

Energy transitions

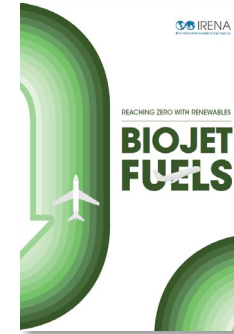
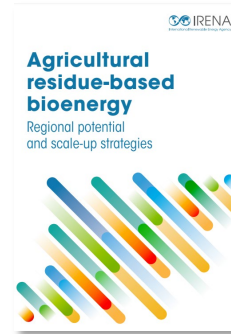
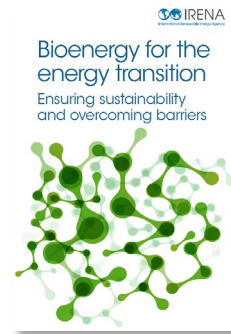
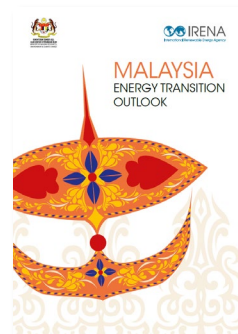
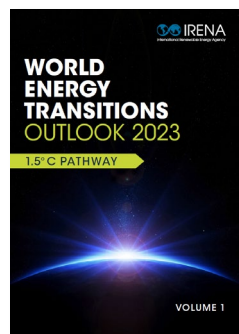
# Role of bioenergy



## Role of bioenergy in energy transition

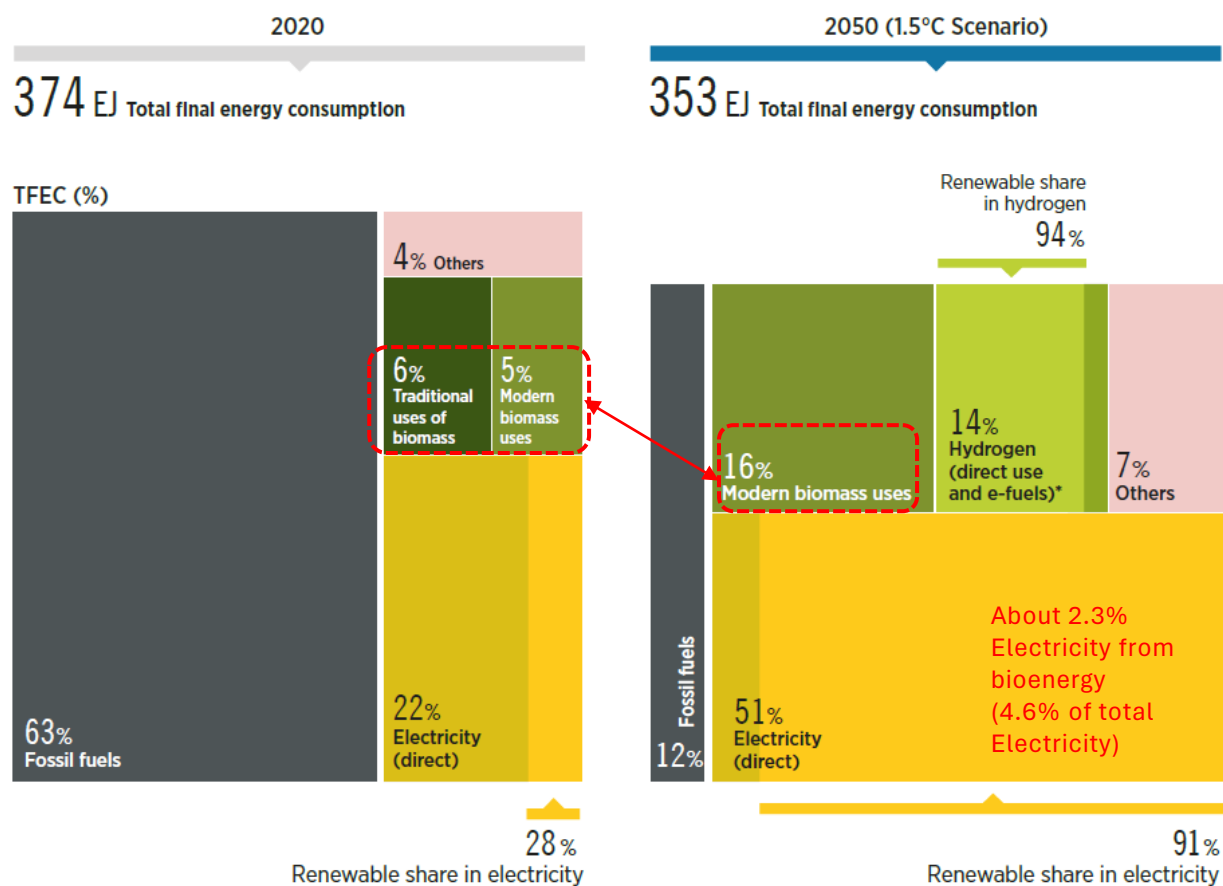
### Bioenergy's pivotal role:

- Sectorial context: Sub-sectors or industries like cement, steel, aviation, and shipping rely on bioenergy for decarbonization
- Regional context: Bioenergy's significance in regions with extensive agriculture and forestry extends beyond energy, providing notable social and environmental benefits
- International Trade: Vital complementary functions through international trade



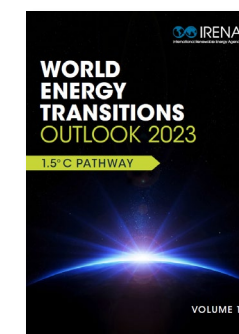
# Bioenergy in the energy mix

**FIGURE 1.2** Breakdown of total final energy consumption by energy carrier between 2020 and 2050 under the 1.5°C Scenario



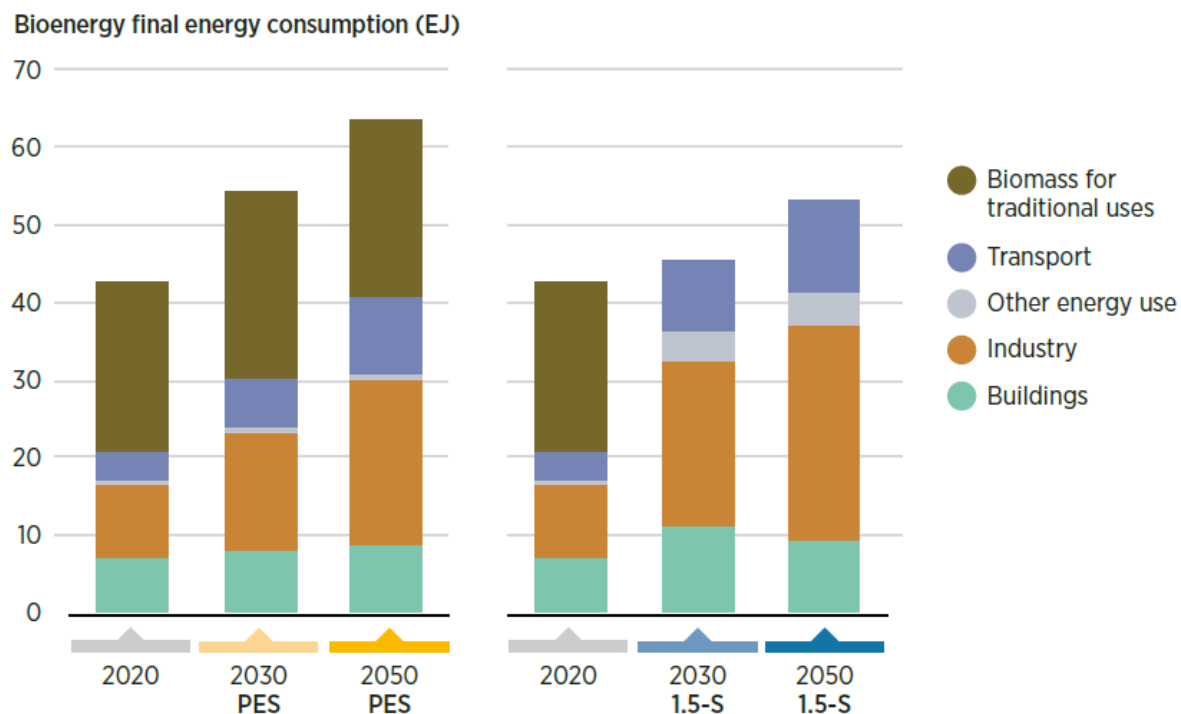
## Contribution of bioenergy in total final energy consumption:

- ~16% of modern biomass uses by 2050
- ~2.3% of electricity from bioenergy



## Sectorial contribution – Overview

**FIGURE 2.8** Bioenergy final energy consumption by sector in 2020, 2030 and 2050 under the Planned Energy Scenario and 1.5°C Scenario



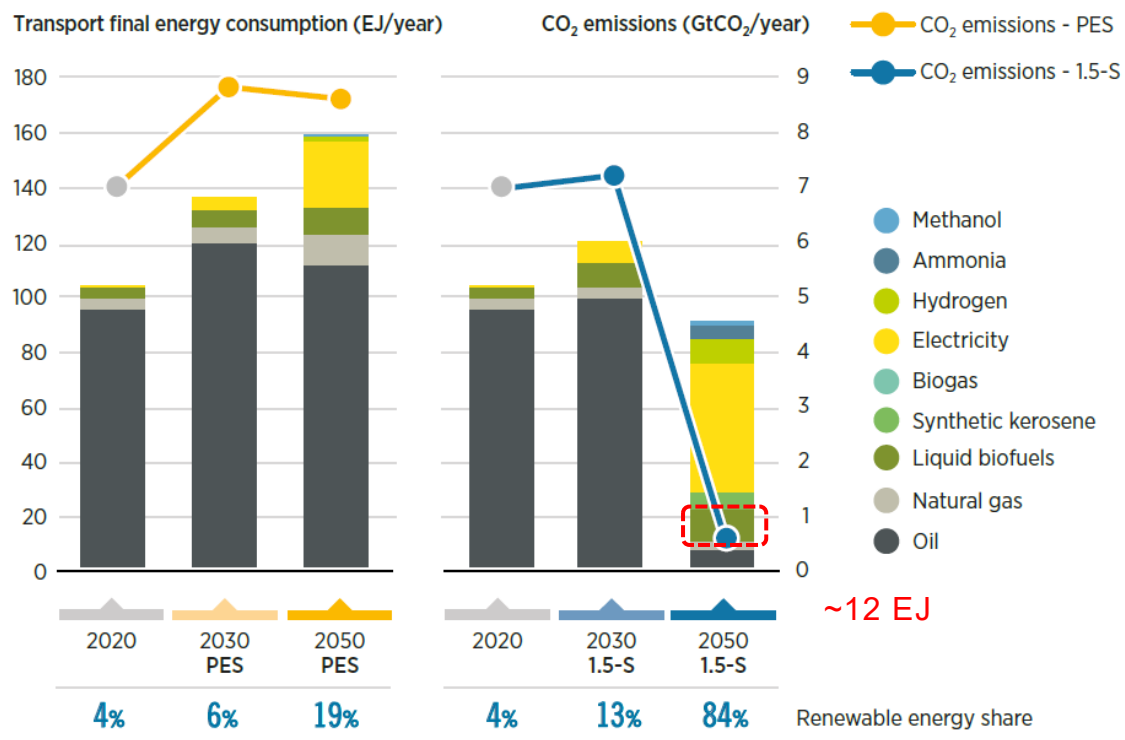
**Notes:** 1.5-S = 1.5°C Scenario; EJ = exajoule; PES = Planned Energy Scenario.

### Key changes from 2020-2050 in 1.5-S:

- A steady growth in transportation biofuels, including sustainable aviation and shipping fuels
- A much larger increase of bioenergy use in Industry compared to PES
- A complete shift from traditional biomass to modern bioenergy

# Sectorial contribution – Transport

**FIGURE 2.14** Transport: Final energy consumption under the Planned Energy Scenario and 1.5°C Scenario in 2020, 2030 and 2050, and corresponding emissions



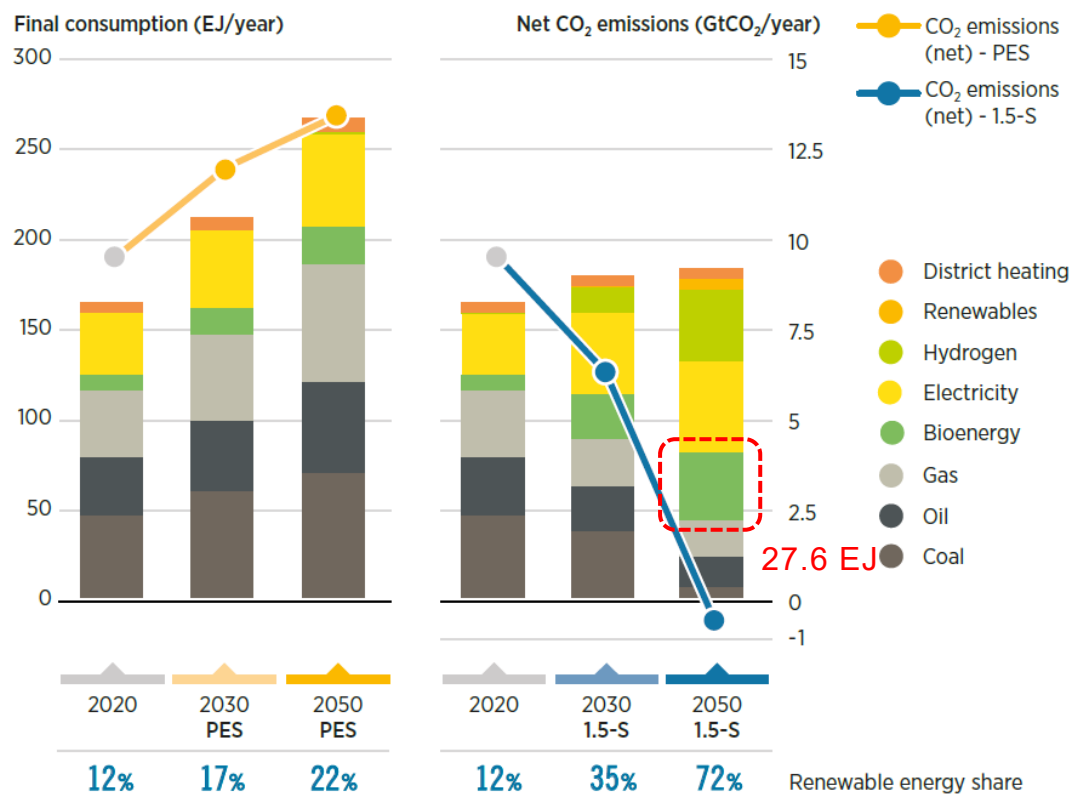
Notes: 1.5-S = 1.5°C Scenario; EJ = exajoule; GtCO<sub>2</sub> = gigatonnes of carbon dioxide; PES = Planned Energy Scenario

## Transportation:

- 23% of emission from transportation
- From ~8.6 GtCO<sub>2</sub> per year in planned energy scenario (PES) to to ~0.6 GtCO<sub>2</sub> per year in 1.5-S
- ~12 EJ from liquid biofuels
- Biofuel as major fuel in some countries
- ~24% of the total consumption in the aviation sector

## Sectorial contribution – Industry

**FIGURE 2.10** Industry: Final consumption under the Planned Energy Scenario and the 1.5°C Scenario in 2020, 2030 and 2050, and corresponding emissions

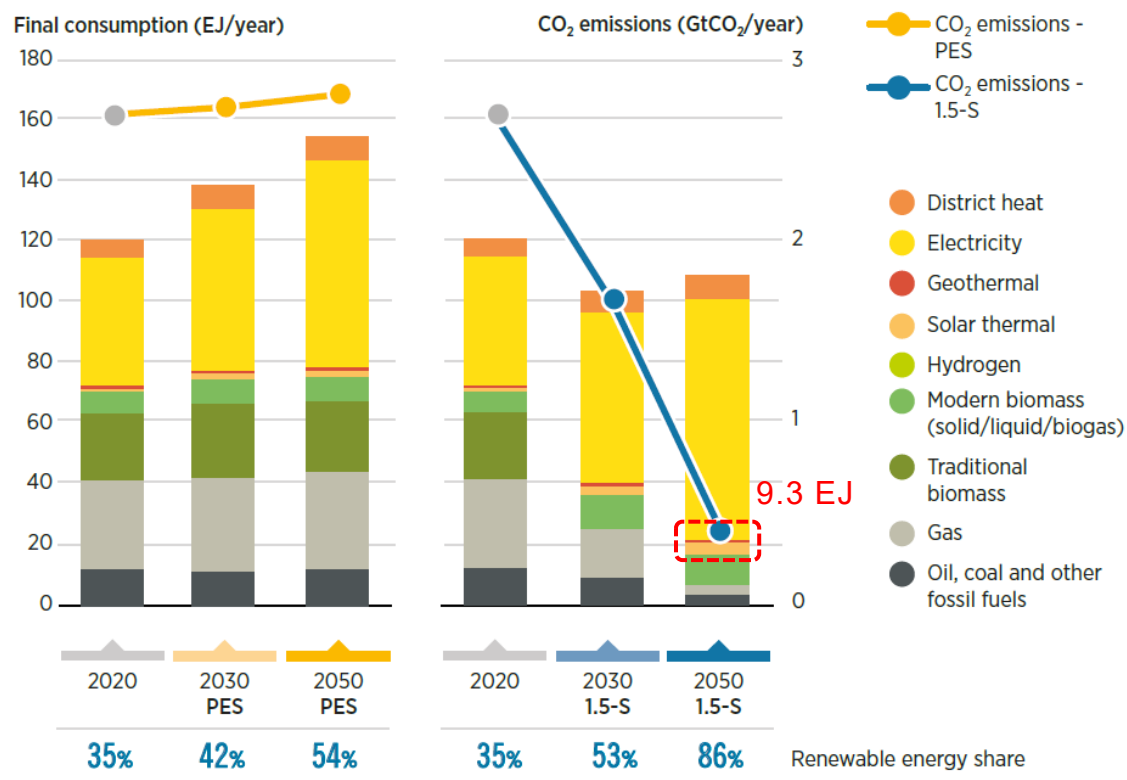


### Industry:

- Up to 20% of industry sector demand by 2050 in 1.5-S
- Biomass in energy-intensive industries - cement, iron & steel and chemical
- Example: Bioenergy in the cement sector would need to be scaled up to 3.5 EJ by 2050 coupled with CCS (BECCS)

# Sectorial contribution – Buildings

**FIGURE 2.12** Buildings: Final energy consumption under the Planned Energy Scenario and 1.5°C Scenario in 2020, 2030 and 2050, and corresponding emissions



Notes: 1.5-S = 1.5°C Scenario; EJ = exajoule; GtCO<sub>2</sub> = gigatonnes of carbon dioxide; PES = Planned Energy Scenario

## Cooking

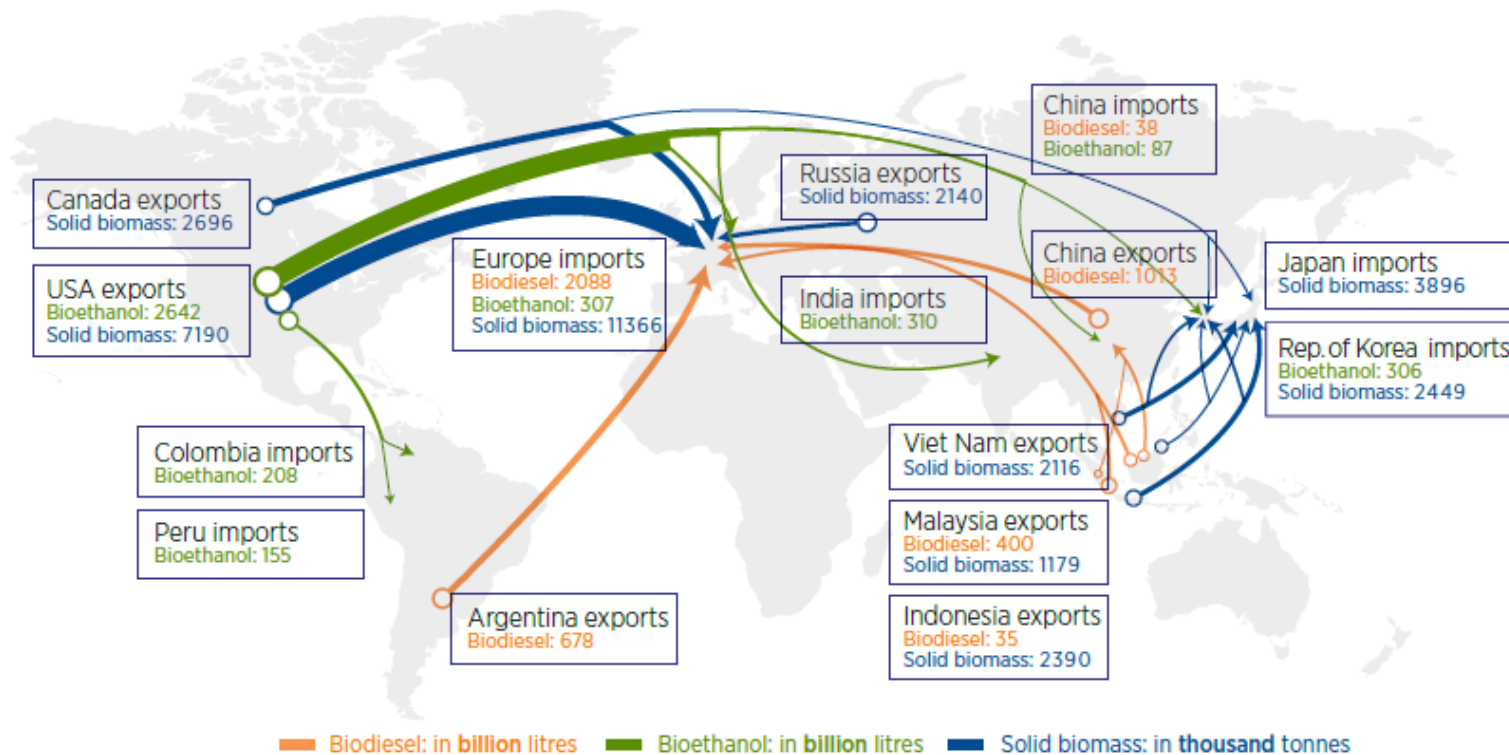
- Replace traditional, unsustainable bioenergy sources causing indoor air pollution with clean, efficient stoves powered by sustainable biomass, biogas and electricity (especially in sub-Saharan Africa)

## Heating

- District heating systems or building-scale boilers using wood chips and pellets

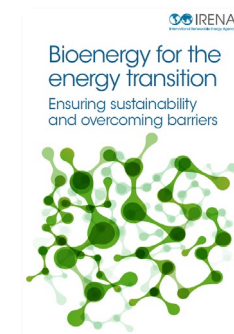
# International trade

FIGURE 3.1. Global bioenergy trade in major markets in 2020



## International trade:

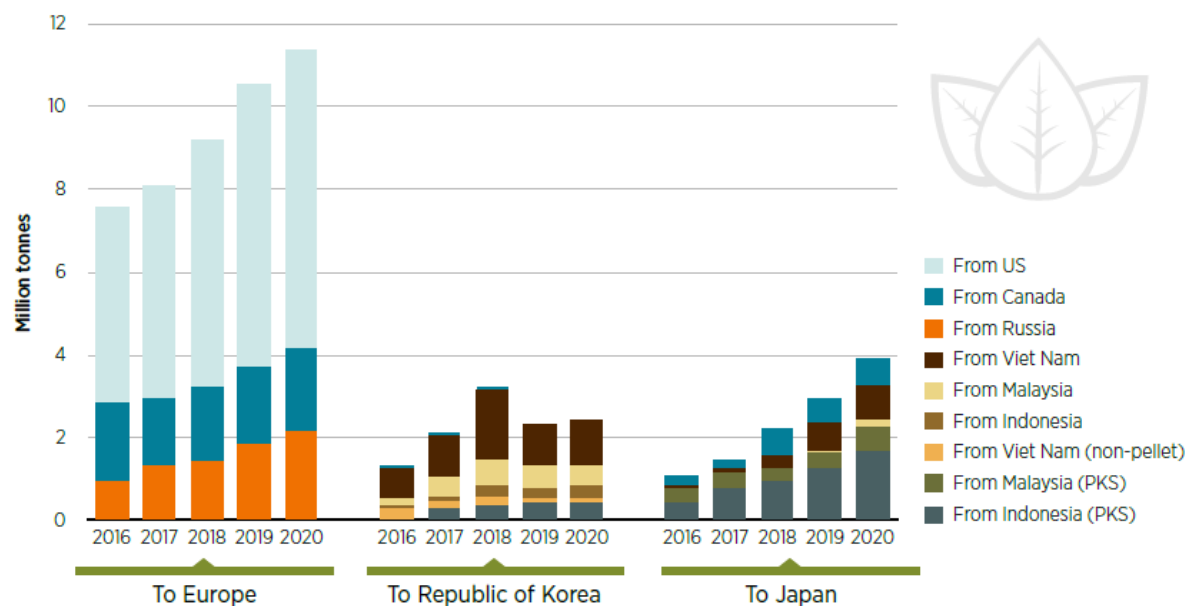
- Trans-regional
- Remain crucial due to the unbalanced distribution of biomass resources and demands
- Dynamics between East Asia and Southeast Asia





# Wood pellet

**FIGURE 3.4.** Estimated export volumes of wood pellets and other solid biofuels from major producers in 2016-2020

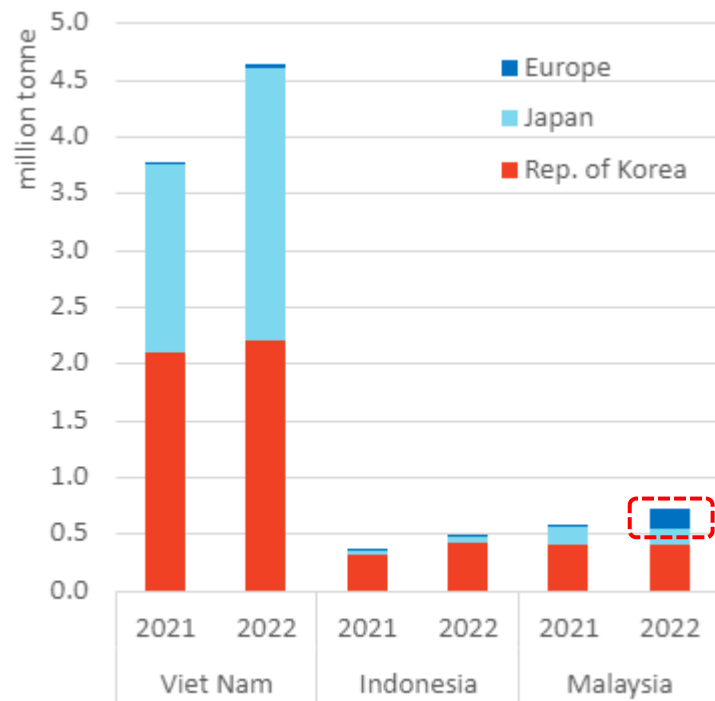


**Source:** Wood pellets data are based on UN Comtrade (2021), HS code 440131 include wood; for fuel, sawdust and wood waste and scrap, agglomerated in logs, briquettes, pellets or similar forms; wood pellets. Wood pellets (Russian Federation to Europe in 2020) is based on Argus (2021a). Non-wood pellets data are based on UN Comtrade (2021), HS code 440139 include wood; for fuel, sawdust and wood waste and scrap, agglomerated in logs, briquettes, pellets or similar forms; other than wood pellets. PKS to Japan is based on Japan Forestry Agency (2019) and Argus (2021b). PKS to Republic of Korea is based on Argus (2019).

## Japan and Republic of Korea as major destinations:

- To Republic of Korea – mainly wood pellets from Viet Nam and Malaysia
- To Japan – mainly PKS but also growing volume of wood pellet from Viet Nam

# Wood pellet



## 2022:

- Growth of Japanese imports of wood pellets from Viet Nam
- Significant volume of wood pellets imported from Malaysia to Europe
- Significant Changes in Vietnam's Forestry Development: Vietnam has witnessed notable transformations in its forestry sector since the introduction of the Vietnam Forestry Development Strategy in 2006.

Imports of wood pellets - unpublished analysis based on data from UN Comtrade

## Forest expansion

FIGURE 5.2. Changes in forested areas in Viet Nam



Source: FAO (2021).

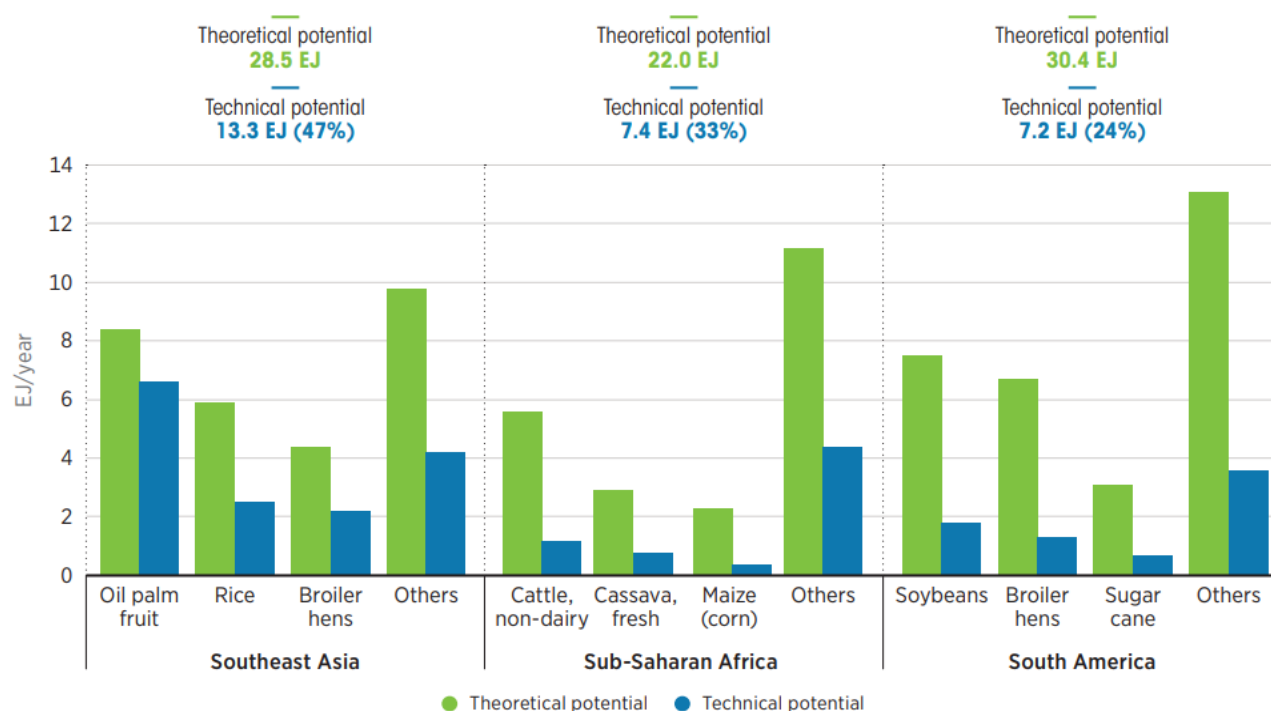
- Forested areas designated for production
- Naturally regenerating forest
- Plantation forest

### Vietnam:

- Expansion of nature forest (+1.7 million ha) and plantation forest timber (+3.8 million ha) in 1990-2020
- Plantations primarily consist of fast-growing species like acacia and eucalyptus.
- Foreign investment, particularly from East Asian countries

# Agricultural residues

**Figure S1** Theoretical and technical potential of agricultural residues for Southeast Asia, sub-Saharan Africa and South America



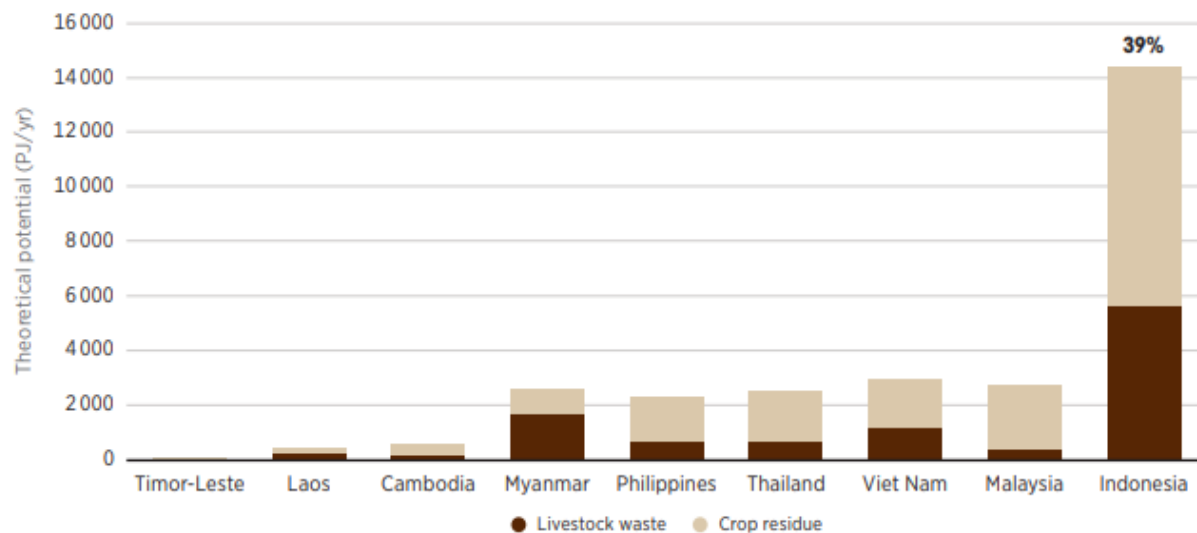
## Overview:

- ~28 EJ (technical potential) in agricultural residues in Southeast Asia, sub-Saharan Africa, and South America
- Each region boasts diverse biomass resources
- Distinct opportunities and challenges for bioenergy development in each region



## Agricultural residues in Southeast Asia

**Figure 2.3** Theoretical livestock waste and crop residue energy potential in Southeast Asia



Based on: 2019 FAO livestock and 2020 FAO crop production data (FAO, 2023).

Note: PJ/yr = petajoule/ year.

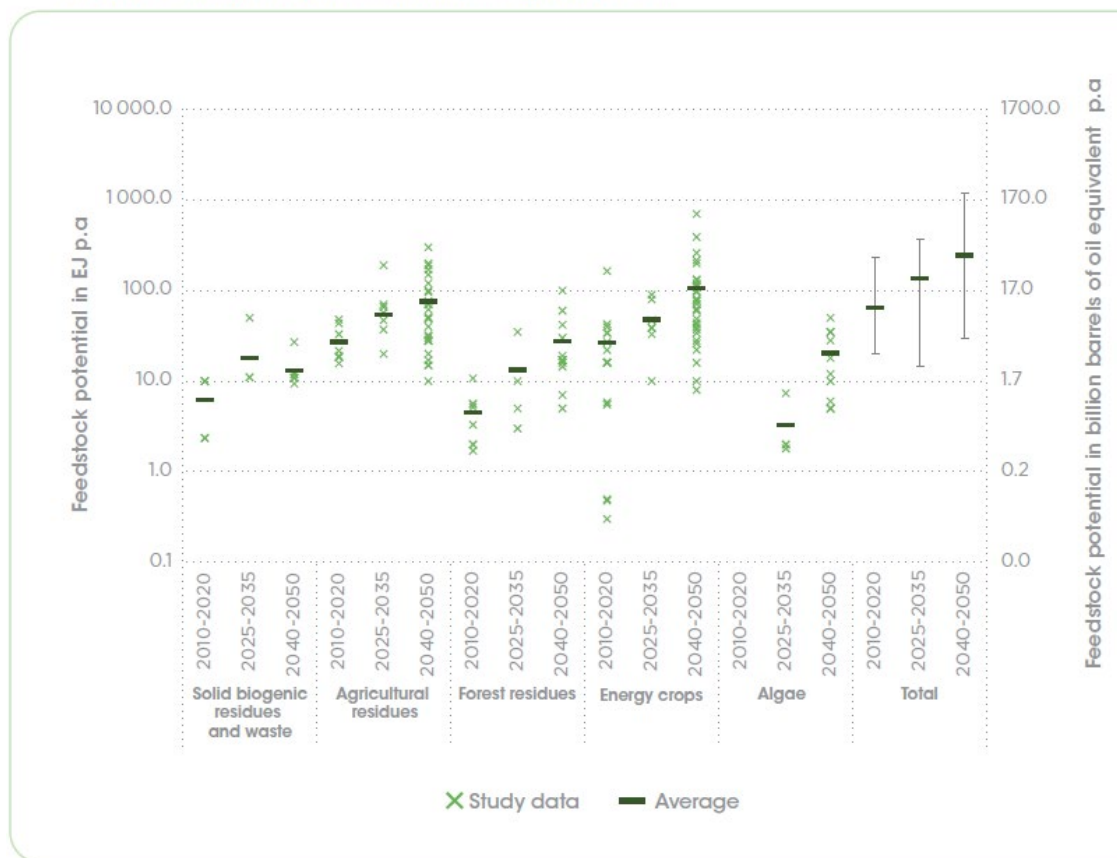
### Overview:

- Indonesia has the highest potential of biomass, especially oil palm residues and also livestock waste



# Aviation fuels

FIGURE 7. Summary of global estimates of biomass feedstock potential



Source: IRENA (2016a).

## Biojetfuels:

- Challenging to decarbonize the aviation sector
- No clear understanding about the potential of biojet fuels
- Competition between different end uses



## Transregional trade and investment

- To establish a robust bioenergy industry in Southeast Asia - trade and investment
- East Asia presents significant opportunity for the bioenergy industry
- Dilemma - substantial overseas investments from East Asia in coal in Southeast Asia, but have made commitments to shift towards renewable energy sources
- Bioenergy to take precedence over coal in investment and trade decision