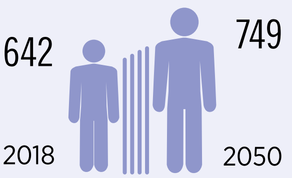
# ENERGY TRANSFORMATION
# SOUTHEAST ASIA

Regional analysis covers the 10 member states of the Association of Southeast Asian Nations:

- Brunei Darussalam
- Cambodia
- Indonesia
- Lao People's Democratic Republic
- Malaysia
- Myanmar
- Philippines
- Singapore
- Thailand
- Viet Nam

## STATUS/CHARACTERISTICS AND NEEDS:

**Population** (millions)




**Current:** **8.5% of global population**.
Highest regional share in Indonesia (41%) followed by Philippines (16%) and Viet Nam (15%).

**2050 outlook:** Average **0.5% per year increase** to **749 million**, or 8% 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 = 4.2%

IRENA analysis based on E3ME.

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

28

2017

60%

95%

**Energy consumption per capita:**

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

**Electricity access:**

Some countries have not yet achieved full electrification. All governments plan for 100% electricity access before 2030.

**Clean cooking access:**

40% of the region's population lack access to modern fuels for cooking.

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**

medium

**Current status:** Indonesia: Large coal deposits; Malaysia: Moderate oil and gas reserves.

**2050 outlook:** **Region shifting to net fossil-fuel imports; Vast untapped renewable energy potential.**
▶ **PES:** The total generation (est. 3664 TWh) represents **25%** 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)

4%

2017

**Current status:** Regional energy use ranges from 1% of global levels in some industries up to **9%** (region's highest share) in **food and tobacco**.

**2050 outlook:** **The region becoming more industrialised;** Need for **emissions reductions** and specific solution to decarbonize in challenging sectors such as heavy industry.

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

**Energy-related $CO_2$ emissions per capita** ($tCO_2$/capita)

2.3

2018

4.1

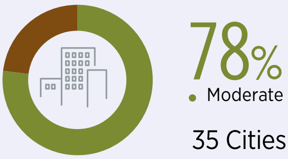
2050

**Recent:** **Region's annual emissions: 1.5 Gt** (2018). 4% of global energy-related $CO_2$ emissions.

**2050 outlook:** ▶ **PES: Almost doubling to 2.9 Gt per year**, coal and natural-gas use drive increase, with more limited increase in oil demand.

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

**Urban air quality** (%)




**Unhealthy air pollution levels in 22% of region's cities and moderately unhealthy levels in most of rest;** Dataset (limited to 35 cities) points to poor and deteriorating urban air quality across region.

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

## Electricity prices and renewables costs

**Electricity price:**

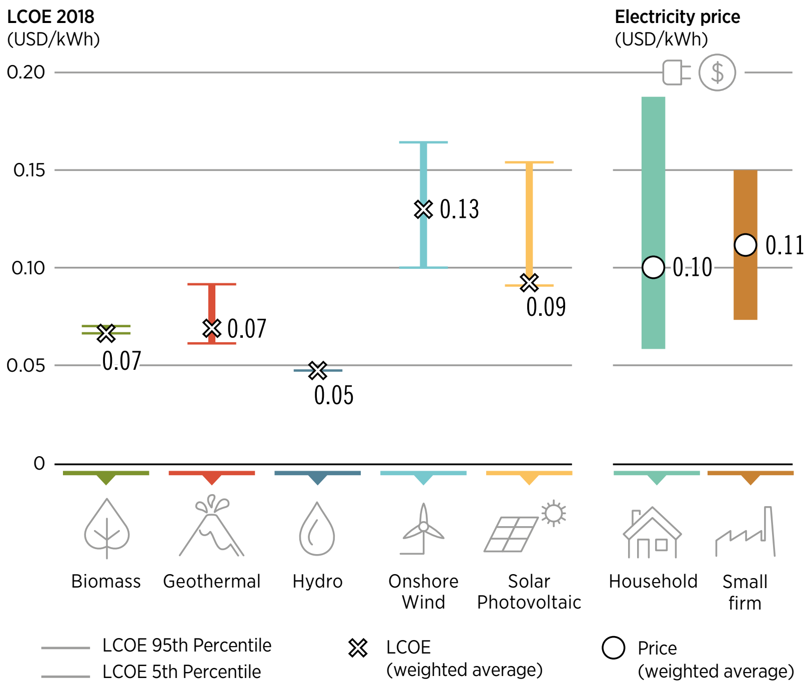
**USD 0.10-0.11/kWh average across region** (lower compared to other regoins).

**Renewables cost and auctions:**

Cost-competitiveness of renewables increasingly reflected in region;

Viet Nam has auctioned 5.5 GW (2019), region's largest installed solar PV capacity.

**Southeast Asia**



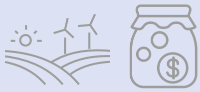

LCOE based on IRENA (2019a) and electricity prices based on Global Petrol Prices (2019).
Note: The LCOE data is for projects commissioned in 2018. Real weighted average cost of capital (WACC) is 7.5% for OECD countries and China and 10% for the rest of the world.

## ENERGY TRANSFORMATION: KEY BENEFITS

### 1

**ENERGY ACCESS AND INFRASTRUCTURE**

- Diversified energy supply
- Lower system costs
- Green industrial revolution



### 2

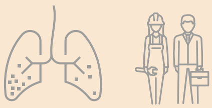
**ENERGY SECURITY**

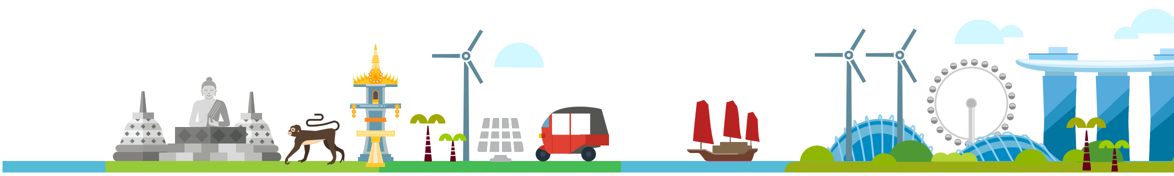
- Greater energy self-sufficiency
- Low-cost renewable energy use
- Increased regional interconnections
- Increasingly electrified transport

### 3

**SUSTAINABLE DEVELOPMENT**

- Economic growth driven by trade gains
- High growth in renewable energy jobs
- Better air quality and improved health
- Improved education and empowered citizens





## ENERGY TRANSFORMATION ROADMAP TO 2050

| Southeast Asia | 2017 | Where we are heading 2030 (PES) | 2040 (PES) | 2050 (PES) | Where we need to be 2030 (TES) | 2040 (TES) | 2050 (TES) |
|---|---|---|---|---|---|---|---|
| **Energy (EJ)** | | | | | | | |
| Supply (TPES) | 28 | 40 | 50 | 60 | 39 | 48 | 54 |
| Consumption (TFEC) | 18 | 21 | 27 | 31 | 21 | 25 | 28 |
| **Renewables shares (modern)** | | | | | | | |
| Supply (TPES) | 13% | 28% | 29% | 31% | 41% | 59% | 75% |
| Consumption (TFEC) | 12% | 16% | 19% | 22% | 27% | 48% | 68% |
| Power generation | 20% | 31% | 34% | 37% | 53% | 73% | 85% |
| **Electricity share in final energy consumption** | | | | | | | |
| End-use consumption | 18% | 22% | 26% | 31% | 20% | 32% | 42% |
| Industry | 22% | 16% | 19% | 23% | 16% | 22% | 27% |
| Transport | 0.2% | 1% | 2% | 3% | 3% | 11% | 23% |
| Buildings | 30% | 68% | 77% | 83% | 63% | 82% | 91% |
| **Renewable installed capacity (GW)** | | | | | | | |
| Bioenergy | 7 | 26 | 32 | 37 | 66 | 111 | 176 |
| Hydropower | 39 | 41 | 51 | 70 | 71 | 81 | 100 |
| Solar PV | 4 | 54 | 109 | 198 | 106 | 399 | 647 |
| Wind | 1 | 5 | 8 | 11 | 13 | 22 | 32 |
| **Biofuels** | | | | | | | |
| Liquid biofuels (billions of litres per year) | 7 | 34 | 39 | 62 | 47 | 57 | 93 |
| **$CO_2$ emissions (energy-related)** | | | | | | | |
| Annual level (Gt $CO_2$/yr) | 1.4 | 2 | 2.6 | 2.9 | 1.6 | 1.3 | 0.8 |
| Reduction vs. today | NA | 45% | 81% | 106% | 15% | -10% | -46% |

| ● **Southeast 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** | | |
| Power | 39 | 66 |
| – Renewable | 12 | 39 |
| – Non-renewable | 13 | 5 |
| – Power grids and system flexibility | 15 | 22 |
| Industry (RE + EE) | 7 | 13 |
| Transport (electrification + EE) | 10 | 20 |
| Buildings (RE + EE) | 27 | 40 |
| Biofuel supply | 3.2 | 6.9 |
| Renewable hydrogen – electrolysers | 0 | 0 |

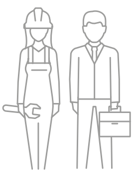
Note: RE = renewable energy; EE = energy efficiency

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

| ● **Southeast Asia** | **2019e** | **2030** | **2050** |
|---|---|---|---|
| Population (thousands) region-wide | 647 605 | 700 587 | 749 019 |
| **GDP (USD 2015)** | | | |
| GDP (million): PES | 2 465 787 | 3 981 401 | 10 065 561 |
| GDP (million): TES | 2 495 821 | 4 155 442 | 10 360 523 |
| GDP changes (million): TES vs. PES | 30 034 | 174 041 | 294 962 |
| GDP changes (%): TES vs. PES | 1.2 | 4.4 | 2.9 |
| Per capita GDP (thousand): PES | 3.8 | 5.7 | 13.4 |
| Per capita GDP (thousand): TES | 3.9 | 5.9 | 13.8 |
| **Employment** | | | |
| **Economy-wide employment (thousands)** | | | |
| Employment: PES | 319 692 | 354 865 | 369 980 |
| Employment: TES | 319 792 | 354 512 | 369 664 |
| Employment changes: TES vs. PES | 101 | -353 | -316 |
| Employment changes (%): TES vs. PES | 0.03% | -0.10% | -0.09% |

| Southeast Asia | 2017 | 2030 (PES) | 2050 (PES) | 2030 (TES) | 2050 (TES) |
|---|---|---|---|---|---|
| **Energy sector jobs (thousands)** | | | | | |
| Nuclear power | 1 | 5 | 10 | 10 | 20 |
| Fossil fuels | 2 000 | 2 682 | 2 764 | 2 647 | 2 429 |
| Renewables | 779 | 1 681 | 2 028 | 3 780 | 6 720 |
| Energy efficiency | 1 005 | 645 | 564 | 978 | 703 |
| Power grids and energy flexibility | 308 | 474 | 451 | 501 | 638 |
| **Total** | **4 092.7** | **5 487.5** | **5 817.2** | **7 915.2** | **10 509.4** |
| Energy jobs in economy-wide employment (%) | | 1.5% | 1.6% | 2.2% | 2.8% |
| **Renewable energy jobs (thousands)** | | | | | |
| Bioenergy | 502 | 1 302 | 1 457 | 2 752 | 4 412 |
| Solar | 91 | 186 | 372 | 628 | 1 882 |
| Hydropower | 155 | 139 | 154 | 285 | 283 |
| Wind | 15 | 18 | 19 | 40 | 45 |
| Geothermal | 15 | 35 | 27 | 56 | 63 |
| Ocean | 0 | 0 | 0 | 18 | 34 |
| **Total** | **779** | **1 681** | **2 028** | **3 780** | **6 720** |
| Renewable energy jobs in energy-sector employment (%) | | 30.6% | 34.9% | 47.8% | 63.9% |



| **Job differential in 2050 (thousands) TES vs. PES** | |
|---|---|
| Economy-wide | -316 |
| Changes in conventional energy (A) | -325 |
| Changes in transition related technologies (B) | 5 018 |
| Net jobs (A+B) | 4 692 |

### Jobs in 2050: TES / ● Southeast Asia

| Technology jobs (thousands) | | Segment value chain (thousands) | | Occupational requirements (thousands) | |
|---|---|---|---|---|---|
| Solar PV | 1 560 | Construction & installation | 805 | Workers and technicians | 1 515 |
| Solar water heaters (SWH) | 322 | Manufacturing | 988 | Experts | 206 |
| Onshore wind | 45 | Operation and maintenance | 198 | Engineers and higher degrees | 176 |
| Offshore wind | - | Biofuel supply | - | Marketing and administrative | 94 |
| Geothermal | 63 | | | | |
| **Total** | **1 991** | | **1 991** | | **1 991** |

| **Welfare improvement (%): TES vs. PES** | **2030** | **2050** |
|---|---|---|
| **Indicator** | | |
| Economic | 0.1 | 0.0 |
| Social | 1.5 | 7.7 |
| Environmental | 1.6 | 3.5 |
| **Total** | **3.2** | **11.2** |

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