3 July 2023

Charting Asia's Protein Transition

Defining pathways for protein security and climate-safety in ten Asian markets.

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China

China is the world's largest producer of pork, eggs, fish and the second-largest chicken producer after the United States. Despite a declining population, consumption is projected to grow further alongside increasing per-capita GDP until 2030. China imports 60% of its soy (for animal feed) and 33% of its beef from Brazil, Argentina, and Paraguay, driving massive deforestation. We project China will not be able to decarbonise its protein system without eliminating deforestation, peaking industrial animal production by 2030, and scaling its alternative proteins to 50% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU)   17.9 Gt CO_2-e in excess of climate-safety

	2020	2060	% Change
Population Size (millions)	1,425	1,205	−15%
GDP per Capita (constant thousand USD)	16.5	51.6	+213%
Protein consumption per capita(kg / year)	17.7	20.6	+17%
Total Protein Consumption (million tonnes / year)	25.2	24.9	−1.3%

Protein Consumption by Protein Type

Legend: Beef, Mutton, Pork, Poultry, Seafood, Milk, Eggs
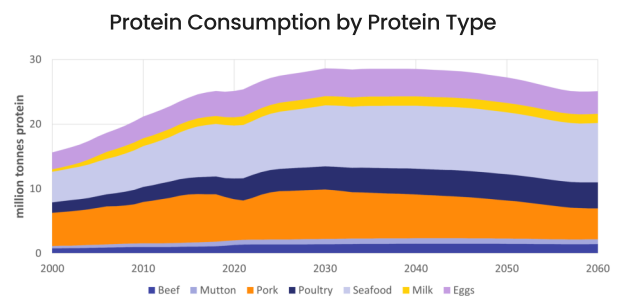
BEST CASE MITIGATION   13.7 Gt CO_2-e mitigated, 4.2 Gt CO_2-e remaining

Emissions from Protein Production

Legend: Business-as-Usual, Best-Case Mitigation, Climate-Safe
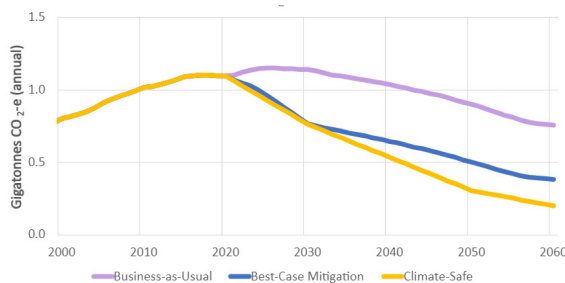
	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	8.7
100% Clean Energy	2055	2.7
Enteric Fermentation Emissions	40%	0.6
Manure Emissions	40%	0.2
Feed (non-LULUC*) Emissions	40%	0.4
Food Waste Reduction	30%	1.1

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION   3.8 Gt CO_2-e further reduced with alternative proteins
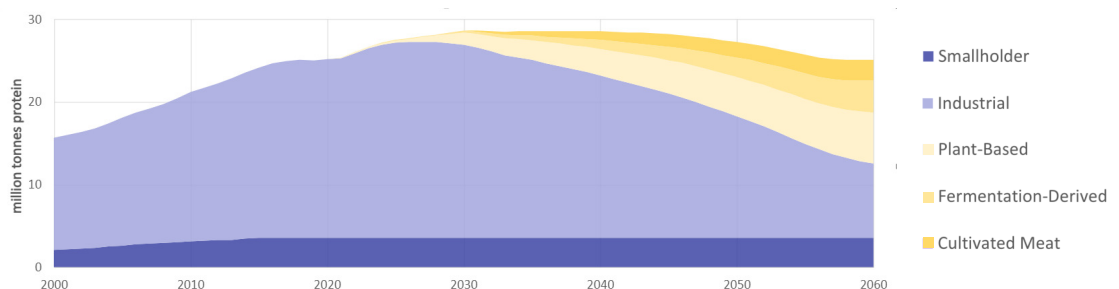
Protein Production by Source

Legend: Smallholder, Industrial, Plant-Based, Fermentation-Derived, Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

• Eliminate Deforestation in Supply Chains by 2030   • Peak Industrial Production by 2030   • 50% Alternative Protein by 2060
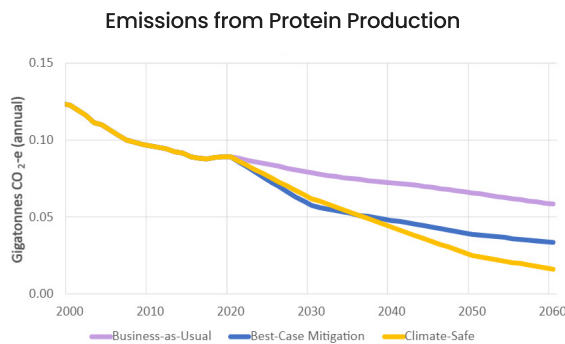
Japan

Japan's animal production is already fully industrialised. Excessive per-capita meat and seafood consumption will almost plateau, while population and total consumption will decline. In 2021, Japan imported ≈13% of its soy (for animal feed) from Brazil, possibly contributing to deforestation. We project that Japan will not be able to decarbonise its protein system without ending growth in industrial animal production ASAP, reducing food waste, and increasing alternative proteins to roughly 45% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU) 1.6 Gt CO_2-e in excess of climate-safety

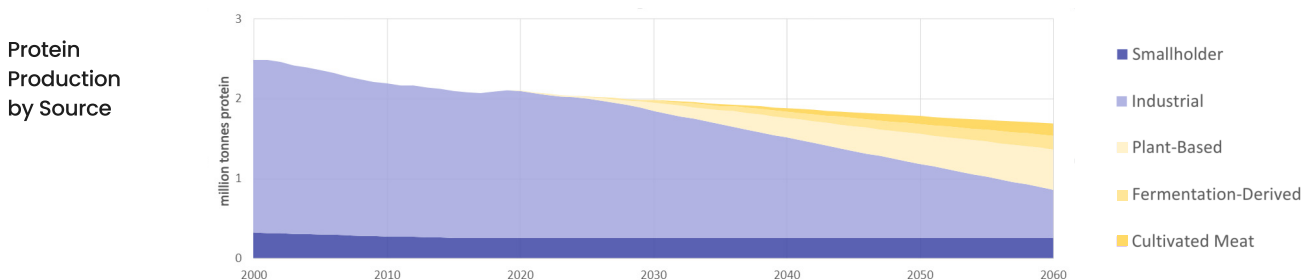|	2020	2060	% Change
Population Size (millions)	125	97	−23%
GDP per Capita (constant thousand USD)	40.8	65.5	+61%
Protein consumption per capita(kg / year)	19.4	18.9	−2.5%
Total Protein Consumption (million tonnes / year)	2.43	1.83	−25%

Protein Consumption by Protein Type

Beef ■ Mutton ■ Pork ■ Poultry ■ Seafood ■ Milk ■ Eggs
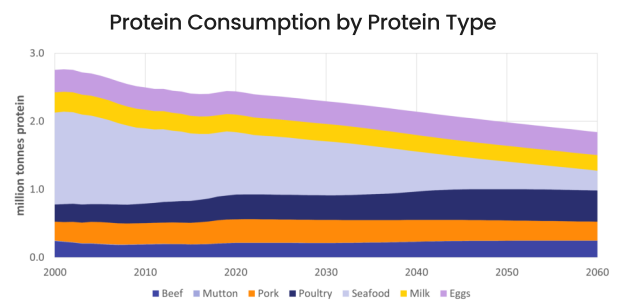
BEST CASE MITIGATION 1.4 Gt CO_2-e mitigated, 0.2 Gt CO_2-e remaining

Emissions from Protein Production

Business-as-Usual — Best-Case Mitigation — Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	0.60
100% Clean Energy	2050	0.26
Enteric Fermentation Emissions	40%	0.04
Manure Emissions	40%	0.02
Feed (non-LULUC*) Emissions	40%	0.02
Food Waste Reduction	30%	0.41

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION 0.3 Gt CO_2-e further mitigated with alternative proteins

Protein Production by Source

■ Smallholder
■ Industrial
■ Plant-Based
■ Fermentation-Derived
■ Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

• Eliminate Deforestation in Supply Chains by 2030   • No New or Replacement Industrial Production ASAP   • 45% Alternative Protein by 2060

South Korea

South Korea's animal production is already fully industrialised. Total meat and seafood consumption continues to grow then stabilise due to declining population. In 2021, South Korea imported around half of its soy (for animal feed) from Brazil, contributing to deforestation. We project that South Korea will not be able to decarbonise its protein system without ending growth in industrial animal production and deforestation by 2025 and scaling its alternative proteins to around 50% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU) 0.7 Gt CO_2-e in excess of climate-safety

	2020	2060	% Change
Population Size (millions)	52	41	−21%
GDP per Capita (constant thousand USD)	41.2	70.2	+70%
Protein consumption per capita(kg / year)	22.4	23.9	+6.4%
Total Protein Consumption (million tonnes / year)	1.16	0.98	−16%

Protein Consumption by Protein Type
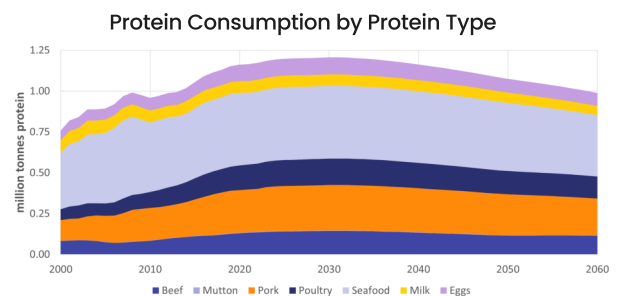
BEST CASE MITIGATION 0.6 Gt CO_2-e mitigated, 0.1 Gt CO_2-e remaining

Emissions from Protein Production
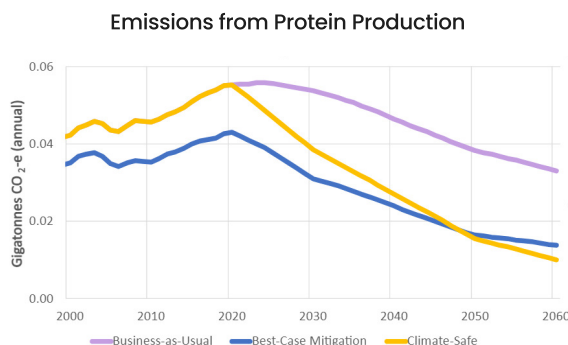
	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	0.31
100% Clean Energy	2050	0.14
Enteric Fermentation Emissions	40%	0.03
Manure Emissions	40%	0.01
Feed (non-LULUC*) Emissions	40%	0.01
Food Waste Reduction	30%	0.05

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION 0.2 Gt CO_2-e further mitigated with alternative proteins
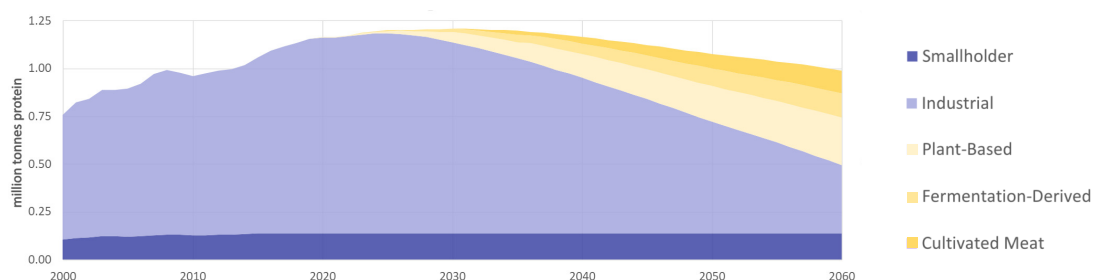
Protein Production by Source

Legend:
- Smallholder
- Industrial
- Plant-Based
- Fermentation-Derived
- Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

• Eliminate Deforestation in Supply Chains by 2030 • Peak Industrial Production around 2025 • 50% Alternative Protein by 2060
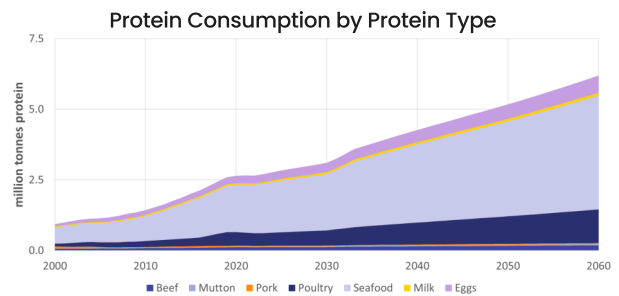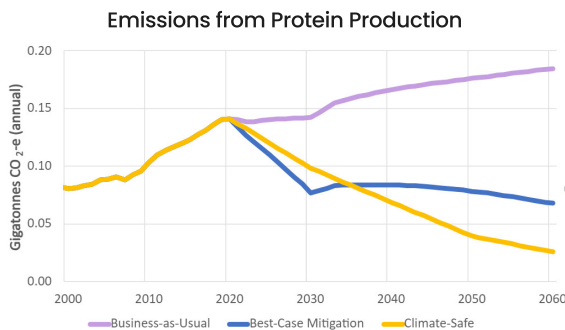
Indonesia

Indonesia's animal protein production–particularly of chicken, dairy, eggs, beef, and fish–is intensifying rapidly. Per-capita and total consumption are growing alongside GDP. Indonesia imports some of its soy (for animal feed) and beef from Argentina and Brazil, but Indonesia's biggest deforestation occurs at home from clearing for pasture and palm plantations. We project that Indonesia will not be able to decarbonise its protein sector without ending deforestation and growth in industrial animal production by roughly 2030 and developing alternative proteins to around 60% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU) 3.7 Gt CO_2-e in excess of climate-safety

	2020	2060	% Change
Population Size (millions)	272	319	+17%
GDP per Capita (constant thousand USD)	11.6	38.6	+232%
Protein consumption per capita(kg / year)	9.8	19.4	+98%
Total Protein Consumption (million tonnes / year)	2.67	6.20	+132%

Protein Consumption by Protein Type

Legend: Beef, Mutton, Pork, Poultry, Seafood, Milk, Eggs

BEST CASE MITIGATION 3.1 Gt CO_2-e mitigated, 0.6 Gt CO_2-e remaining

Emissions from Protein Production

Legend: Business-as-Usual, Best-Case Mitigation, Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	2.23
100% Clean Energy	2060	0.57
Enteric Fermentation Emissions	40%	0.06
Manure Emissions	40%	0.03
Feed (non-LULUC*) Emissions	40%	0.04
Food Waste Reduction	30%	0.15

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION 0.6 Gt CO_2-e further mitigated with alternative proteins
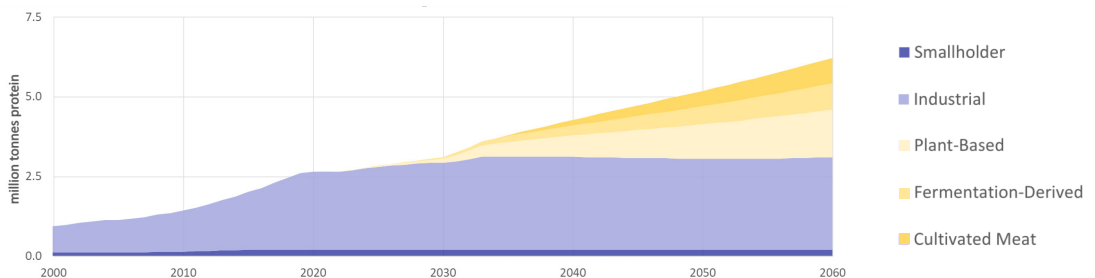
Protein Production by Source

Legend: Smallholder, Industrial, Plant-Based, Fermentation-Derived, Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

• Eliminate Deforestation in Supply Chains by 2030   • Peak Industrial Production around 2030   • 60% Alternative Protein by 2060
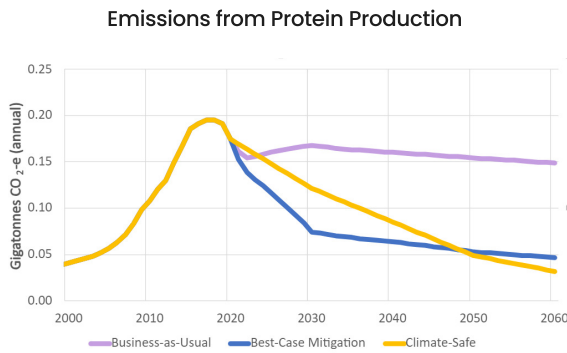
Vietnam

Vietnam's animal production is intensifying rapidly. High per-capita GDP growth is driving consumption of meat and seafood beyond already excessive levels. Vietnam is a large importer of soy (for animal feed) from Argentina. Expansion of local pastures and farms also contributes to deforestation. We project that Vietnam will not be able to decarbonise its protein sector without ending deforestation and growth in industrial animal production by 2030 and boosting alternative proteins to roughly 40% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU)   2.8 Gt CO_2-e in excess of climate-safety

	2020	2060	% Change
Population Size (millions)	97	106	+10%
GDP per Capita (constant thousand USD)	10.5	59.2	+466%
Protein consumption per capita(kg / year)	17.3	26.7	+54%
Total Protein Consumption (million tonnes / year)	1.67	2.83	+69%

Protein Consumption by Protein Type

Legend: Beef, Mutton, Pork, Poultry, Seafood, Milk, Eggs
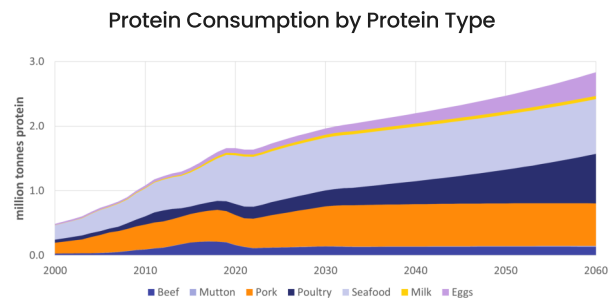
BEST CASE MITIGATION   2.9 Gt CO_2-e mitigated

Emissions from Protein Production

Legend: Business-as-Usual, Best-Case Mitigation, Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	2.88
100% Clean Energy	2050	0.32
Enteric Fermentation Emissions	40%	0.06
Manure Emissions	40%	0.02
Feed (non-LULUC*) Emissions	40%	0.05
Food Waste Reduction	30%	0.12

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION   1.0 Gt CO_2-e further mitigated with alternative proteins
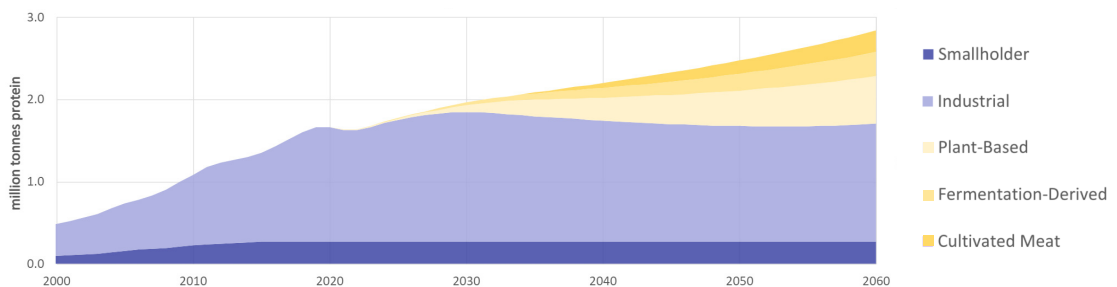
Protein Production by Source

Legend: Smallholder, Industrial, Plant-Based, Fermentation-Derived, Cultivated Meat

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PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

• Eliminate Deforestation in Supply Chains by 2030   • Peak Industrial Production around 2030   • 40% Alternative Protein by 2060
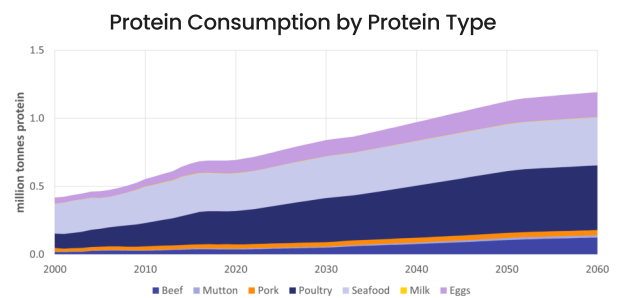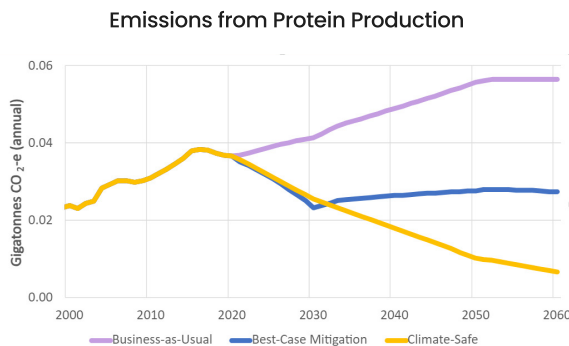
Malaysia

Malaysia's animal protein production is mostly industrialised, particularly of chicken, dairy, eggs, fish, and beef. Growth in per-capita GDP is driving consumption of meat and seafood beyond already excessive levels. Malaysia imports its soy (for animal feed) primarily from Argentina, while local pasture expansion also contributes to deforestation. We project that Malaysia will not be able to decarbonise its protein sector without eliminating supply chain deforestation and growth in industrial animal production by 2030 and boosting alternative proteins to around 50% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU) 1.3 Gt CO_2-e in excess of climate-safety

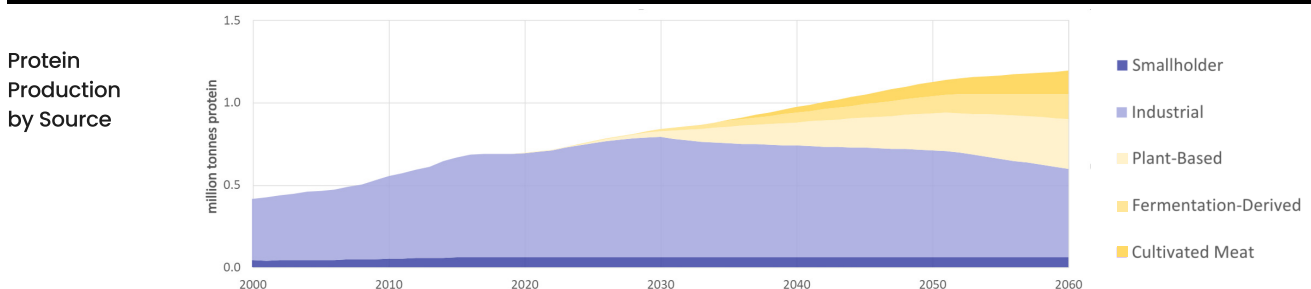|	2020	2060	% Change
Population Size (millions)	33	42	+27%
GDP per Capita (constant thousand USD)	25.8	63.0	+144%
Protein consumption per capita(kg / year)	21.2	28.4	+34%
Total Protein Consumption (million tonnes / year)	0.70	1.19	+70%

Protein Consumption by Protein Type

Legend: Beef, Mutton, Pork, Poultry, Seafood, Milk, Eggs

BEST CASE MITIGATION 1.0 Gt CO_2-e mitigated, 0.3 Gt CO_2-e remaining

Emissions from Protein Production

Legend: Business-as-Usual, Best-Case Mitigation, Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	0.76
100% Clean Energy	2050	0.17
Enteric Fermentation Emissions	40%	0.03
Manure Emissions	40%	0.01
Feed (non-LULUC*) Emissions	40%	0.01
Food Waste Reduction	30%	0.05

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION 0.3 Gt CO_2-e further mitigated with alternative proteins

Protein Production by Source

Legend: Smallholder, Industrial, Plant-Based, Fermentation-Derived, Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

- Eliminate Deforestation in Supply Chains by 2030
- Peak Industrial Production by 2030
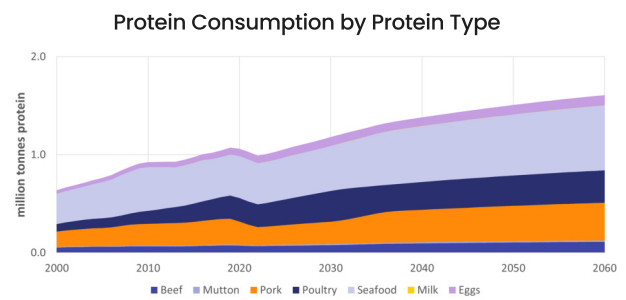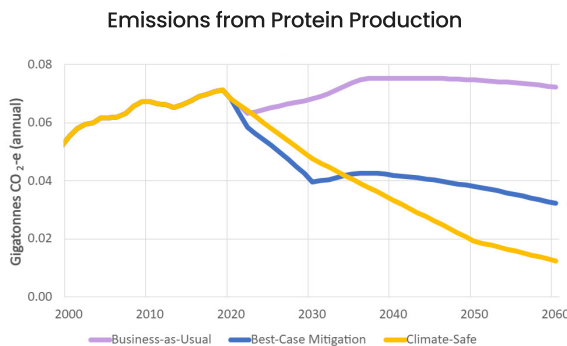- 50% Alternative Protein by 2060

Philippines

Philippine animal production is steadily intensifying, especially chicken, pork, eggs, fish, and beef. Rising population will drive consumption of animal proteins. The Philippines imports around a third of its soy (for animal feed) from Argentina and Brazil, while local pasture expansion also contributes to deforestation. We project that the Philippines will not be able to decarbonise its protein sector without ending supply chain deforestation and growth in industrial animal production by 2030 and boosting alternative proteins to roughly 50% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU) — 1.5 Gt CO_2-e in excess of climate-safety

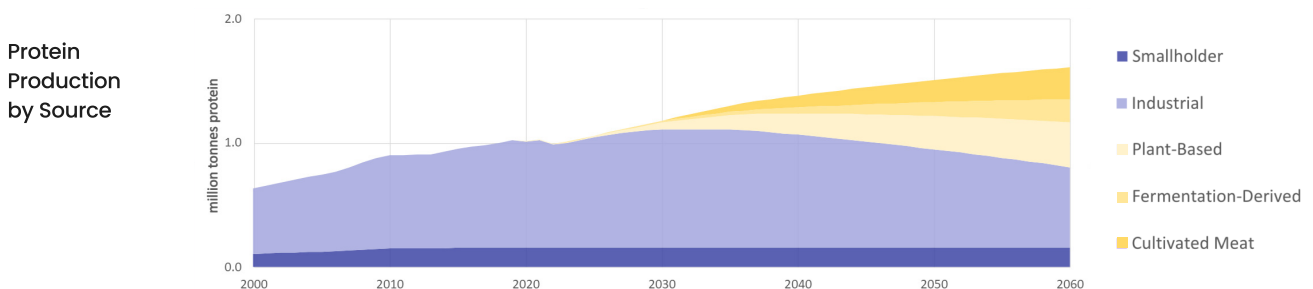|	2020	2060	% Change
Population Size (millions)	112	168	+50%
GDP per Capita (constant thousand USD)	7.8	26.6	+243%
Protein consumption per capita(kg / year)	9.6	9.6	+0.0%
Total Protein Consumption (million tonnes / year)	1.08	1.62	+50%

Protein Consumption by Protein Type

Legend: Beef, Mutton, Pork, Poultry, Seafood, Milk, Eggs

BEST CASE MITIGATION — 1.2 Gt CO_2-e mitigated, 0.3 Gt CO_2-e remaining

Emissions from Protein Production

Legend: Business-as-Usual, Best-Case Mitigation, Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	0.90
100% Clean Energy	2060	0.15
Enteric Fermentation Emissions	40%	0.03
Manure Emissions	40%	0.01
Feed (non-LULUC*) Emissions	40%	0.03
Food Waste Reduction	30%	0.07

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION — 0.3 Gt CO_2-e further mitigated with alternative proteins

Protein Production by Source

Legend: Smallholder, Industrial, Plant-Based, Fermentation-Derived, Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

- Eliminate Deforestation in Supply Chains by 2030
- Peak Industrial Production around 2030
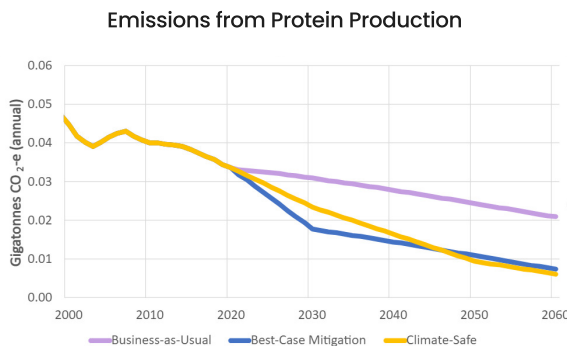- 50% Alternative Protein by 2060

Thailand

Thailand's animal production is largely industrialised. Total consumption will decline with the population. Thailand imports its soy (for animal feed) primarily from Brazil, Argentina, and Paraguay, contributing to deforestation. We project that Thailand will not be able to decarbonise its protein sector without ending growth in industrial animal production ASAP, ending supply chain deforestation by 2030 and boosting alternative proteins to 30% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU)   0.4 Gt CO_2-e in excess of climate-safety

	2020	2060	% Change
Population Size (millions)	71	63	−11%
GDP per Capita (constant thousand USD)	16.8	52.1	+209%
Protein consumption per capita(kg / year)	10.9	10.9	−0.0%
Total Protein Consumption (million tonnes / year)	0.78	0.69	−12%

Protein Consumption by Protein Type

Legend: Beef, Mutton, Pork, Poultry, Seafood, Milk, Eggs
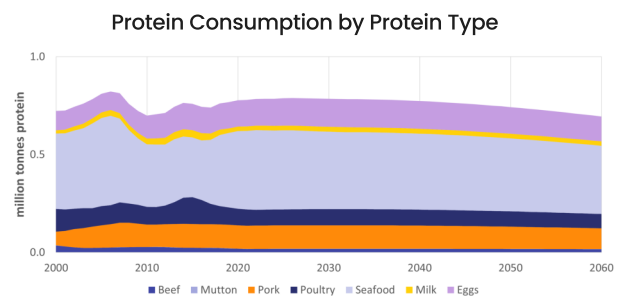
BEST CASE MITIGATION   0.5 Gt CO_2-e mitigated

Emissions from Protein Production

Legend: Business-as-Usual, Best-Case Mitigation, Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	0.34
100% Clean Energy	2060	0.09
Enteric Fermentation Emissions	40%	0.01
Manure Emissions	40%	0.00
Feed (non-LULUC*) Emissions	40%	0.03
Food Waste Reduction	30%	0.04

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION   0.1 Gt CO_2-e further mitigated with alternative proteins
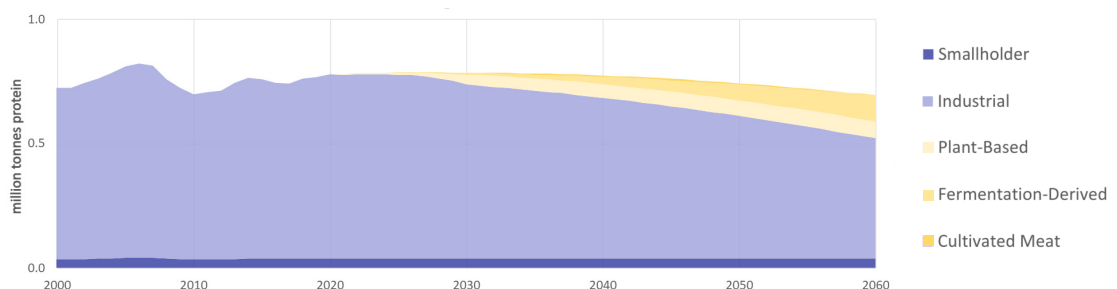
Protein Production by Source

Legend: Smallholder, Industrial, Plant-Based, Fermentation-Derived, Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

• Eliminate Deforestation in Supply Chains by 2030   • No New or Replacement Industrial Production ASAP   • 30% Alternative Protein by 2060
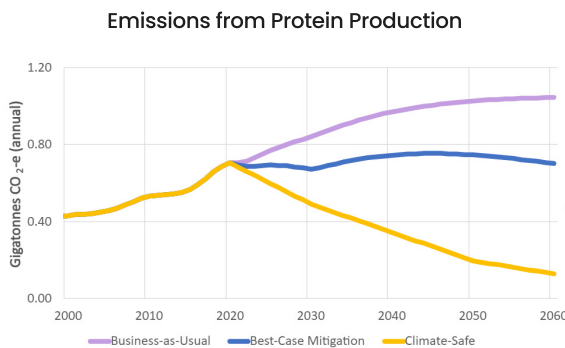
India

India has a relatively low per-capita animal protein consumption, but massive per-capita GDP growth will drive significant consumption growth. India imports 45% of its soy (for animal feed) from Argentina and Brazil, contributing to deforestation. We project India will be unable to decarbonize its protein sector without ending supply chain deforestation and growth in industrial animal production by 2030 and boosting alternative or traditional plant proteins to 85% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU)   23.2 Gt CO_2-e in excess of climate-safety

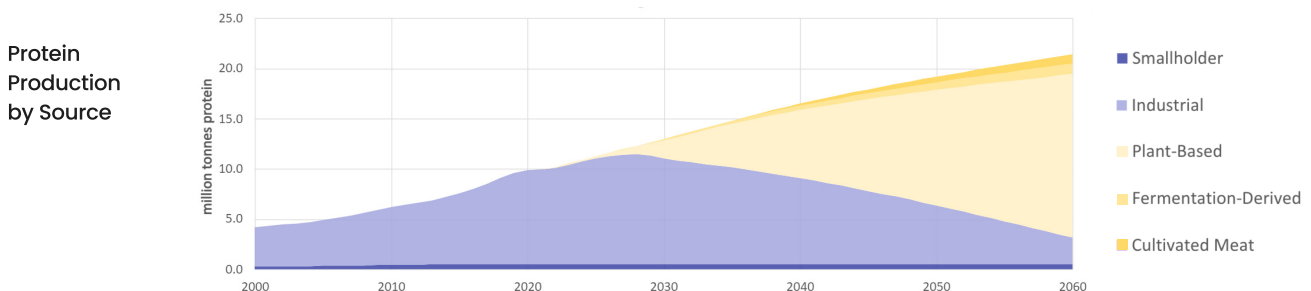|	2020	2060	% Change
Population Size (millions)	1,396	1,695	+21%
GDP per Capita (constant thousand USD)	6.0	24.9	+313%
Protein consumption per capita(kg / year)	7.1	12.7	+77%
Total Protein Consumption (million tonnes / year)	10.0	21.5	+115%

Protein Consumption by Protein Type

Beef ■ Mutton ■ Pork ■ Poultry ■ Seafood ■ Milk ■ Eggs
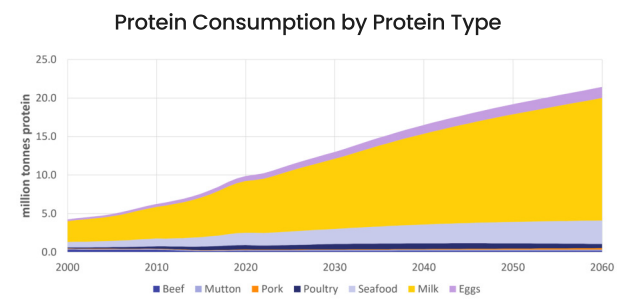
BEST CASE MITIGATION   7.6 Gt CO_2-e mitigated, 14.6 Gt CO_2-e remaining

Emissions from Protein Production

Business-as-Usual — Best-Case Mitigation — Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	4.82
100% Clean Energy	2060	1.24
Enteric Fermentation Emissions	40%	0.84
Manure Emissions	40%	0.12
Feed (non-LULUC*) Emissions	40%	0.21
Food Waste Reduction	30%	1.35

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION   11.9 Gt CO_2-e further mitigated with alternative proteins

Protein Production by Source

- Smallholder
- Industrial
- Plant-Based
- Fermentation-Derived
- Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

• Eliminate Deforestation in Supply Chains by 2030   • Peak Industrial Production by 2030   • 85% Alternative Protein by 2060
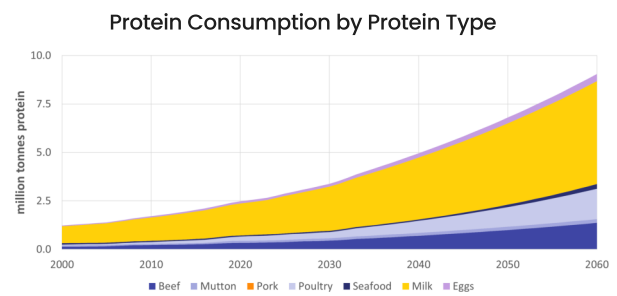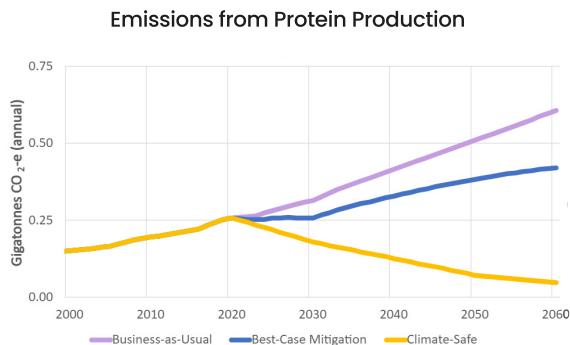
Pakistan

Rapid per-capita GDP growth may more than double per-capita consumption from relatively low levels. Total consumption is set to grow more rapidly with a boom in the population. We project Pakistan will not be able to decarbonise its protein sector without ending growth in industrial animal production by 2030 and increasing alternative or traditional plant proteins to 90% of protein volume by 2060.

BUSINESS-AS-USUAL (BAU) 11.7 Gt CO_2-e in excess of climate-safety

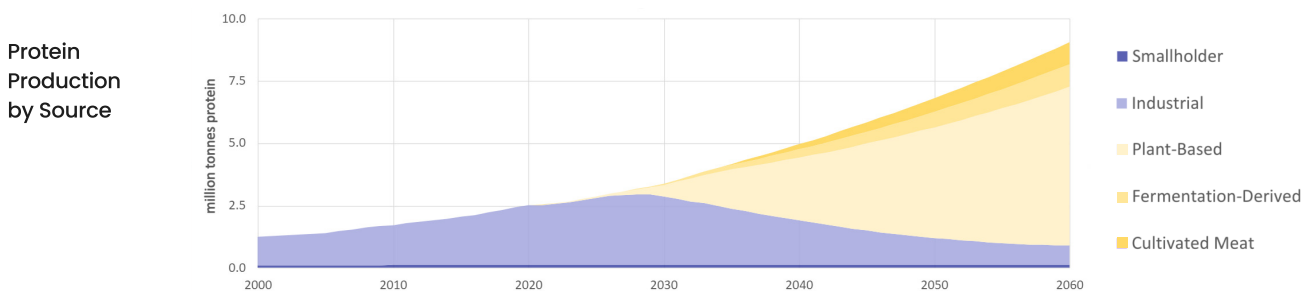|	2020	2060	% Change
Population Size (millions)	227	408	+79%
GDP per Capita (constant thousand USD)	5.0	16.0	+219%
Protein consumption per capita(kg / year)	11.1	22.4	+102%
Total Protein Consumption (million tonnes / year)	2.52	9.13	+262%

Protein Consumption by Protein Type

Legend: Beef, Mutton, Pork, Poultry, Seafood, Milk, Eggs

BEST CASE MITIGATION 3.7 Gt CO_2-e mitigated, 8.0 Gt CO_2-e remaining

Emissions from Protein Production

Legend: Business-as-Usual, Best-Case Mitigation, Climate-Safe

	Mitigation Target (Year / %)	Potential Mitigation (Gt CO_2-e)
Zero-Deforestation	2030	2.02
100% Clean Energy	2050	0.40
Enteric Fermentation Emissions	40%	0.46
Manure Emissions	40%	0.06
Feed (non-LULUC*) Emissions	40%	0.09
Food Waste Reduction	30%	0.63

*LULUC refers to Land Use, Land Use Change

PROTEIN TRANSITION 7.3 Gt CO_2-e further mitigated with alternative proteins

Protein Production by Source

Legend: Smallholder, Industrial, Plant-Based, Fermentation-Derived, Cultivated Meat

PRIORITY ACTIONS FOR CLIMATE-SAFETY AND PROTEIN-SECURITY

- Eliminate Deforestation in Supply Chains by 2030
- Peak Industrial Production by 2030
- 90% Alternative Protein by 2060