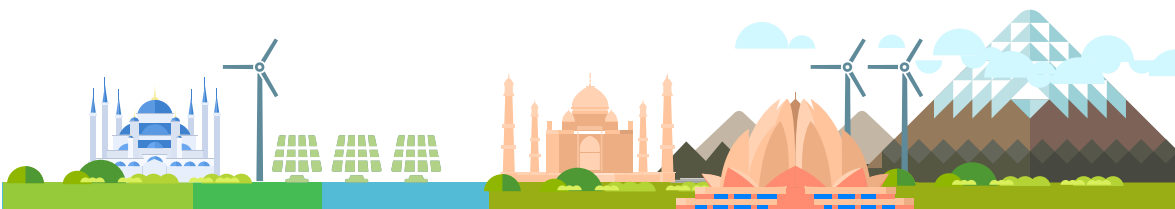
- ▶ Distributed renewable power to isolated communities
- ▶ Diversified energy supply
- ▶ Improved clean cooking access



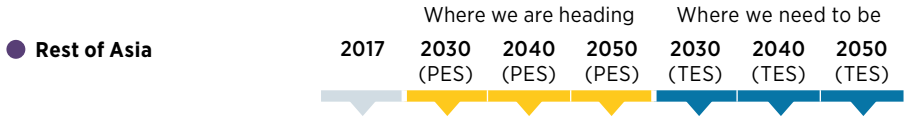
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ECONOMIC AND SUSTAINABLE DEVELOPMENT

- ▶ Economic growth and poverty alleviation
- ▶ Modern energy job creation and skills development
- ▶ Transformative health impacts
- ▶ Active role for communities



ENERGY TRANSFORMATION ROADMAP TO 2050



Energy (EJ)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Supply (TPES)	64	89	107	124	77	82	86
Consumption (TFEC)	42	61	75	87	51	54	55

Renewables shares (modern)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Supply (TPES)	8%	17%	19%	22%	27%	41%	58%
Consumption (TFEC)	8%	14%	17%	21%	24%	40%	59%
Power generation	18%	37%	44%	51%	52%	68%	81%



Electricity share in final energy consumption	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
End-use consumption	18%	21%	24%	26%	26%	37%	47%
Industry	21%	15%	15%	15%	19%	25%	32%
Transport	1%	6%	7%	9%	18%	37%	52%
Buildings	20%	45%	57%	66%	51%	63%	75%

Renewable installed capacity (GW)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Bioenergy	12	30	32	35	39	45	55
Hydropower	110	149	175	185	154	202	240
Solar PV	24	216	430	733	314	706	1072
Wind	41	162	254	404	223	374	541



Biofuels	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Liquid biofuels (billions of litres per year)	1	11	29	38	14	53	81



CO ₂ emissions (energy-related)	2017	2030 (PES)	2040 (PES)	2050 (PES)	2030 (TES)	2040 (TES)	2050 (TES)
Annual level (Gt CO ₂ /yr)	3.5	5.4	6.4	7.2	3.8	3.1	2
Reduction vs. today	NA	53%	81%	105%	8%	-11%	-43%

● Rest of Asia

Where we are heading
**Planned Energy
Scenario 2016 - 2050**
(PES)

Where we need to be
**Transforming Energy
Scenario 2016-2050**
(TES)

Energy system investments (average annual, 2016-50) USD billion/year

	Planned Energy Scenario 2016 - 2050 (PES)	Transforming Energy Scenario 2016-2050 (TES)
Power	122	151
- Renewable	46	84
- Non-renewable	30	16
- Power grids and system flexibility	45	52
Industry (RE + EE)	22	33
Transport (electrification + EE)	37	70
Buildings (RE + EE)	78	114
Biofuel supply	2	12
Renewable hydrogen – electrolyzers	0.2	3

Note: RE = renewable energy; EE = energy efficiency

The findings in this report consider targets and developments as of April 2019. The wind and solar PV capacities in the Transforming Energy Scenario in 2030 in this report are slightly higher than the estimates presented in IRENA's reports (IRENA, 2019b; 2019c) which consider developments as of the third quarter of 2019.

SOCIO-ECONOMIC OUTLOOK TO 2050

● Rest of Asia

2019e 2030 2050

	2019e	2030	2050
Population (thousands) region-wide	2 088 441	2 326 499	2 601 942

GDP (USD 2015)

GDP (million): PES	5 699 443	11 092 911	31 609 299
GDP (million): TES	5 892 431	11 194 938	31 994 075
GDP changes (million): TES vs. PES	192 988	102 027	384 776
GDP changes (%): TES vs. PES	3.4	0.9	1.2
Per capita GDP (thousand): PES	2.7	4.8	12.1
Per capita GDP (thousand): TES	2.8	4.8	12.3

Employment**Economy-wide employment (thousands)**

Employment: PES	1 020 945	1 251 416	1 562 473
Employment: TES	1 021 164	1 250 735	1 561 263
Employment changes: TES vs. PES	219	(681)	(1 210)
Employment changes (%): TES vs. PES	0.02%	-0.05%	-0.08%



● Rest of Asia

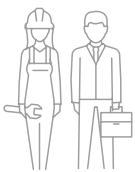


Energy sector jobs (thousands)

	2017	2030 (PES)	2050 (PES)	2030 (TES)	2050 (TES)
Nuclear power	60	103	86	91	65
Fossil fuels	3 424	6 170	6 621	5 163	4 495
Renewables	1 422	2 846	3 577	3 795	5 164
Energy efficiency	2 615	2 596	1 034	3 925	1 815
Power grids and energy flexibility	1 654	2 483	3 009	2 551	3 220
Total	9 175	14 198	14 326	15 523	14 759
Energy jobs in economy-wide employment (%)		1.1%	0.9%	1.2%	0.9%

Renewable energy jobs (thousands)

	2017	2030 (PES)	2050 (PES)	2030 (TES)	2050 (TES)
Bioenergy	238	860	756	1 243	1 491
Solar	340	941	1 687	1 422	2 504
Hydropower	760	821	798	821	774
Wind	80	220	333	305	386
Geothermal	4	4	4	5	9
Ocean	0	0	0	0	0
Total	1 422	2 846	3 577	3 795	5 164
Renewable energy jobs in energy-sector employment (%)		20.0%	25.0%	24.4%	35.0%



Job differential in 2050 (thousands) TES vs. PES

Economy-wide	-1210
Changes in conventional energy (A)	-2147
Changes in transition related technologies (B)	2579
Net jobs (A+B)	432

► Jobs in 2050: TES / ● Rest of Asia

Technology jobs (thousands)		Segment value chain (thousands)		Occupational requirements (thousands)	
Solar PV	1819	Construction & installation	1580	Workers and technicians	2191
Solar water heaters (SWH)	519	Manufacturing	195	Experts	250
Onshore wind	295	Operation and maintenance	958	Engineers and higher degrees	253
Offshore wind	91	Biofuel supply	-	Marketing and administrative	39
Geothermal	9				
Total	2733		2733		2733

Welfare improvement (%):
TES vs. PES

Indicator	2030		2050	
Economic		0.1		0.2
Social		7.7		11.3
Environmental		2.0		4.2
Total		9.8		15.7



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