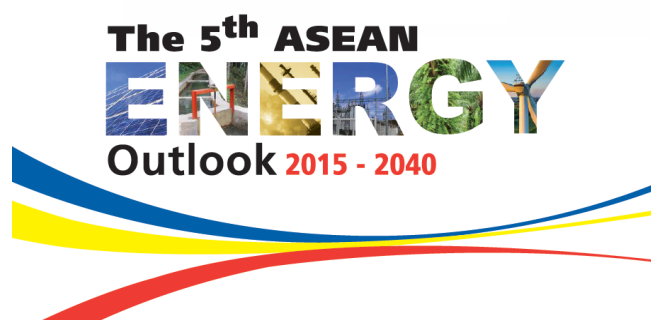

MULTIPLE BENEFITS OF ENERGY EFFICIENCY AND RENEWABLE ENERGY IN ASEAN



**Matthias Reuter, Jose Antonio Ordonez,
Wolfgang Eichhammer¹⁾**

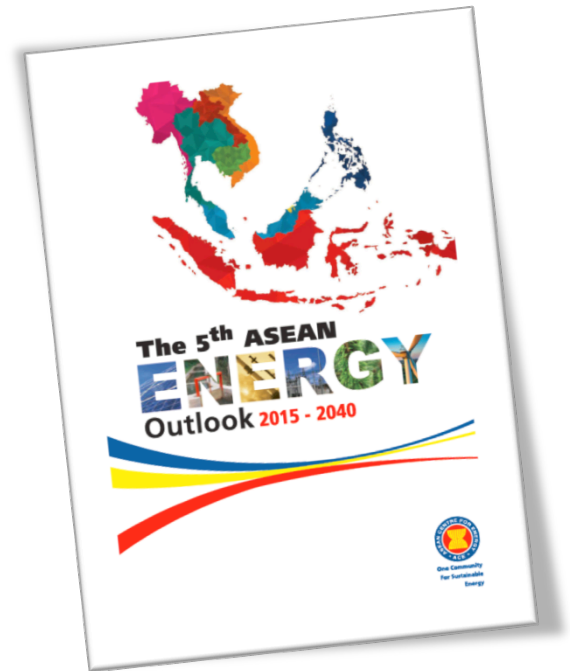
Fraunhofer Institute for Systems and Innovation Research
ISI (Karlsruhe, Germany)

eccee Summer Study 2019

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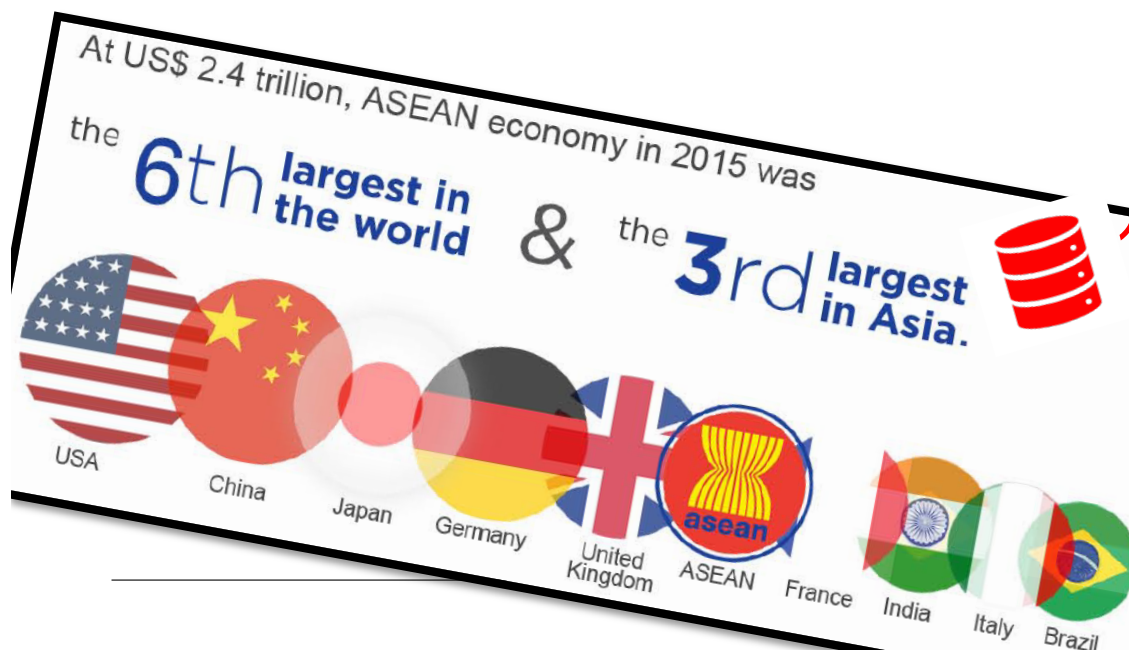
The 5th ASEAN Energy Outlook (AE05)

1. Association of South East Asia 's Nations
2. Scenarios in 5th ASEAN Energy Outlook
3. Energy system in 2040
4. Multiple benefits of EE and RES in ASEAN

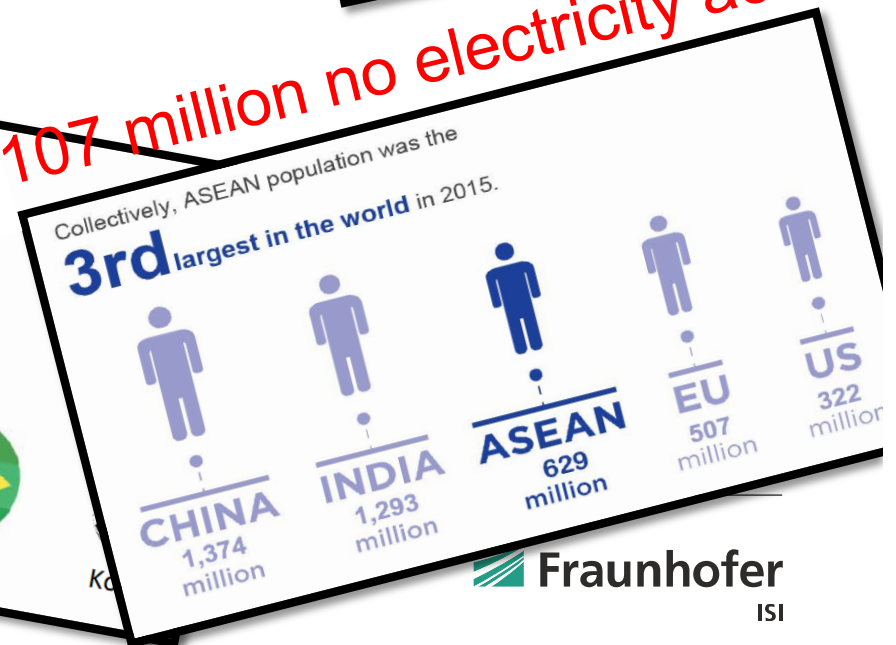


Association of South East Asian Nations

- ASEAN established 1967
- ASEAN Centre for Energy (ACE) established 1999
- AEO used to derive ASEAN Plan for Energy Cooperation



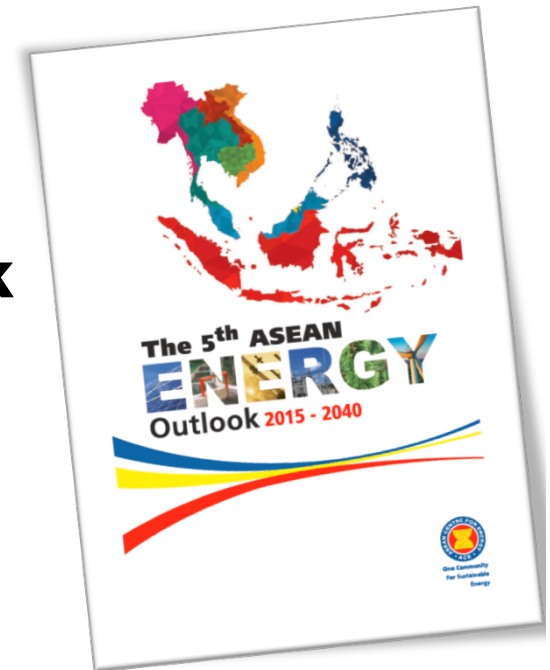
107 million no electricity access



Agenda

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Scenarios - 5th ASEAN Energy Outlook

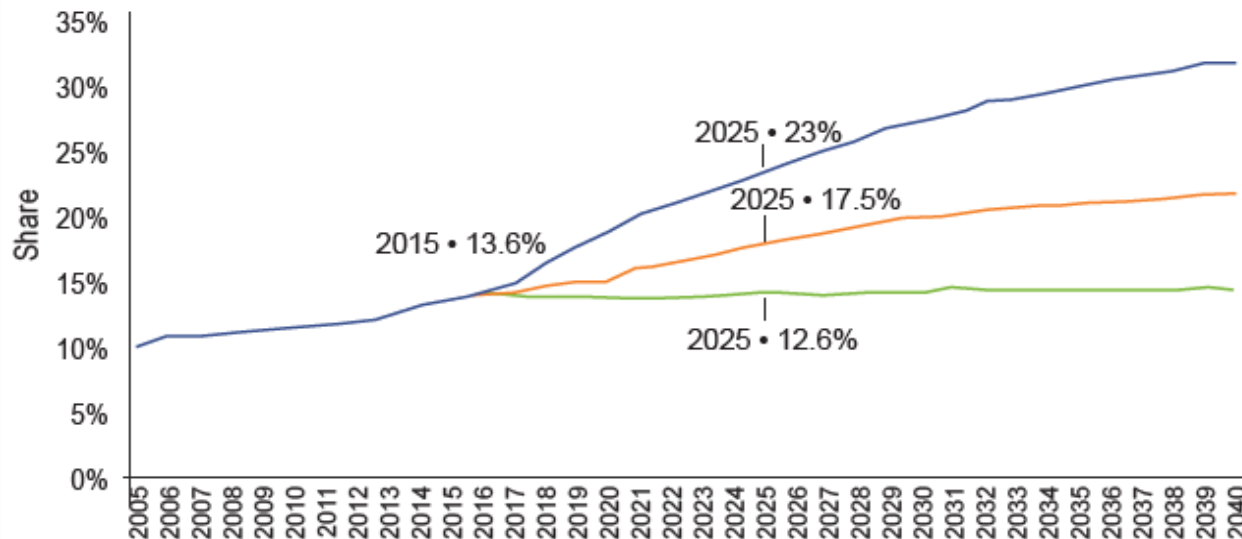
AE05 comprises 3 scenarios and their implications for the energy system in ASEAN and its member states

- 1. BAU Scenario:** without significant changes to past practices and assuming that AMS develop no specific policies in reaching their most recently issued EE and RE targets.
- 2. ATS Scenario:** target-based scenario assuming that the most recently-issued **EE and RE national targets** are reached.
- 3. APS Scenario:** target-based scenario assuming that **regional targets** of South East Asia are reached.

ASEAN Regional Targets

- **Increase RE to 23% by 2025** in energy mix (Primary Energy)
- **Reduce EI by 20% in 2020** based on 2005 level (GDP USD 2005)

Share of RE in TPES



Source The 5th ASEAN Energy Outlook

Power Sector

APS: 320 GW RE
55% of total 580 GW

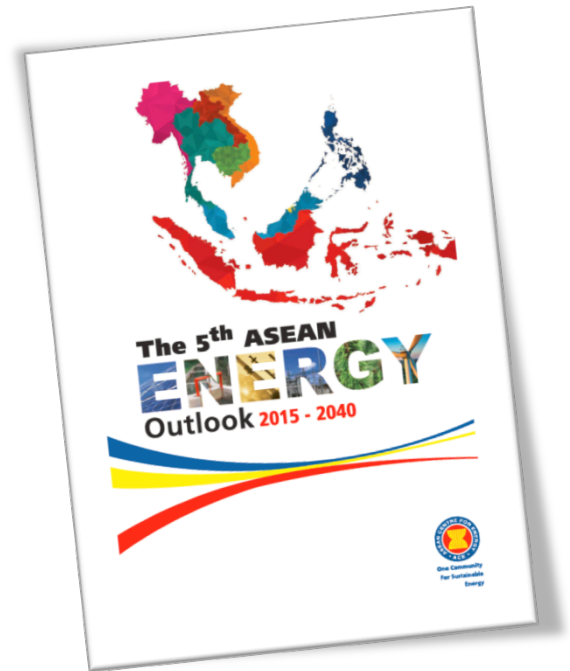
ATS: 252 GW RE
43% of total 588 GW

BAU: 183 GW of RE
29% of total 629 GW

Agenda

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AE05 Projections: TPES in 2040

Projections of Total Primary Energy Supply (TPES)

Business-as-Usual Scenario (BAU)

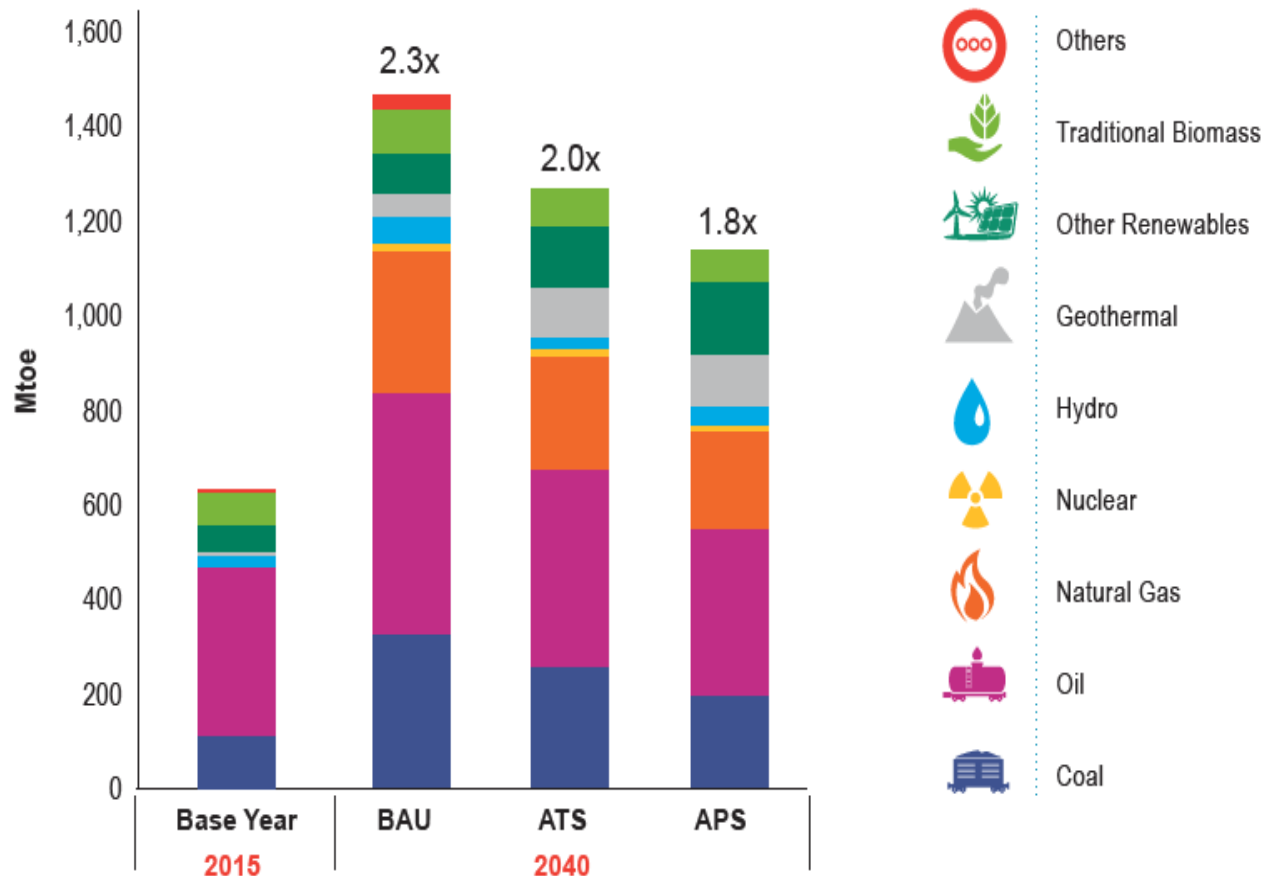
No significant changes
√ Fossil 79% vs RE 14%

AMS Targets Scenario (ATS)

National targets are fully attained
√ 14% lower, Fossil 79% vs RE 14%

ASEAN Progressive Scenario (APS)

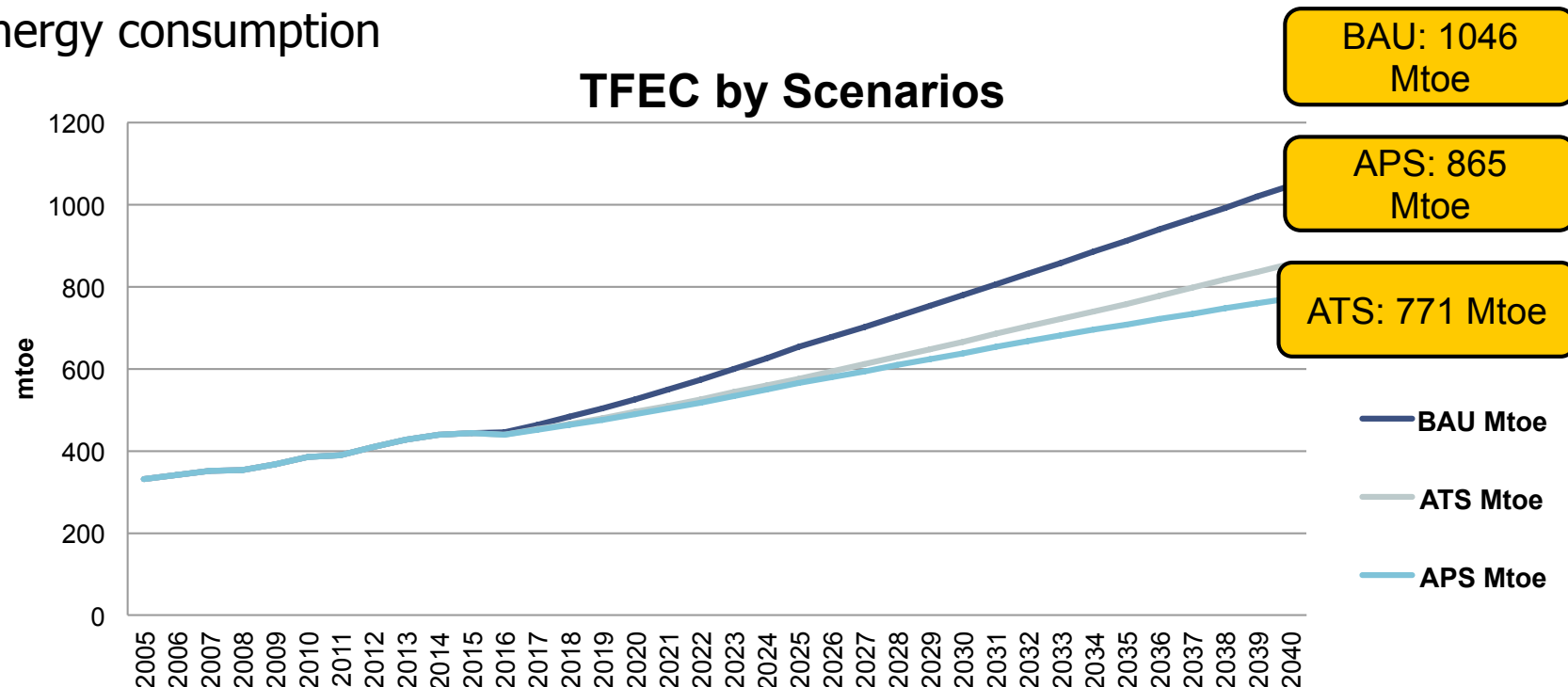
Higher ambition level in clean tech
√ 23% lower, Fossil 63% vs RE 32%



Source The 5th ASEAN Energy Outlook

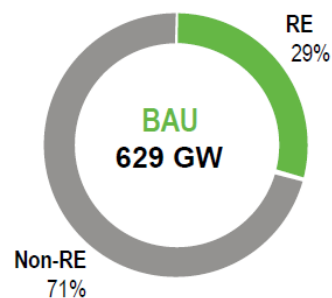
AE05 Projections: TFEC

- Energy efficiency leads to a lower final energy demand for electricity across all consumption sectors (residential, industrial, commercial, agricultural)
- But strong growth of GDP in ASEAN (~5% per year) region leads to increased energy consumption

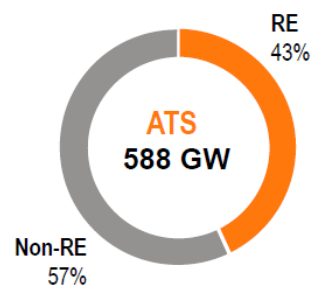


Source The 5th ASEAN Energy Outlook

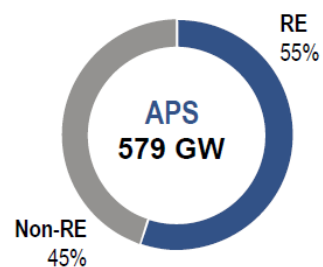
AE05 Projections: RES



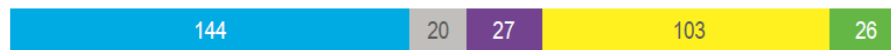
RE Installed Capacity in BAU 183 GW



RE Installed Capacity in ATS 252 GW



RE Installed Capacity in APS 319 GW

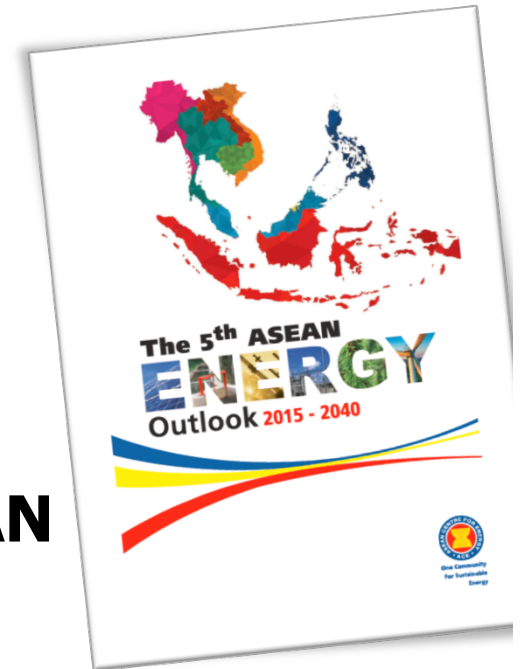


Source The 5th ASEAN Energy Outlook

Agenda

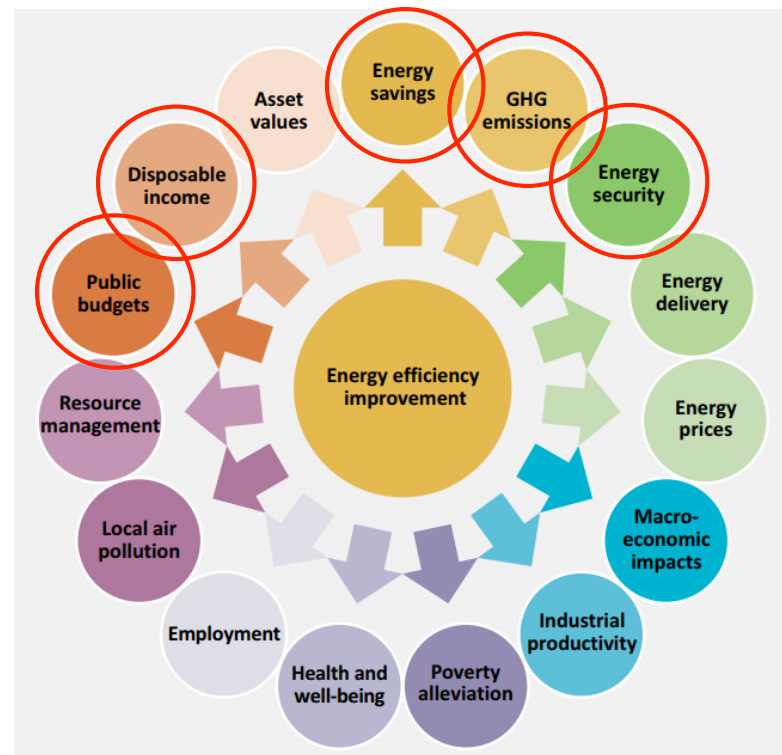
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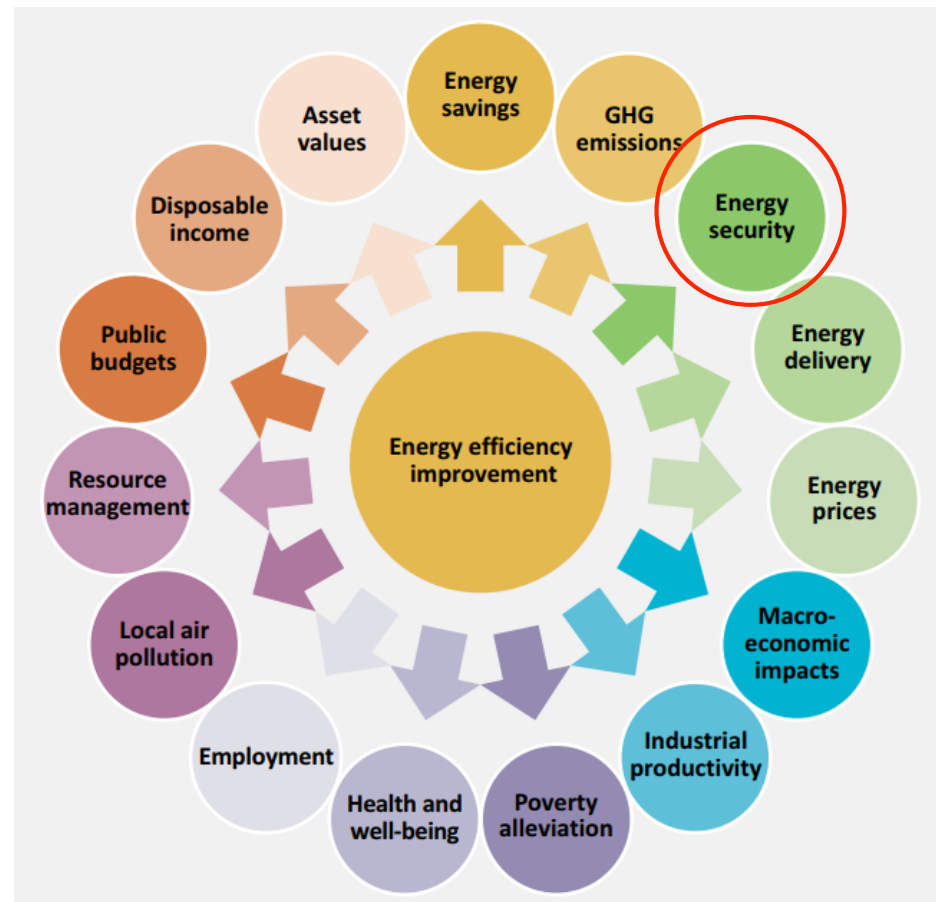
Multiple Benefits in ASEAN: a first look

- First estimation of MB related to *energy security, GHG emissions, disposable income, public budgets*
- Why? Make energy efficiency and renewables more attractive

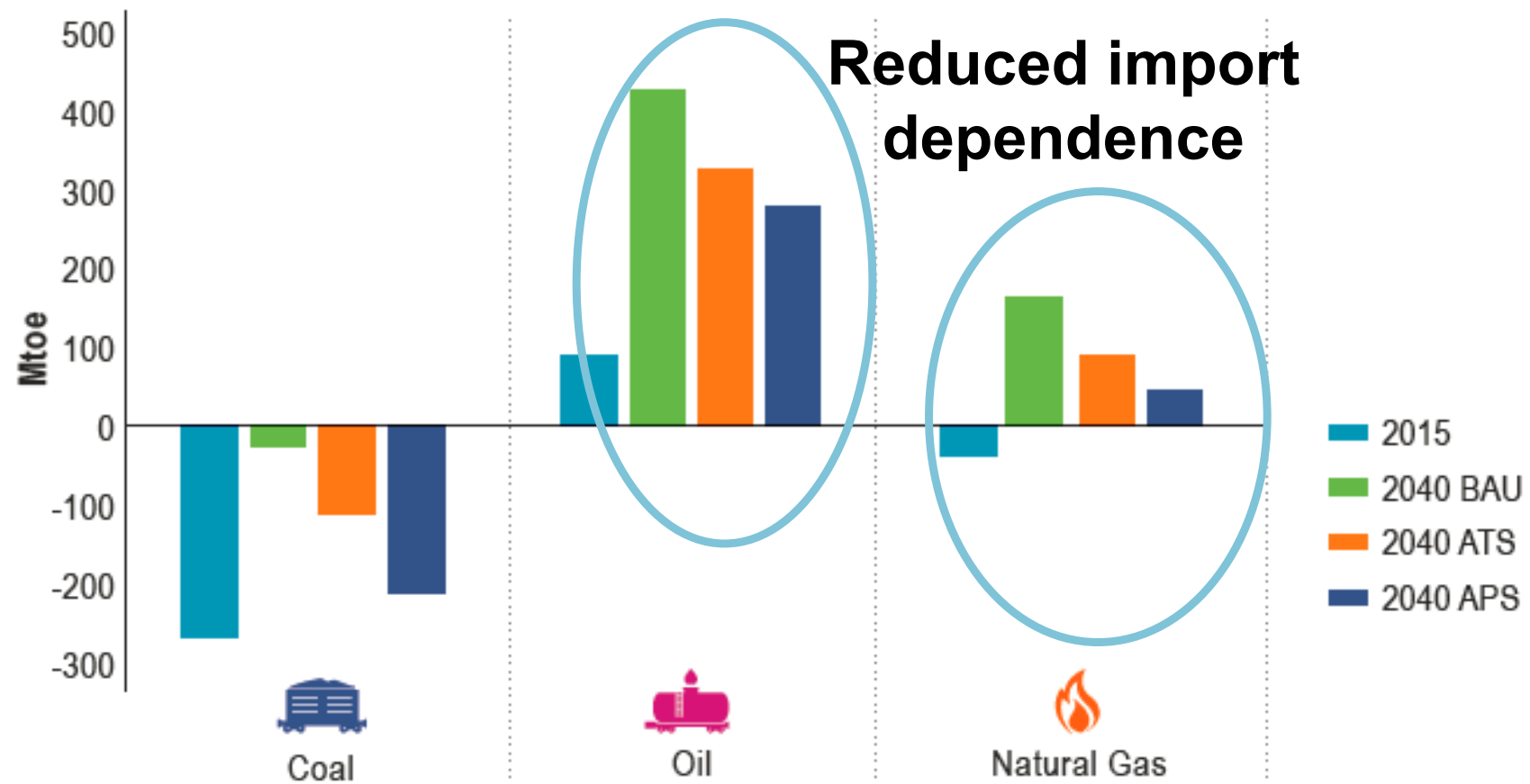


Source: IEA (2014)

Multiple Benefits in ASEAN **Energy Security**

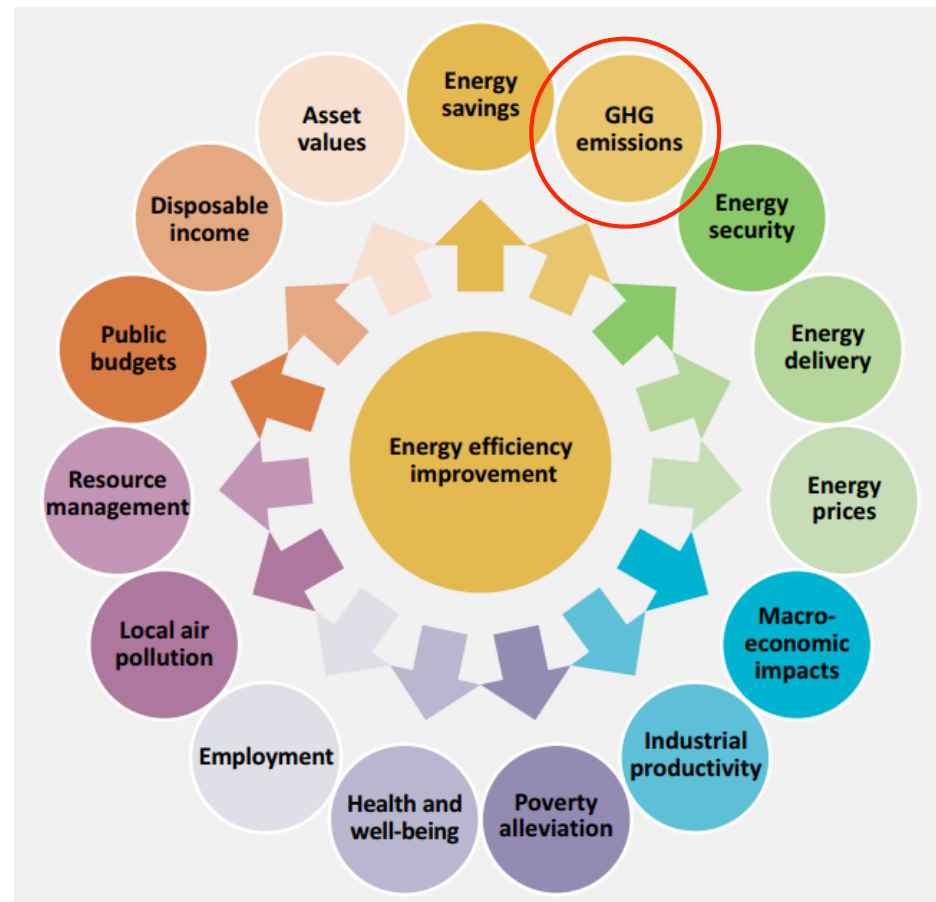


EE and RE substantially improve resource management and supply security in ASEAN



Source The 5th ASEAN Energy Outlook

Multiple Benefits in ASEAN **GHG Emissions**



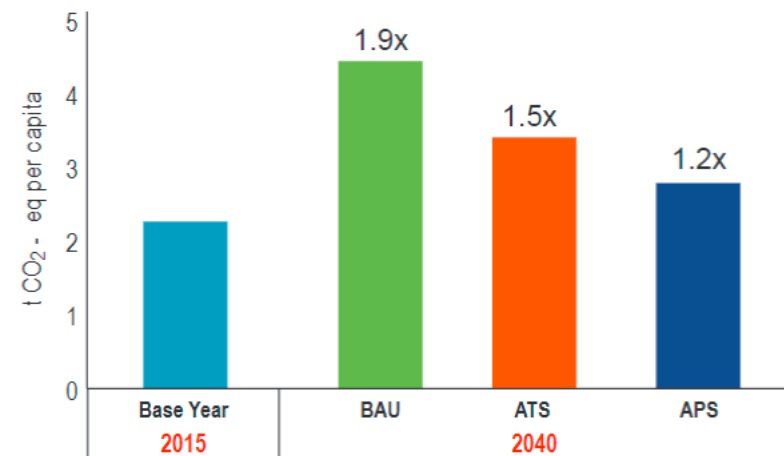
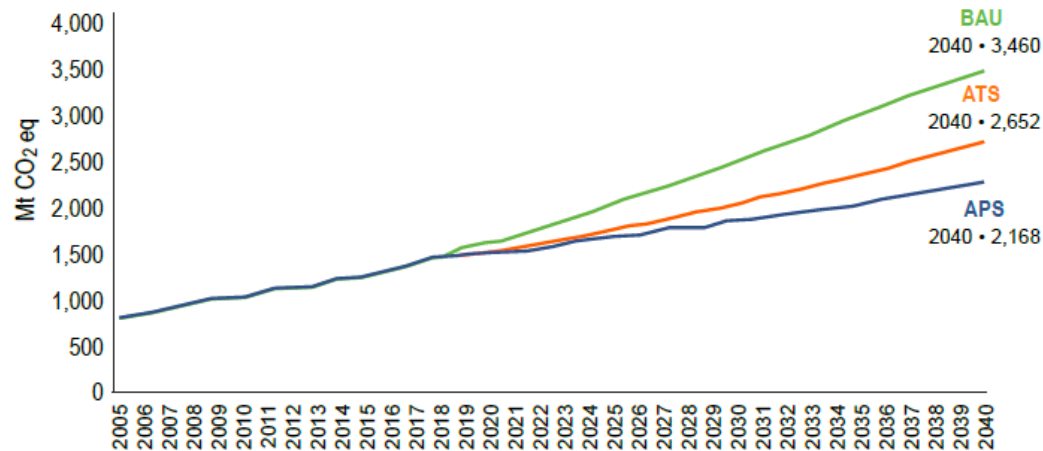
Reduced GHG Emissions

- GHG Emissions can be reduced substantially if EE and RE targets are reached.

BAU: 2.4x = 3,460 Mt CO₂eq in 2040

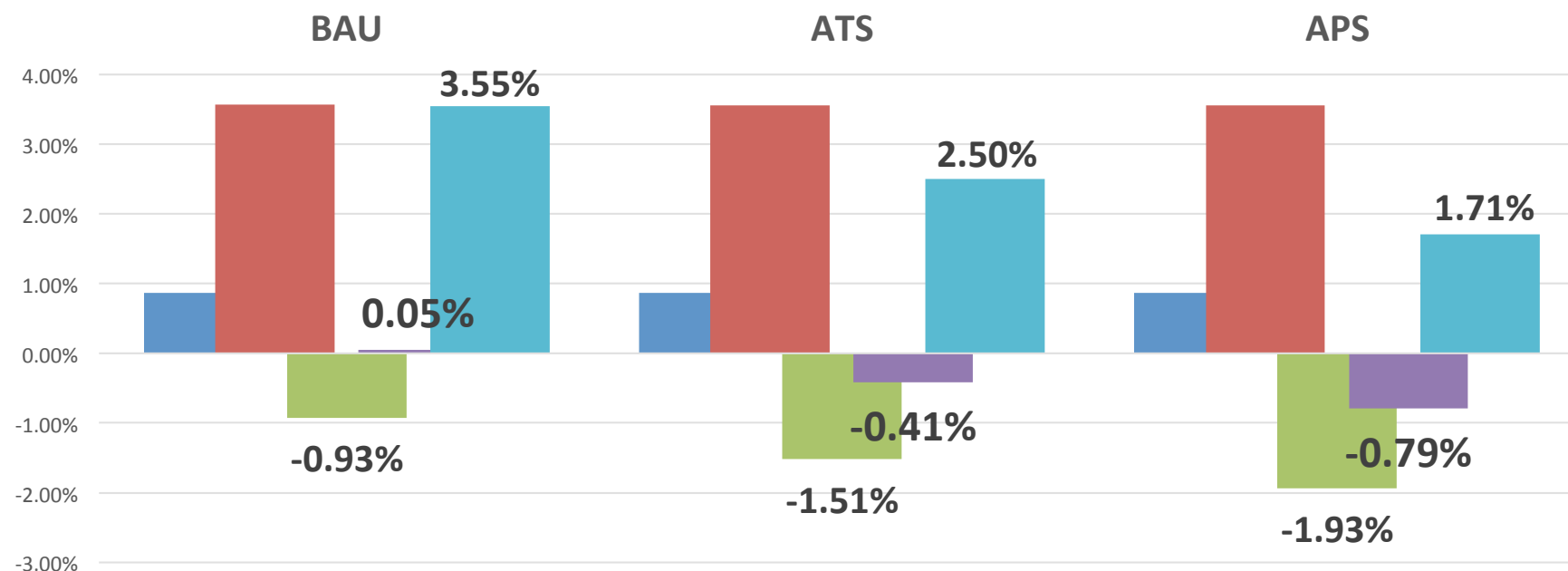
ATS: 1.8x = 2,652 Mt CO₂eq in 2040 (-988 Mt CO₂eq, -28%)

APS: 1.5x = 2,168 Mt CO₂eq in 2040 (-1474 Mt CO₂eq, -37%)



Source The 5th ASEAN Energy Outlook

Reduced GHG Emissions: KAYA Decomposition analysis



$$\text{CO}_2 = \text{Population} * \text{per capita GDP} * \text{energy intensity} * \text{CO}_2 \text{ intensity}$$

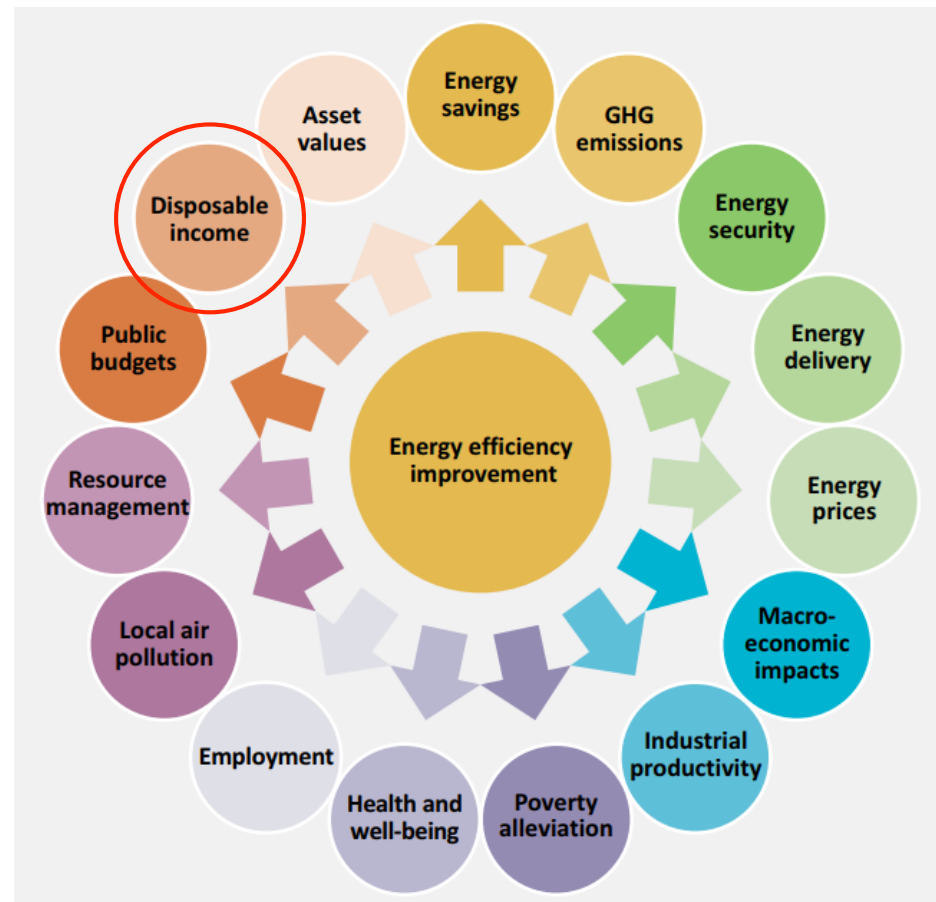
$$\text{CO}_2 = \text{POP} * \text{GDP/POP} * \text{TPES/GDP} * \text{CO}_2/\text{TPES}$$

- POP
- Per capita GDP (GDP/POP)
- Primary Energy Intensity (TPES/GDP)
- Carbon Intensity (CO2/TPES)

Source The 5th ASEAN Energy Outlook

Multiple Benefits in ASEAN

Disposable Income

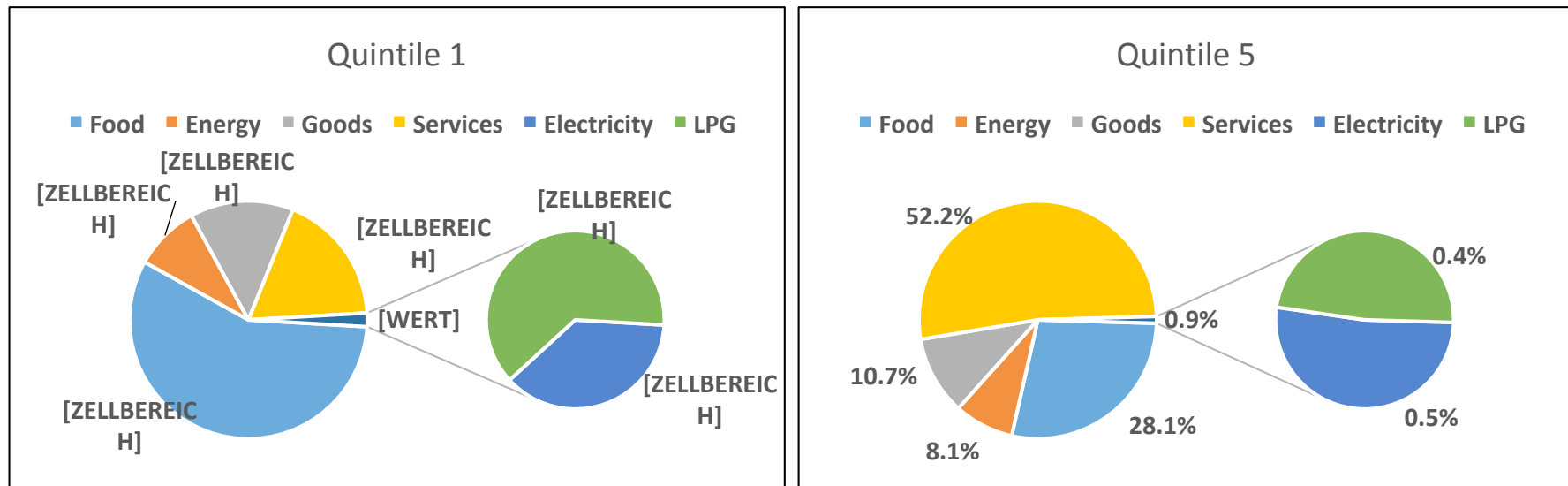


Multiple Benefits in ASEAN

Disposable Income

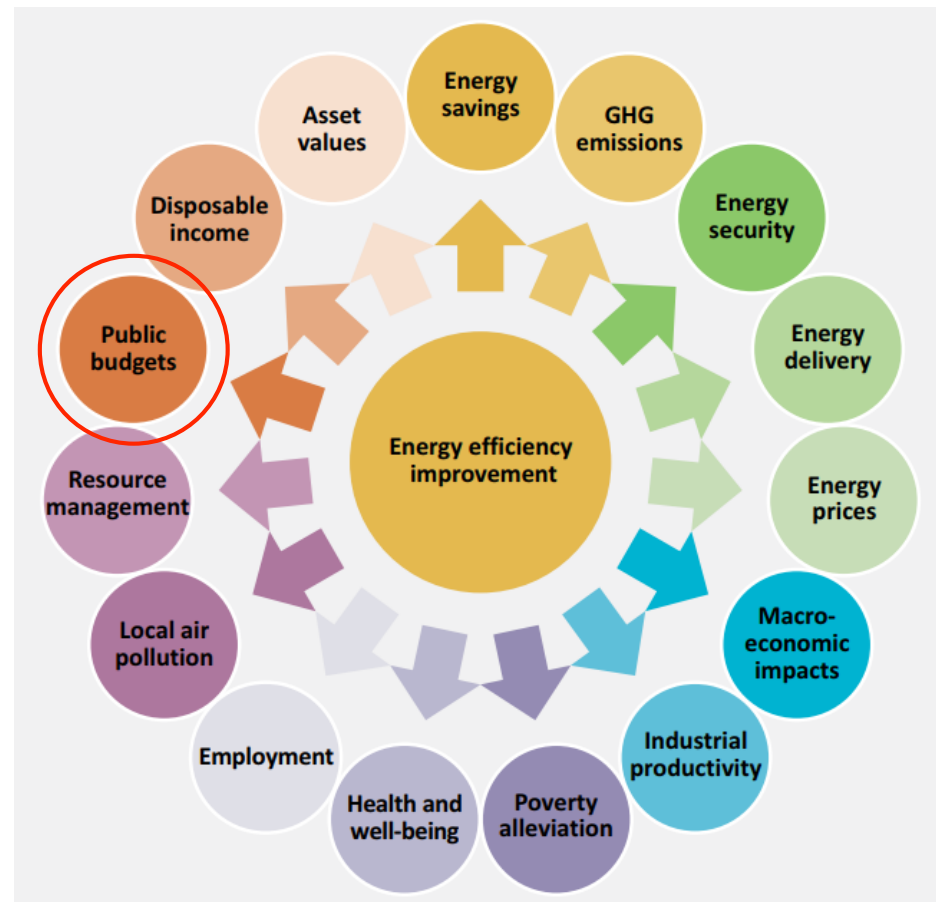
- Electricity and LPG expenditures comprises a minor share of expenditures both for richer (0.9% of total income) as poorer households (1.9%)
- Highly subsidized electricity and LPG prices provide little incentive for the household sector to adopt more efficient appliances

-> Almost no effects of EE and RES on share of energy costs



Source: Own elaboration using India's households expenditures as proxy

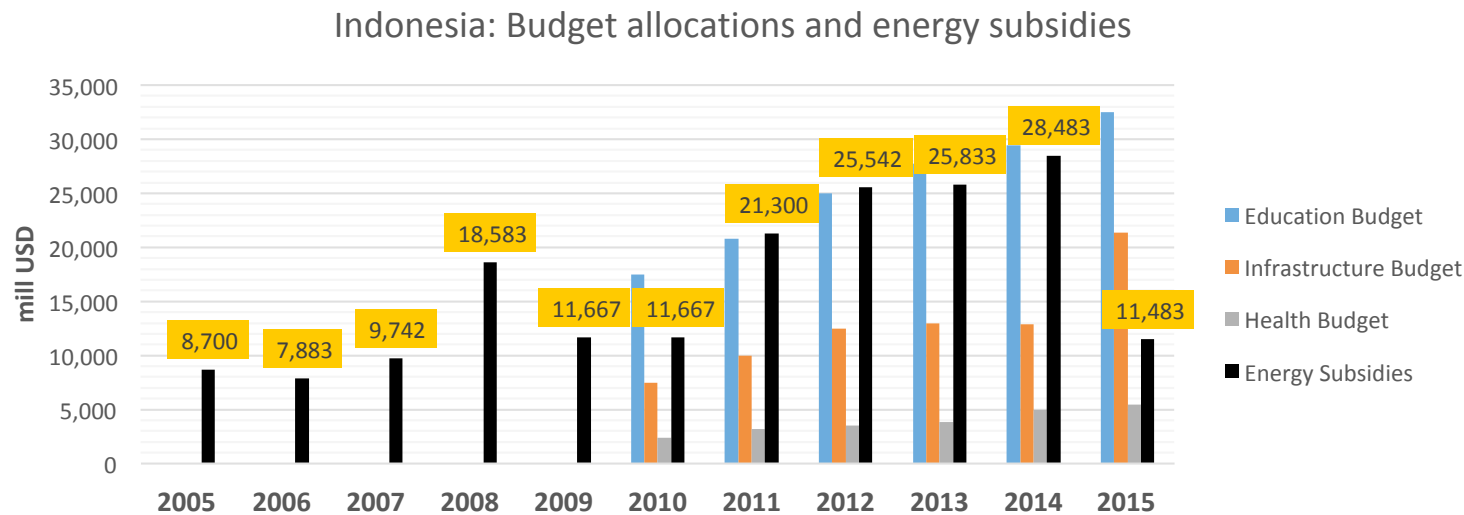
Multiple Benefits in ASEAN Public Budgets



Multiple Benefits in ASEAN

Public Budgets

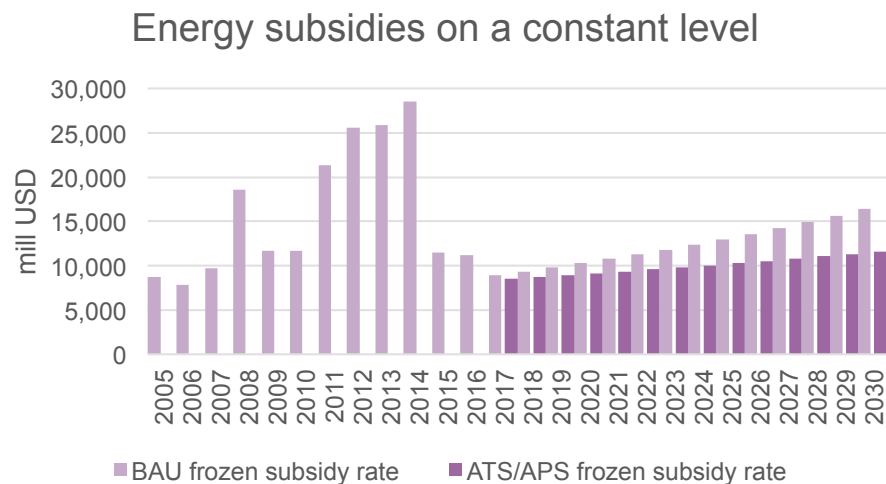
- In South East Asia, energy subsidies are present for electricity, gasoline, diesel, LPG and Kerosene in several countries.
- Indonesia's energy subsidies surpass the health and infrastructure budget allocations.
- Energy subsidies were already reduced in 2015 when president Joko Widodo took office (re-directed to infrastructure), yet still represent about 1% of GDP



Source: Adapted after Ordóñez et al -Coal, Power and Coal Fired Politics in Indonesia (forthcoming)

Multiple Benefits in ASEAN Public Budgets

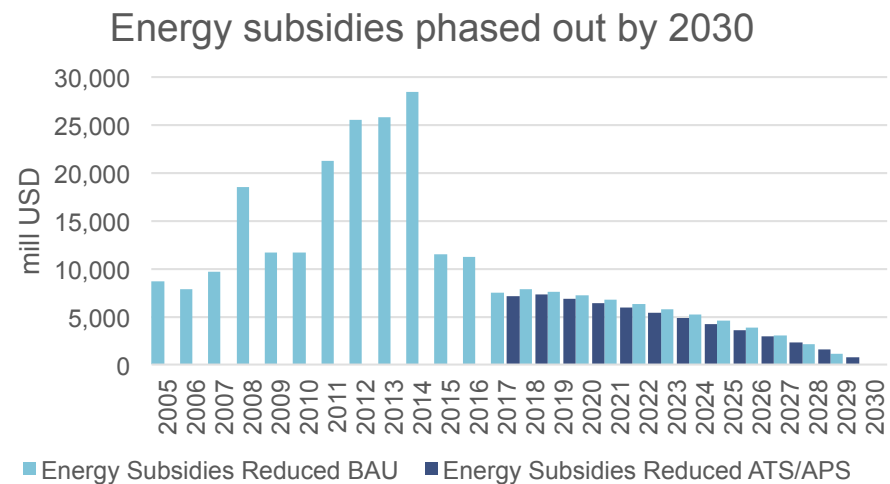
- In prevalence of energy subsidies, reaching the stipulated EE-Targets of Indonesia would free financial resources, which could be re-directed to health or education spending
- **Case 1 (left):** If subsidies remain on a constant level, cummulative savings would amout to 32 bill USD by 2030 due to energy efficiency.
- **Case 2 (right):** If subsidies are phased out by 2030, cummulative savings would amout to 9.5 bill USD by 2030 due to energy efficiency



Source: Own elaboration

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Multiple Benefits in ASEAN

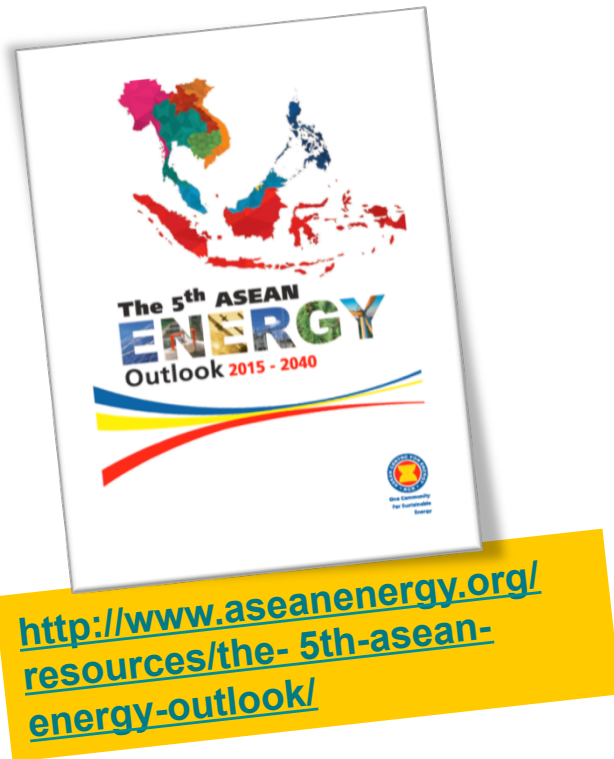
Next steps

Planned work:

- Adding other relevant benefits
 - Local emissions (NO_x, SO₂, PM_{2.5})
 - > Power sector highly dependent on fossil fuels, relatively weak emission standards
 - Premature deaths
 - > Indonesia: 210 000 premature deaths due to local emissions (2015)
- Job creation
 - > important argument for politicians/policy makers

Problems: data availability...

Questions?



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wolfgang.eichhammer@isi.fraunhofer.de

Further information:

<https://www.isi.fraunhofer.de/en/competence-center/energiepolitik-energiemaerkte/projekte/asean-energy-outlook-2017.html>

<https://www.isi.fraunhofer.de/en/presse/2017/presseinfo-24-2017-asean-energy-outlook.html>

Thank you very much for your attention.

Back-up: Modeling Parameters for AEO5

Parameters	Business-as-Usual Scenario (BAU)	AMS Target Scenario (ATS)	ASEAN Progressive Scenario (APS)
Socio-Economic	<ul style="list-style-type: none">• GDP growth: used AMS official projections into 2025, adjusted with moderate rate after 2025 based on PwC's The World in 2050.• Population growth: used AMS official projections, or the UN World Population Prospect for the medium fertility population forecasts as per 2015.		
Final Energy Demand	<ul style="list-style-type: none">• Determined using regression analysis for each AMS at sectoral level.	<ul style="list-style-type: none">• Based on BAU, but adopting full achievement on AMS national targets on EE, RE (i.e. biofuels and modern biomass).	<ul style="list-style-type: none">• Extended ATS targets, applied until 2040.• <i>ASEAN RE Outlook</i>: higher share of biofuels.
Power Sector	<ul style="list-style-type: none">• Official Power Development Plan (PDP).	<ul style="list-style-type: none">• Adopted the official national target on RE.	<ul style="list-style-type: none">• <i>Renewable Energy Outlook for ASEAN: RE map Analysis</i>: used for higher share of RE to achieve APAEC's 23% Target of RE on TPES by 2025.
Refining	<ul style="list-style-type: none">• National plans on new units or future expansion.		
Production of Fossil Fuels	<ul style="list-style-type: none">• National plans on future productions.		
Reserves	<ul style="list-style-type: none">• Follows reserves to production approach: reserves are assumed to be constant at the 2015 value. Reserve development thus shows the theoretical depletion assuming no additions to reserves are present during the projection period.		

Back-up: Socio Economic Assumptions of AEO5

AMS ³	GDP (USD Billion) Current Value	GDP PPP Projection CAGR (%)		Population (thousand people)	Population CAGR 2016- 2040 (%)
		2016- 2025	2016-2040		
Brunei Darussalam	12.9	4.0%	1.0%	417	0.9%
Cambodia	18.5	7.2%	6.2%	15,581	1.1%
Indonesia	857.6	5.6%	4.5%	257,754	0.8%
Lao PDR	12.6	7.8%	6.3%	6,809	1.2%
Malaysia	294.4	3.8%	3.1%	30,440	1.1%
Myanmar	65.4	7.4%	6.8%	53,972	1.0%
Philippines	289.5	7.4%	6.2%	100,735	1.5%
Singapore	291.9	2.0%	2.0%	5,555	1.4%
Thailand	395.7	3.9%	3.5%	68,003	0.03%
Vietnam	193.4	6.8%	5.5%	91,706	0.6%
ASEAN	2,432.0	5.4%	4.5%	630,971	0.9%

Back up: EE targets for ATS scenario

AMS	Target Description	Saving Rate per year	Horizon
Brunei Darussalam	• Reduce EI (TFEC/GDP) to 2035 by 45% based on 2005 levels.	All sectors: 2.7%	2035
Cambodia	• Reduce TFEC by 20% in 2035 compared to BAU.	All sectors: 1.2%	2035
Indonesia	• Reduce TFEC in 2025 by 17% in industry, 20% in transport, 15% in household, 15% in commercial building as compared to BAU.	Industry 1.9% Transport 2.4% Residential 1.6% Commercial 1.7%	2025
Lao PDR	• Reduce TFEC 10% in 2030 compared to BAU.	All sectors: 0.7%	2030
Malaysia	• Reduce Electricity Consumption in TFEC by 8% in 2025 as compared to BAU.	Electricity: 0.9%	2025
Myanmar	• Reduce Electricity Consumption in TFEC by 20% in 2030 as compared to BAU.	Electricity: 1.5%	2030
Philippines	• Reduce TFEC by 1% per year compared to BAU until 2040.	All sectors: 1.0%	2040
Singapore	• Reduce EI (TFEC/GDP) by 35% from 2005 levels by 2030.	All sectors: 0.3%	2030
Thailand	• Reduce EI (TFEC/GDP) by 30% in 2030 compared to 2010 level.	All sectors: 2.6%	2030
Vietnam	• Reduce TFEC by 8% in 2020 compared to BAU.	All Sectors: 1.7%	2020

Back up: EE targets for APS scenario

AMS	Reference Targets	Saving Rate per year	Horizon
Brunei Darussalam	• Reduce EI (TFEC/GDP) to 2035 by 45% based on 2005 level.	All sectors: 2.7%	2040
Cambodia	• Reduce TFEC by 20% in 2035 compared to BAU.	All sectors: 1.2%	2040
Indonesia	• Reduce TFEC in 2025 by 17% in industry, 20% in transport, 15% in household, 15% in commercial building compared to BAU.	Industry 1.9% Transport 2.4% Residential 1.6% Commercial 1.7%	2040
Lao PDR	• Reduce TFEC by 10% in 2030 compared to BAU.	All sectors: 0.7%	2040
Malaysia	• Reduce Electricity Consumption in TFEC by 16% in 2025 compared to BAU.	Electricity: 1.7%	2040
Myanmar	• Reduce Electricity Consumption in TFEC by 20% in 2030 compared to BAU.	Electricity: 1.5%	2040
Philippines	• Reduce TFEC by 1.3% per year compared to BAU until 2040.	All sectors: 1.3%	2040
Singapore	• Reduce EI (TFEC/GDP) by 35% from 2005 levels by 2030.	All sectors: 0.3%	2040
Thailand	• Reduce EI (TFEC/GDP) by 30% in 2030 compared to 2010 level.	All sectors: 2.6%	2040
Vietnam	• Reduce TFEC by 8% in 2020 compared to BAU.	All Sectors: 1.7%	2040

Back-up 11:(I)NDC Targets

MYANMAR

20% electricity saving potential by 2030, increase hydropower generation 9.4 GW by 2030, and use 30% RE sources for electricity generation

LAO PDR

30% RE share of total energy consumption by 2025, 10% biofuel use in transport sectors by 2025

VIETNAM

8% GHG emission reduction by 2030 relative to BAU, 25% with international support

MALAYSIA

35%-45% emission intensity reduction based on GDP 05, in 2030

THAILAND

20% GHG reduction by 2030 relative to BAU and up to 25% with assistance

CAMBODIA

27% emission reduction, by 2030 relative to BAU in energy industry, industries, energy conservation

PHILIPPINES

70% CO₂ emission reduction by 2030 relative to BAU scenario

BRUNEI DARUSSALAM

63% energy saving by 2035 relative to BAU

SINGAPORE

36% emission intensity reduction by 2030 from 2005 level

INDONESIA

29% to 41% emission reduction by 2030, includes promotion clean and renewable energy and energy conservation