

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

FINAL STUDY

WEDNESDAY 11 JANUARY 2012

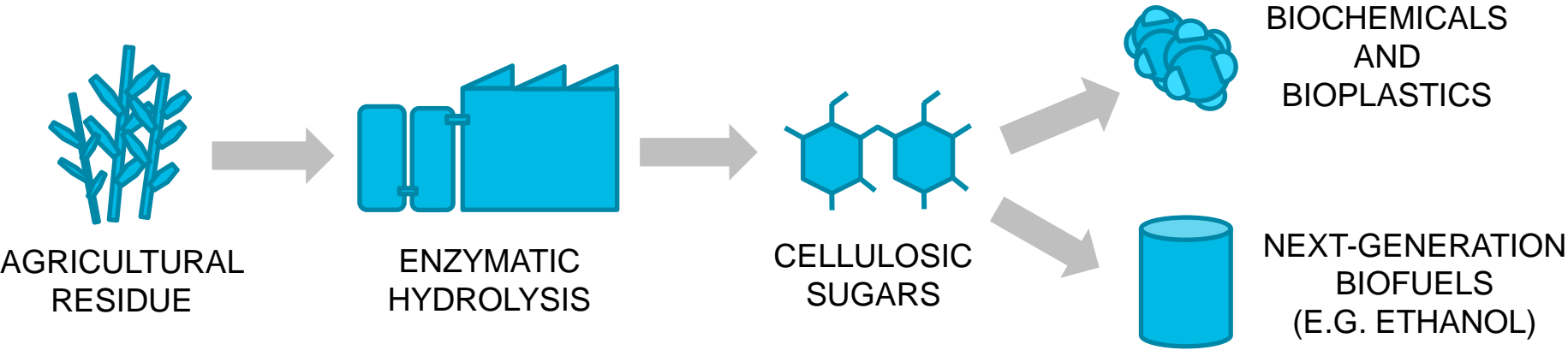


Bloomberg
NEW ENERGY FINANCE

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

1. Introduction
2. What is the resource?
3. Agricultural residue collection economics
4. Ethanol potential and investment
5. Societal benefits
6. Industry barriers
7. Roadmap to next-generation ethanol

NEXT-GENERATION ETHANOL AND BIOPRODUCTS



Enzymatic hydrolysis is the most developed technology in producing cellulosic sugars. In the coming decades these sugars could be used to produce a variety of bioproducts. In this study, we assume next-generation ethanol will be the primary output. However, ethanol can be used as a proxy output for other potential bioproducts like biobutanol, bio-succinic acid or farnesene.

Source: Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL SCENARIO ASSUMPTIONS, 2011–2030

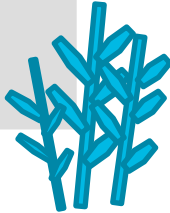
“FUEL DEMAND” SCENARIO

Using our estimates for global transport fuel demand, we have calculated what it will take to replace 10% of gasoline demand with next-generation ethanol. These volume projections represent an addition to existing first-generation ethanol supply. The scenario is designed to illustrate a reasonable but achievable ethanol penetration that would not rely on significant changes to the vehicle fleet.



“RESIDUE POTENTIAL” SCENARIO

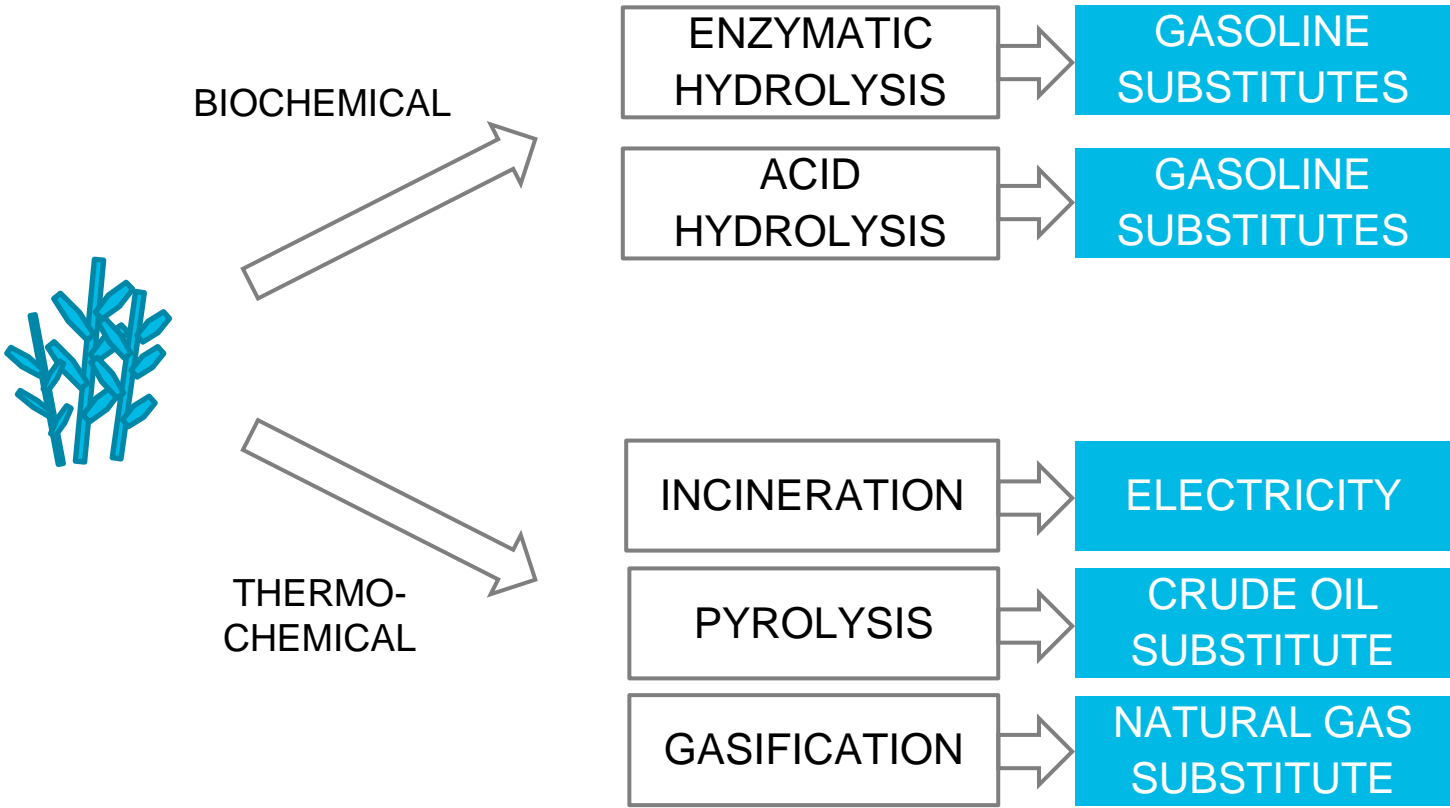
Using our fuel demand estimates again, we have projected how much gasoline could be replaced with next-generation ethanol if the available agricultural residues were all converted into next-generation ethanol.



Note: Conventional gasoline vehicles in Brazil already run on gasoline and 20%+ first-generation ethanol blends.

Source: Bloomberg New Energy Finance

NEXT-GENERATION BIOPRODUCTS FROM AGRICULTURAL RESIDUES, 2011–2030



Source: Bloomberg New Energy Finance

FIRST-GENERATION ETHANOL AND GASOLINE INDUSTRY METRICS, 2010 (MILLION LITRES)

| | First-generation ethanol consumption | Gasoline demand | Ethanol market share |
|-----------|--------------------------------------|-----------------|----------------------|
| ARGENTINA | 190 | 4,200 | 4.5% |
| AUSTRALIA | 280 | 20,000 | 1.5% |
| BRAZIL | 25,000 | 38,000 | 65.8% |
| CHINA | 2,500 | 85,000 | 2.9% |
| EU-27 | 9,500 | 140,000 | 7.0% |
| INDIA | N/A | 15,000 | N/A |
| MEXICO | N/A | 48,000 | N/A |
| US | 45,000 | 538,000 | 8.4% |

Note: "N/A" represents either a very small or no ethanol consumption. Gasoline demand is derived from IEA data.

Source: Bloomberg New Energy Finance, IEA

NEXT-GENERATION ETHANOL METHODOLOGY

YIELDS

We estimate the next-generation ethanol yield, per dry tonne of agricultural residue, will increase linearly from 250 litres today to 400 litres by 2030.

SCENARIOS

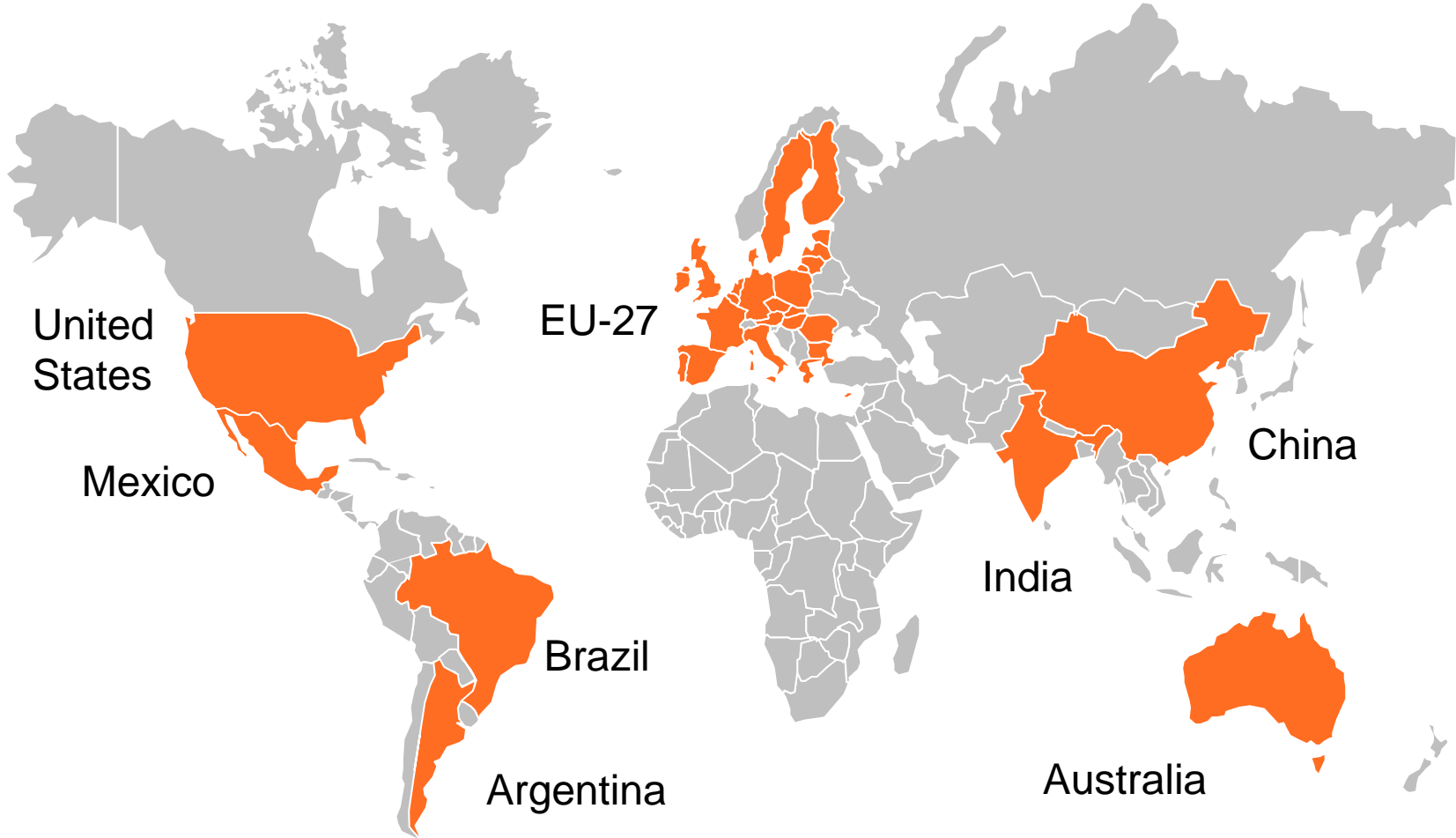
We have chosen two scenarios to illustrate how much next-generation ethanol could be supplied under certain conditions. In the “Residue potential” scenario 17.5% of the available agricultural residues are converted: in the “Fuel demand” scenario ethanol demand is limited to 10% of each region’s gasoline consumption.

| SCENARIO | Blending target | Annual total (2030) |
|---------------------|-----------------|---------------------|
| “Residue potential” | N / A | 351bn litres |
| “Fuel demand” | 10% | 115bn litres |

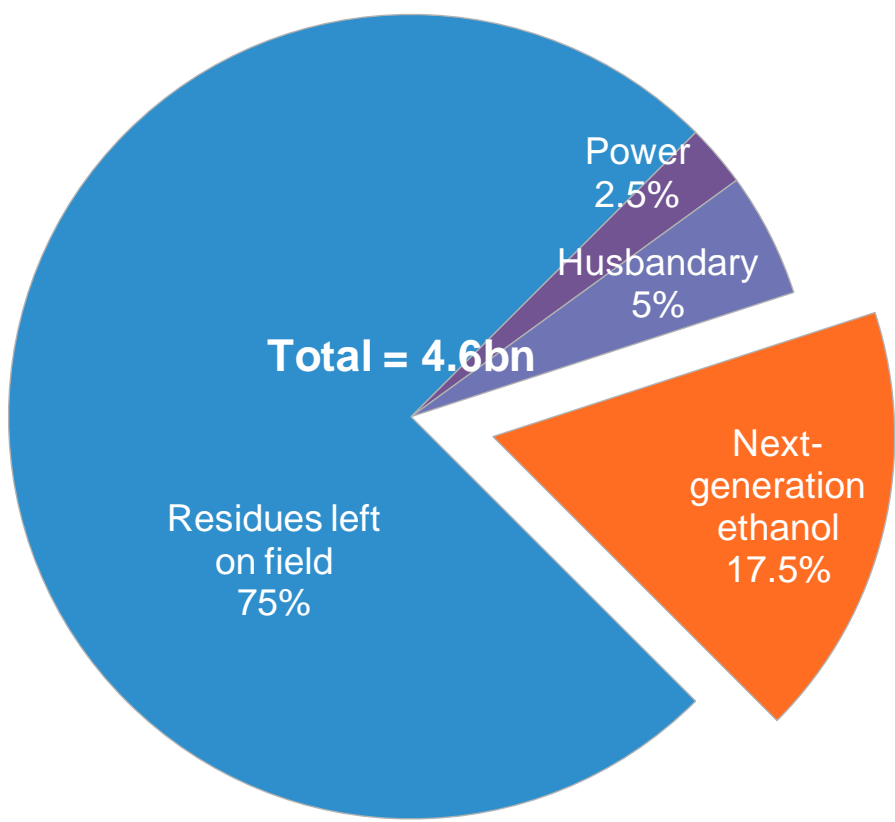
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8 SELECT REGIONS COVERED



AGRICULTURAL RESIDUE AVAILABILITY IN 8 SELECT REGIONS, 2030 (BILLION DRY TONNES)



We assume a maximum of 17.5% will be available for next-generation ethanol production.

Collecting only 25% of agricultural residue is a conservative methodology that takes into accounts technical and ecological constraints.

Our estimates purposefully aim to preserve soil quality and are in the low-to-medium range of comparable studies.

Note: This total does not include bagasse as we consider it an industrial residue. However, in this study we assume that 70% of all sugarcane bagasse is used for electricity production; and the remaining 30% is used for next-generation ethanol production.

Source: Bloomberg New Energy Finance, FAO

WHAT ARE OUR SUSTAINABILITY ASSUMPTIONS?

LAND USE PATTERNS

In this study we assume **land use patterns will not change** before 2030; existing activities are not altered nor is new agricultural land added.

HUMUS BALANCE

We assume a maximum of 17.5% is potentially available for bioenergy production; it is a **conservative estimate** which deliberately steers clear of removing a high level of nutrients.

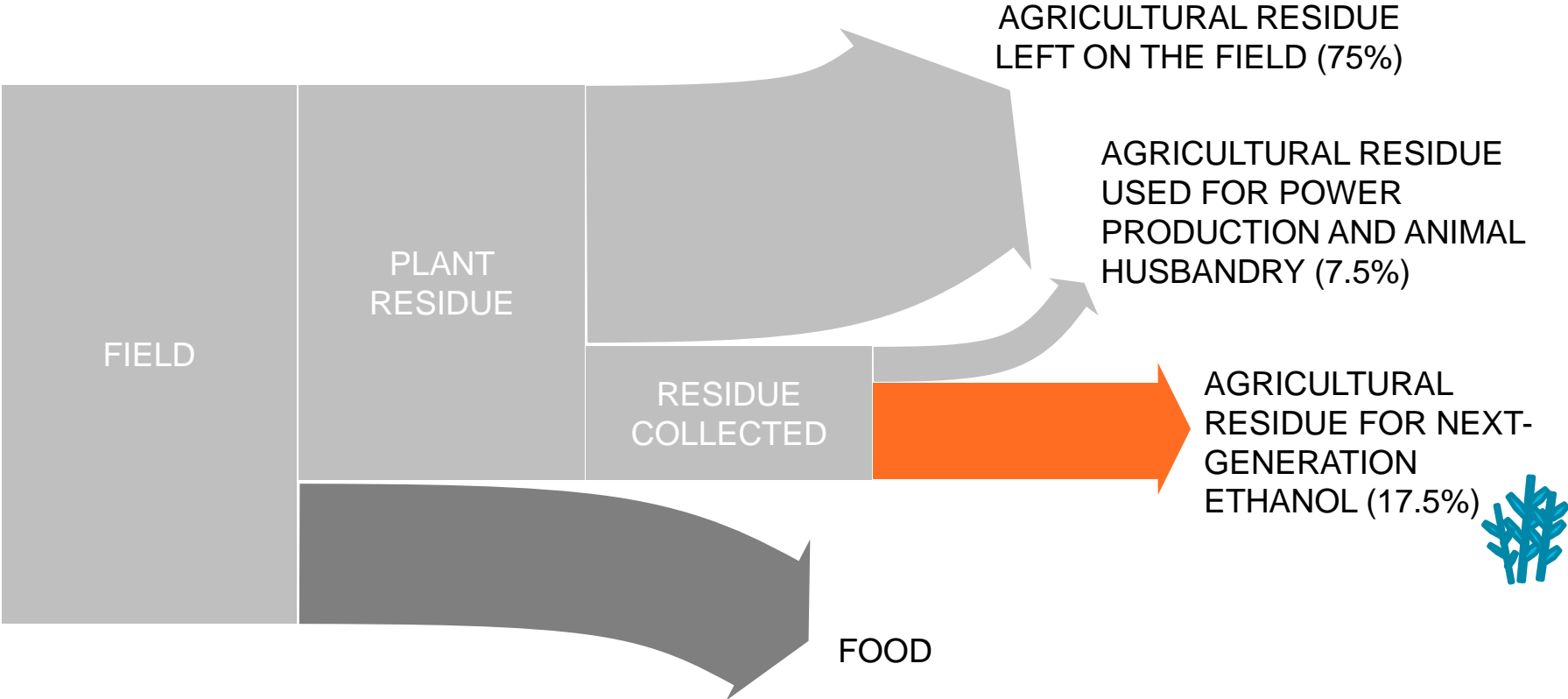
YIELD GROWTH

Our methodology assumes **stable yield growth** rates, based on historic data between 1989 and 2010.

ENERGY CROPS

We **excluded energy crops and forestry residues**. Taking them into account would however increase total biomass availability.

FIELD TO BIOREFINERY PROCESS



Note: Using historical national yield data and crop-specific food-to-residue ratios (“harvest indexes”) we have calculated agricultural residue availability for bioenergy from today until 2030 for the following crops: maize, wheat, sugarcane, rice, soybeans, sugar beet, cotton, sorghum, barley, beans, rapeseed, cassava, oats, tomatoes, sunflower, potatoes, apples, grapes, safflower, nuts, peas, palm, rye, olives, and flaxseed.

Source: Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL METHODOLOGY

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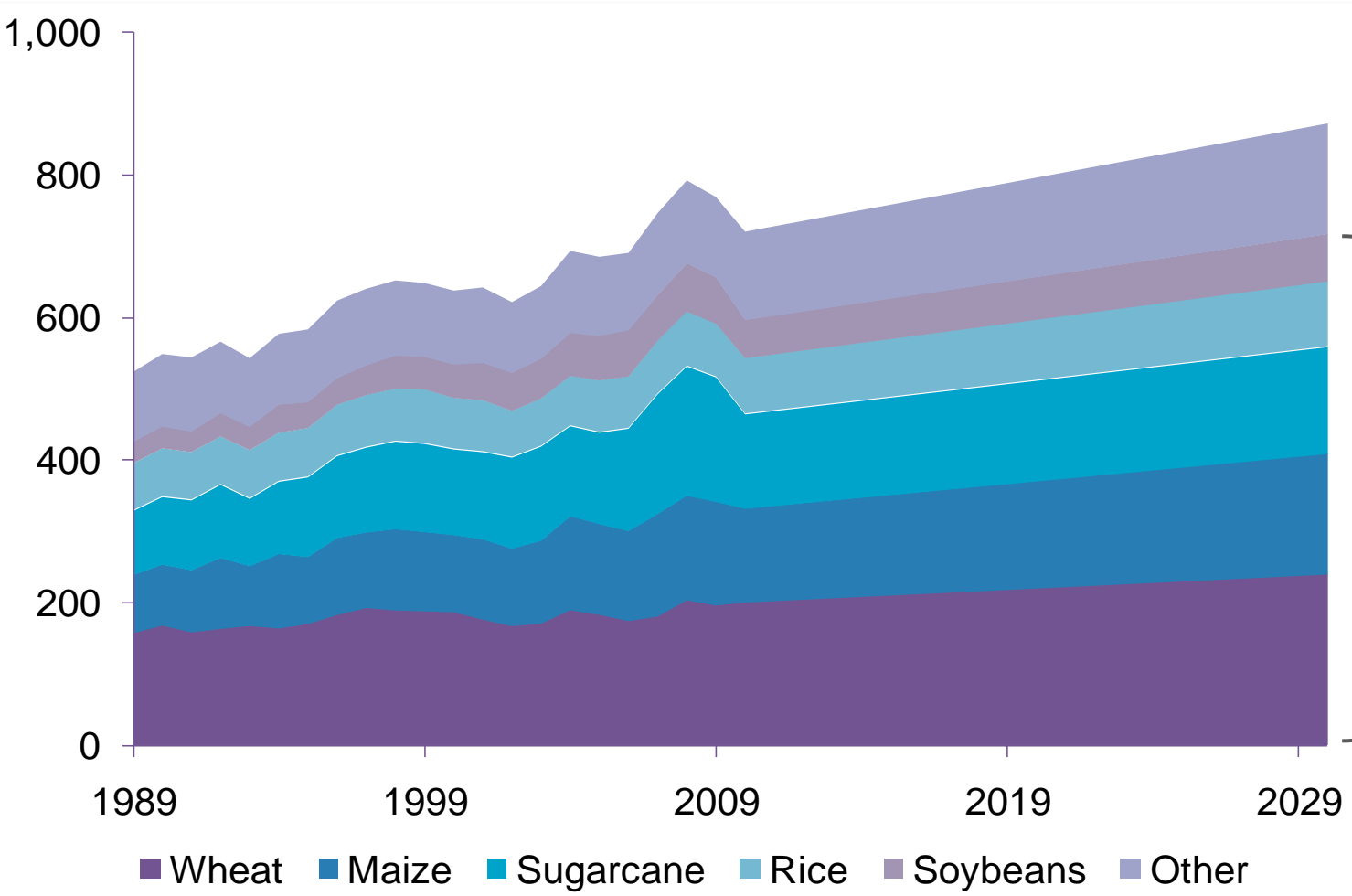
SCENARIOS

We have chosen two scenarios to illustrate how much next-generation ethanol could be supplied under certain conditions. In the “Residue potential” scenario 17.5% of the available agricultural residues are converted: in the “Fuel demand” scenario ethanol demand is limited to 10% of each region’s gasoline consumption.

BAGASSE

However, we also assume that 70% of all sugarcane bagasse is used for electricity production; and only the remaining 30% is used for next-generation ethanol production.

AGRICULTURAL RESIDUE AVAILABILITY, 1989–2030 (MILLION DRY TONNES)



Five major crops represent 88% of the 24 crops analysed, totalling 800m tonnes in 2030 available for next-generation ethanol conversion.

Note: Agricultural residue projections are based on food yield projections. “Other” includes: cotton, sorghum, barley, beans, rapeseed, cassava, oats, tomatoes, sunflower, potatoes, apples, grapes, safflower, nuts, peas, palm, rye, olives, sugar beet and flaxseed agricultural residues. A total of 3.8bn tonnes are left on the field or are used for other purposes.

Source: Bloomberg New Energy Finance, FAO

BIOENERGY FEEDSTOCK POTENTIAL COMPARISON FROM SELECT STUDIES

| Reference | Type | Region | Year | Min. potential (Exajoule) | Max. potential (Exajoule) |
|------------------------------|----------------------|--|-----------|---------------------------|---------------------------|
| De Wit and Faaij, 2010 | Energy crops | EU-27 and Ukraine | 2010 | 1.7 | 12.8 |
| | Agricultural residue | | | 3.1 | 3.9 |
| Ericsson and Nilson, 2006 | Energy crops | EU-27 | 2015-2025 | 1.5 | N/A |
| | Agricultural residue | EU-27 | | 0.6 | 0.9 |
| Bloomberg New Energy Finance | Agricultural residue | EU-27 | 2020 | 3.7 | 4.6 |
| | Agricultural residue | ARG, AUS, BRA, CHN, EU-27, IND, MEX, USA | 2030 | 16.1 | 16.1 |
| Sims et. al., 2006 | Energy crops | World | 2025 | 22 | 34 |
| Erb et. al., 2009 | Energy crops | World | 2050 | 77 | 100 |
| | Agricultural residue | World | | 28 | 28 |

ENERGY CROP POTENTIAL, 2012–2030

KEY FACTORS

Studies on the potential of energy crops make assumptions about: land availability from competing uses and food and energy crop yield forecasts – often examining in detail how these two key considerations develop over time.

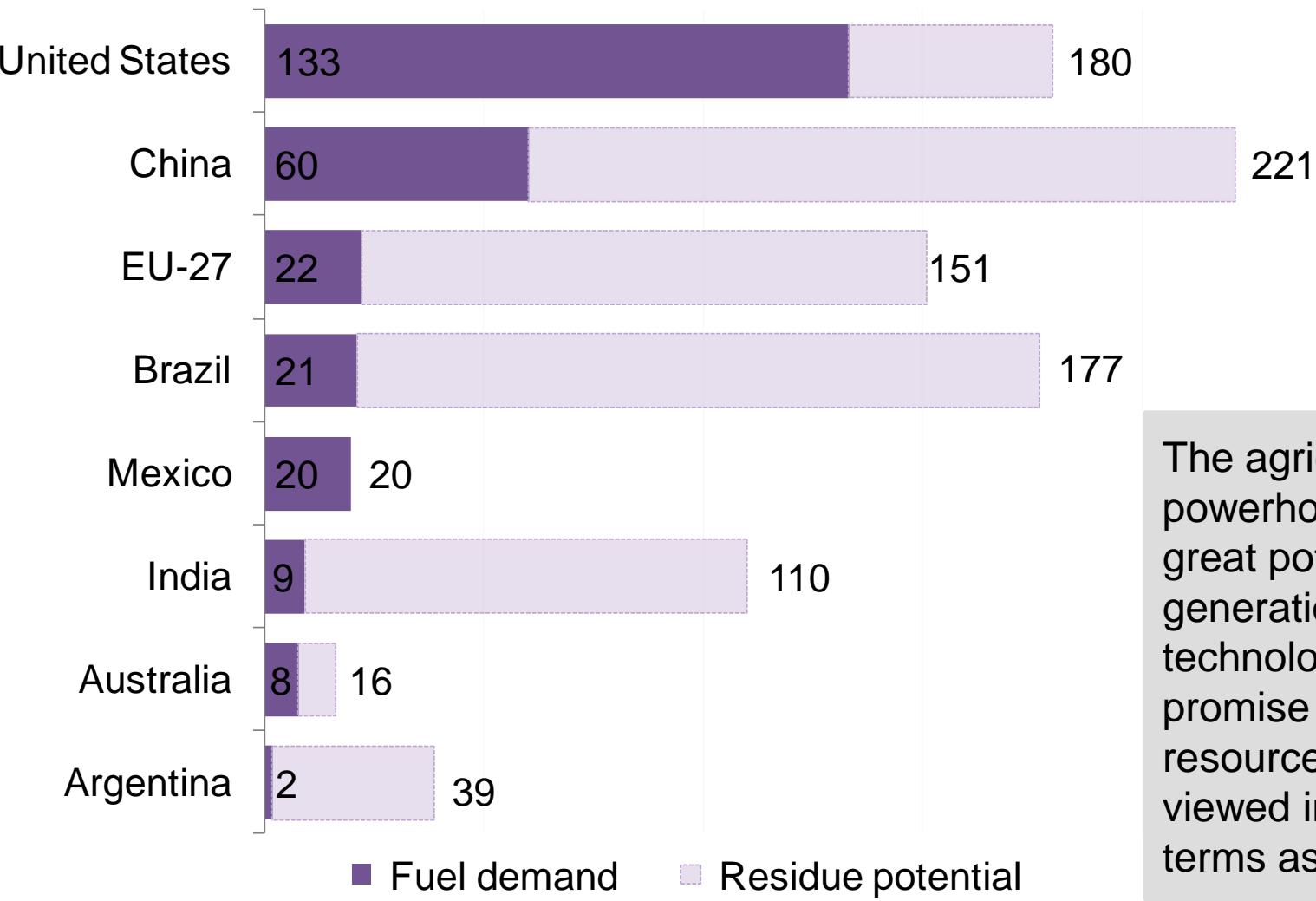
SAMPLE PLOTS

While there have been promising trials, practical estimates to date have simply been extrapolated from sample plots or based on energy crops production for non-bioenergy purposes.

IMPORTANT ROLE

This study deliberately only looks at next-generation ethanol potential from agricultural residue. However, we believe energy crops will have an important role to play in terms of bioenergy feedstock availability – provided they do not adversely interfere with world food supplies.

AGRICULTURAL RESIDUE AVAILABILITY IN EIGHT SELECT REGIONS, 2030 (MILLION DRY TONNES)



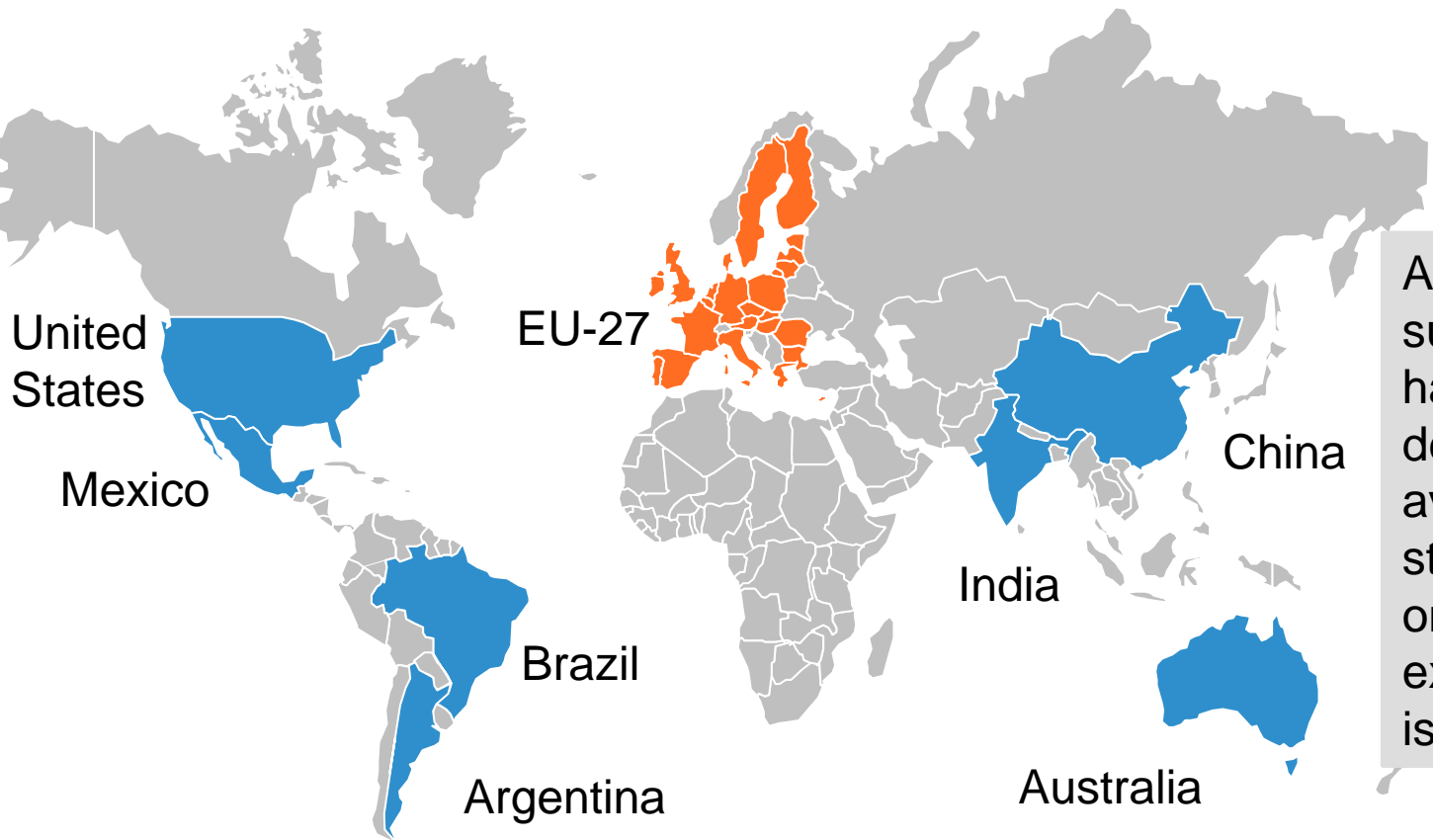
The agricultural powerhouses still hold great potential. If next-generation technologies fulfil their promise then these resources can be viewed in the same terms as a barrel of oil.

Source: Bloomberg New Energy Finance, FAO

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AGRICULTURAL RESIDUE SUPPLY ECONOMICS IN THE EU-27



Agricultural residue supply costs will have a key role in determining availability; the study focuses only on the EU-27 in exploring these issues.

EU-27 AGRICULTURAL RESIDUE SUPPLY COST METHODOLOGY

COLLECTION

- Optimal machine utilisation and operating times, calculated on a crop-by-crop basis.
- National projections for yields, labour costs and fuel prices in 2015.

LOADING

- Optimal machine utilisation and operating times, calculated on a crop-by-crop basis.

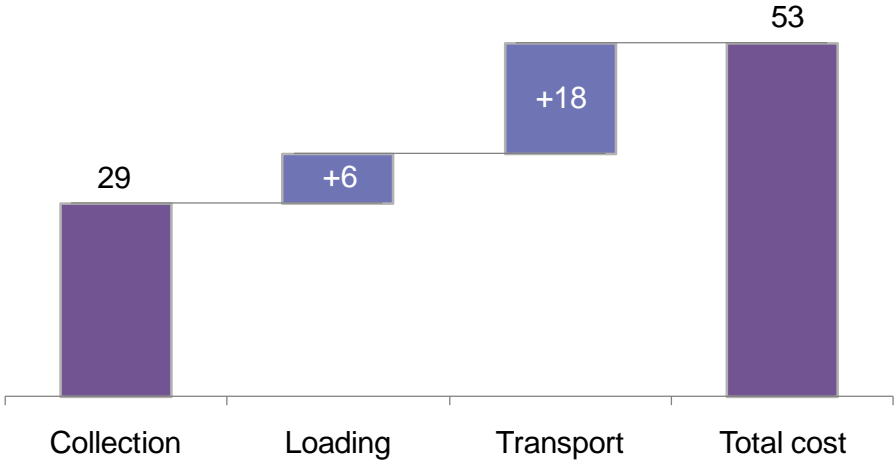
TRANSPORT

- Transport by flatbed truck or by container truck.
- Optimal loading and unloading times.
- Fixed distance of 100 km (50km including empty run back).

Supply costs represent minimum national estimates

FRENCH STRAW SUPPLY COSTS, 2015 (\$ PER DRY TONNE)

PROCESS COST BREAKDOWN



Labour, fuel and machinery costs represent the most important factors in supply curve calculations.

France is just one example of efficient farming as it is one of Europe's largest wheat producers.

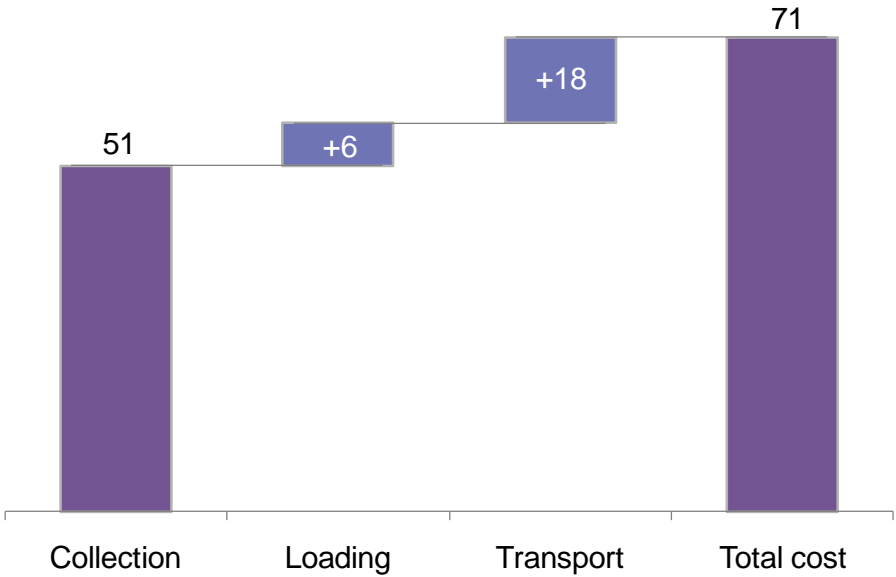
Farming economies with high yields and efficient transport networks will be able to reduce supply costs.

Note: Costs have been levelised to a common \$ per dry tonne metric to allow cost comparisons between different agricultural residue types.

Source: Bloomberg New Energy Finance

POLISH WHEAT STRAW SUPPLY, 2015 (\$ PER DRY TONNE)

PROCESS COST BREAKDOWN



Less advanced agricultural methods result in an increase in supply costs.

Polish wheat straw costs will increase by approximately \$18 per dry tonne when compared to France.

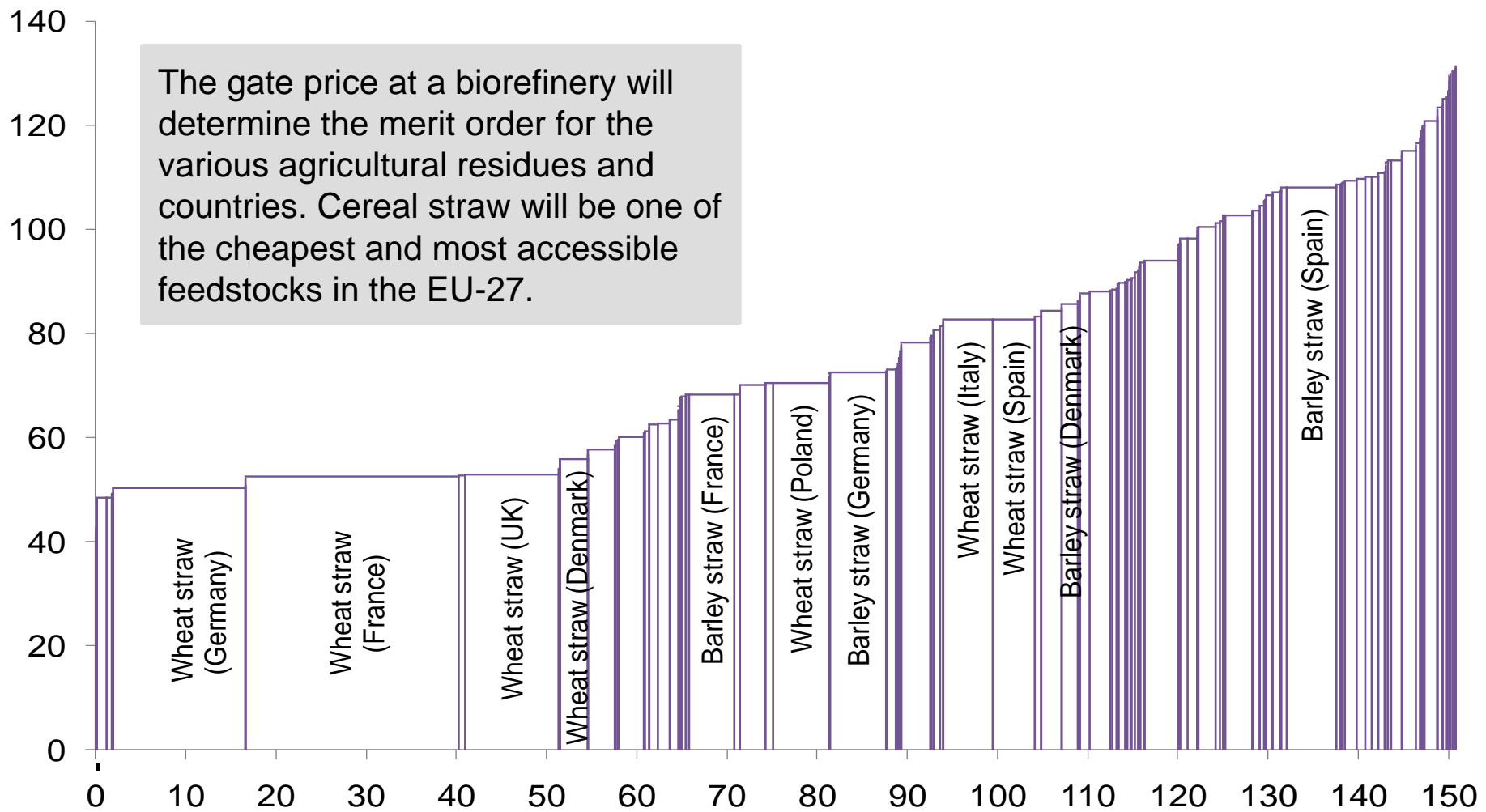
Cost increases occur due to longer hours for machinery due to lower yields of residue per hectare.

Note: Costs have been levelised to a common \$ per dry tonne metric to allow cost comparisons between different agricultural residue types.

Source: Bloomberg New Energy Finance

EU-27 AGRICULTURAL RESIDUE SUPPLY CURVE, 2015

(\$/TONNE; MILLION DRY TONNES)



Note: Supply costs represent the sum of all the collecting, transporting and loading agricultural residue costs; although, the EU-27 2020 agricultural residues potential amounts to approximately 175m dry tonnes we had to limit our x-axis supply cost curve to 150m dry tonnes.

Source: Bloomberg New Energy Finance

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| “Residue potential” | N / A | 351bn litres |
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ECONOMIC ASSUMPTIONS

PLANT COSTS

We assume total facility costs for a next-generation ethanol refinery will be approximately \$1.50 per litre of annual capacity

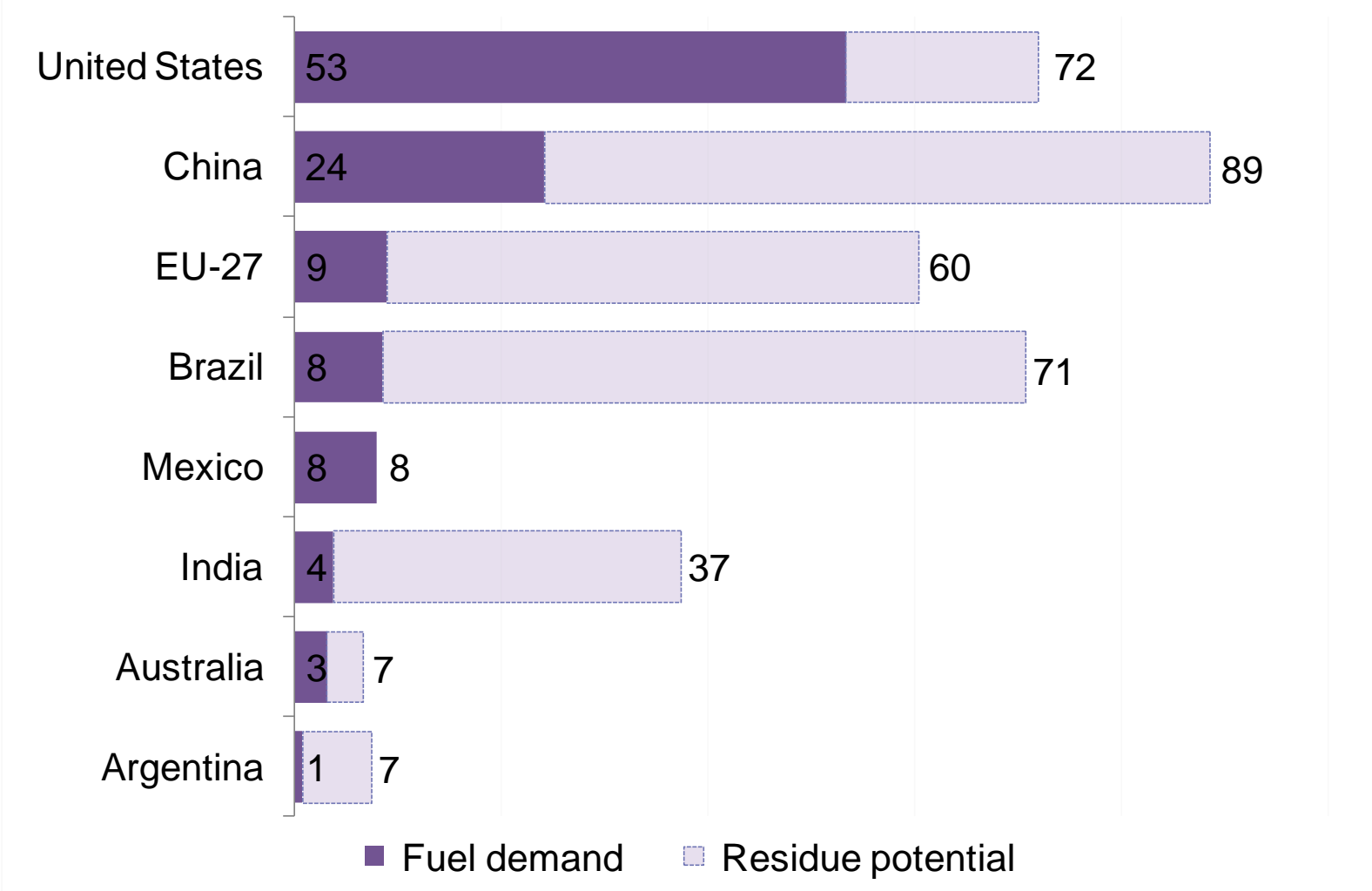
ETHANOL REVENUES

For this example we used \$0.44 per litre as it is roughly the energy equivalent price with an oil price of \$100 per barrel

GHG EMISSIONS

Following the EU Renewable Energy Directive indications, the study assumes next-generation ethanol, using the enzymatic hydrolysis technology, reduces emissions by 80%

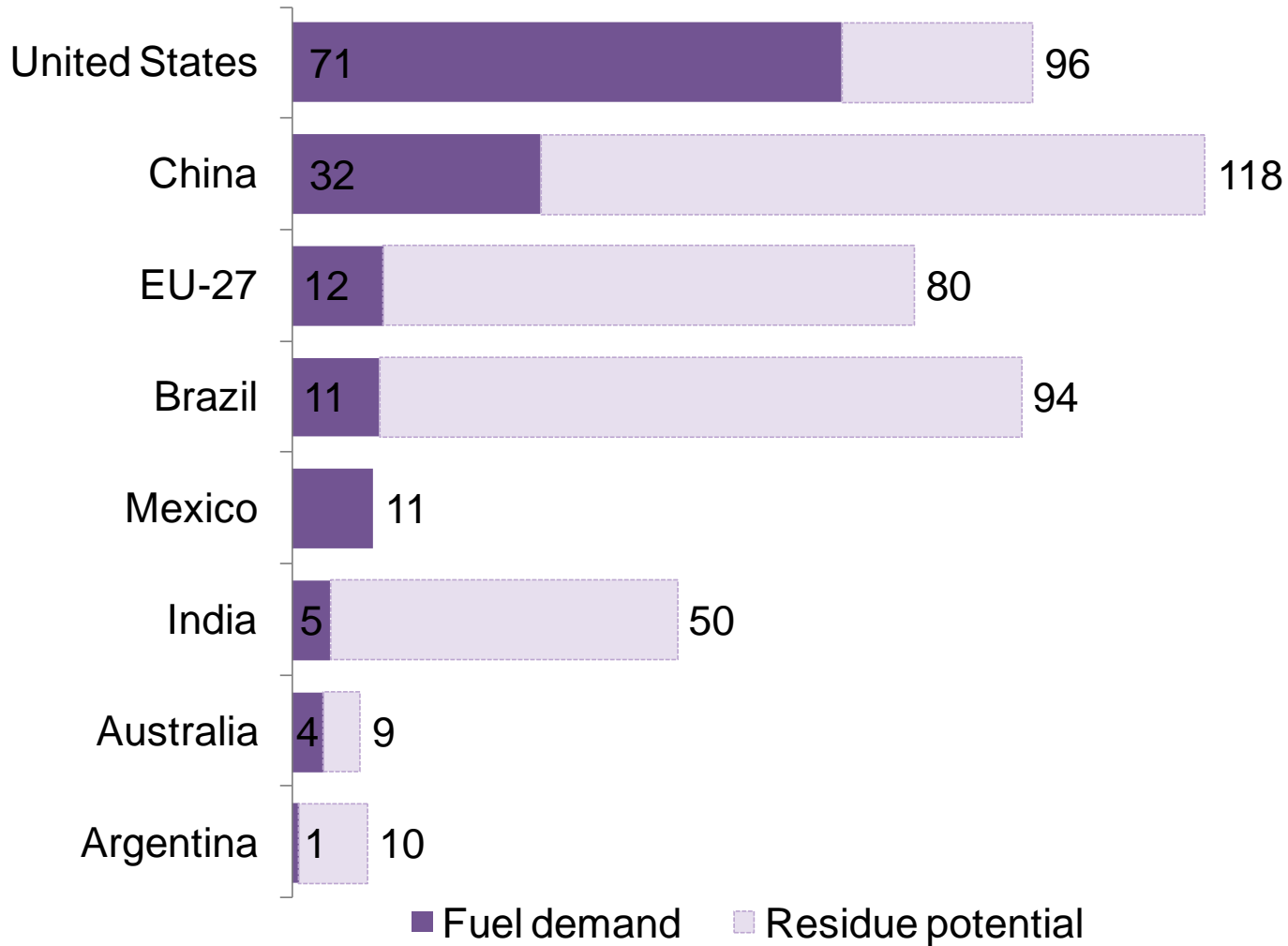
NEXT-GENERATION ETHANOL INSTALLED CAPACITY IN 2030 (BN LITRES)



Note: India and Argentina meet 100% of their gasoline requirements without using all their residues.
 Mexico uses all its residues before reaching 10%.

Source: Bloomberg New Energy Finance

INVESTMENT REQUIRED FOR NEXT-GENERATION ETHANOL INSTALLED CAPACITY, 2011–2030 (\$BN)



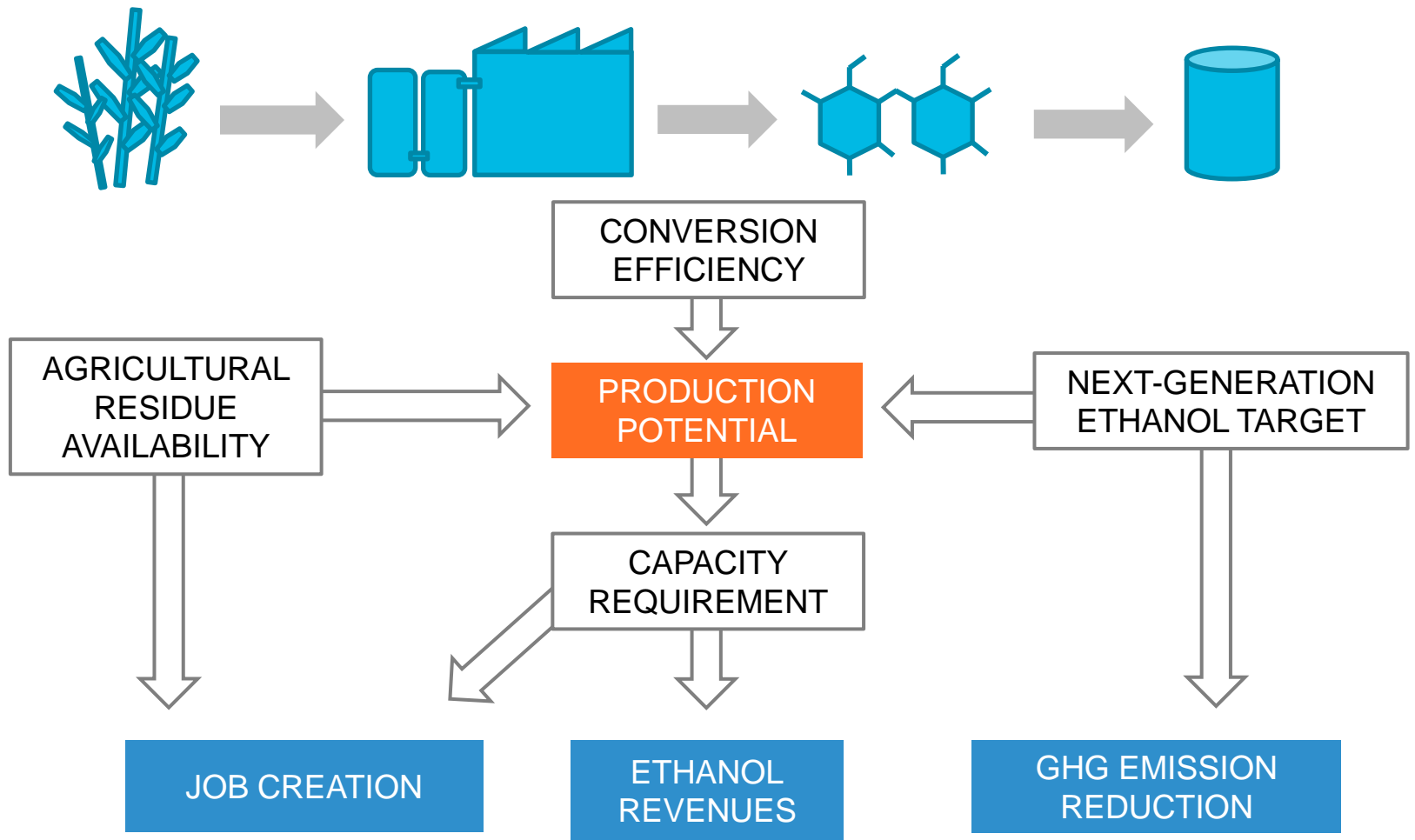
Note: We assume total facility costs for a next-generation ethanol refinery will be approximately USD 1.50 per litre of annual capacity.

Source: Bloomberg New Energy Finance

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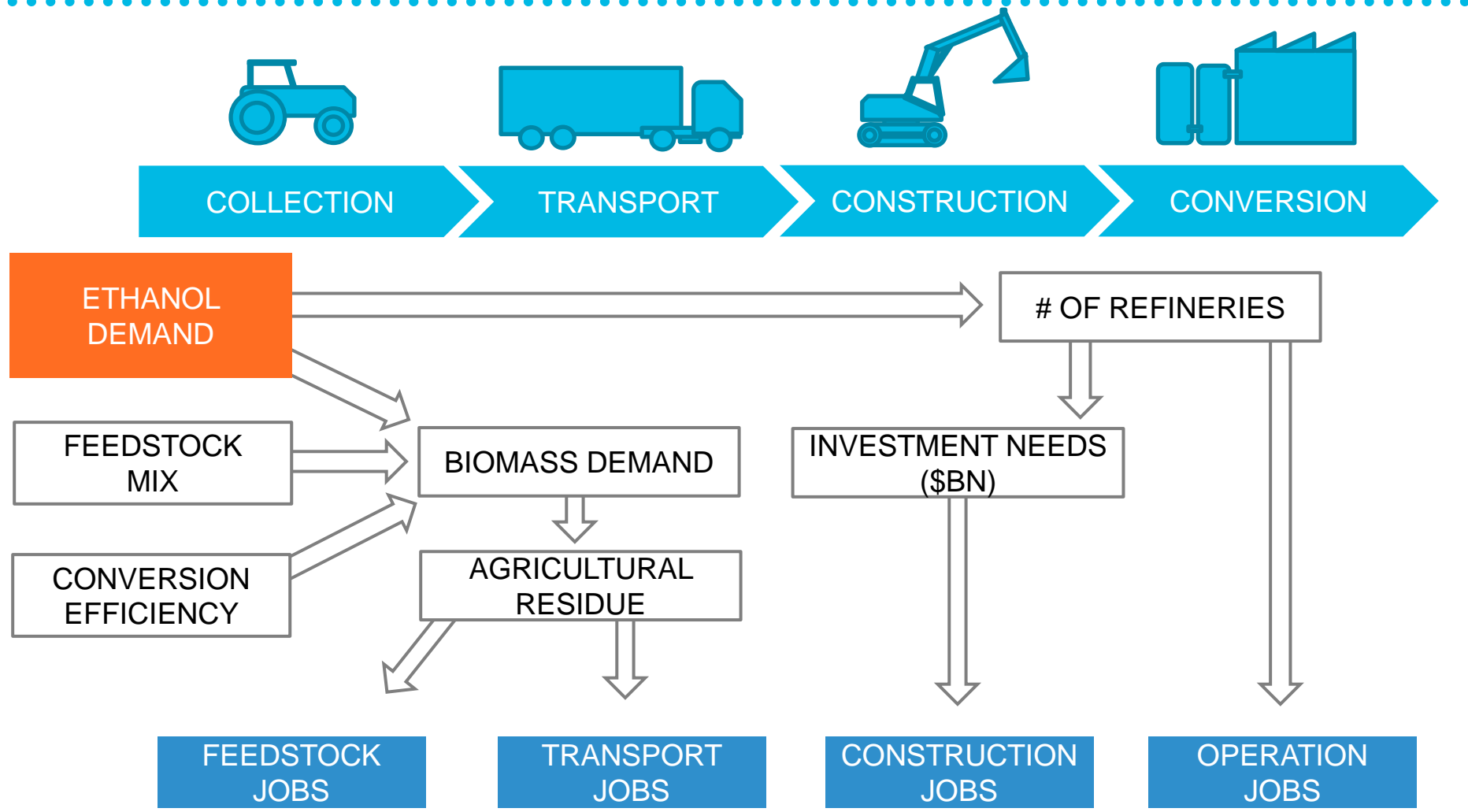
BENEFITS ACROSS THE NEXT-GENERATION ETHANOL VALUE CHAIN



Note: This study uses next-generation ethanol as an example for all bioproducts.

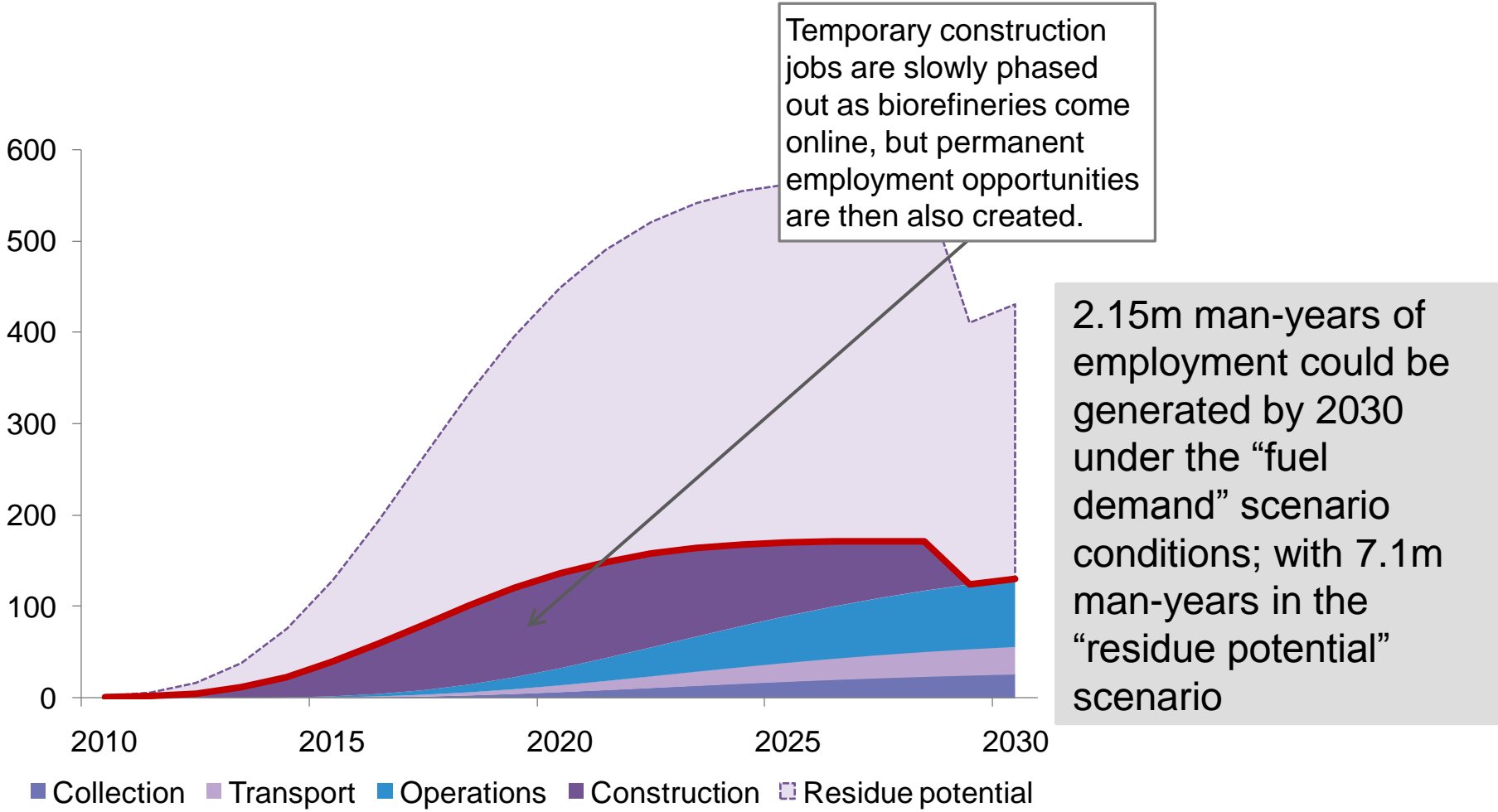
Source: Bloomberg New Energy Finance

JOB CREATION ACROSS THE NEXT-GENERATION ETHANOL SUPPLY CHAIN



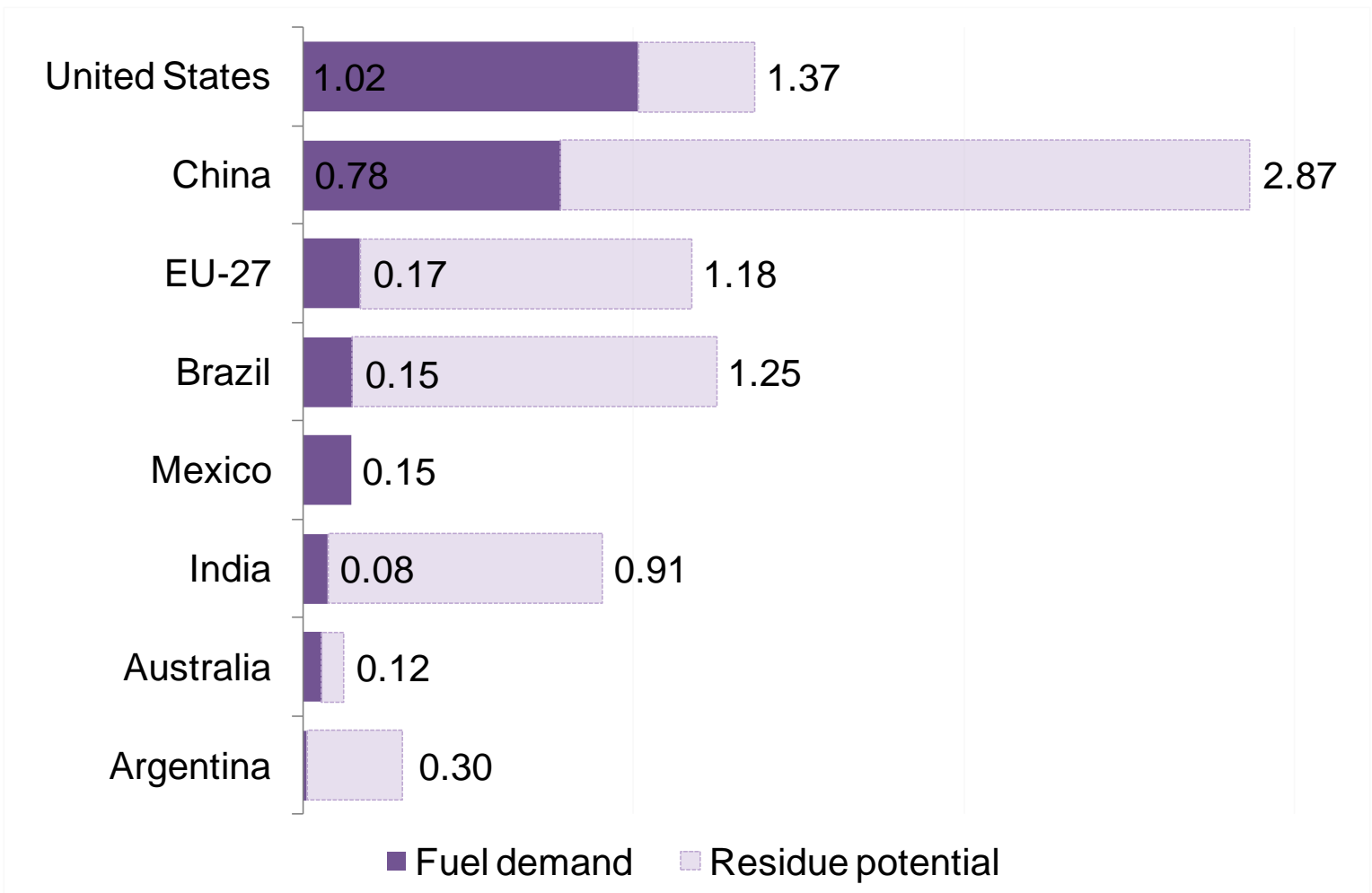
Source: Bloomberg New Energy Finance

TOTAL JOB CREATION IN EIGHT SELECT REGIONS, 2011–2030 (FULL-TIME EQUIVALENT JOBS; THOUSANDS)



Note: Full-time equivalent jobs in the bioproduct industry come in two parts: firstly, biorefinery construction and operation jobs; and secondly, agricultural residue supply chain jobs. Source: Bloomberg New Energy Finance Danish Construction Association

JOB CREATION BY REGION IN BOTH SCENARIOS, 2011–2030 (MAN-YEARS OF EMPLOYMENT; MILLIONS)

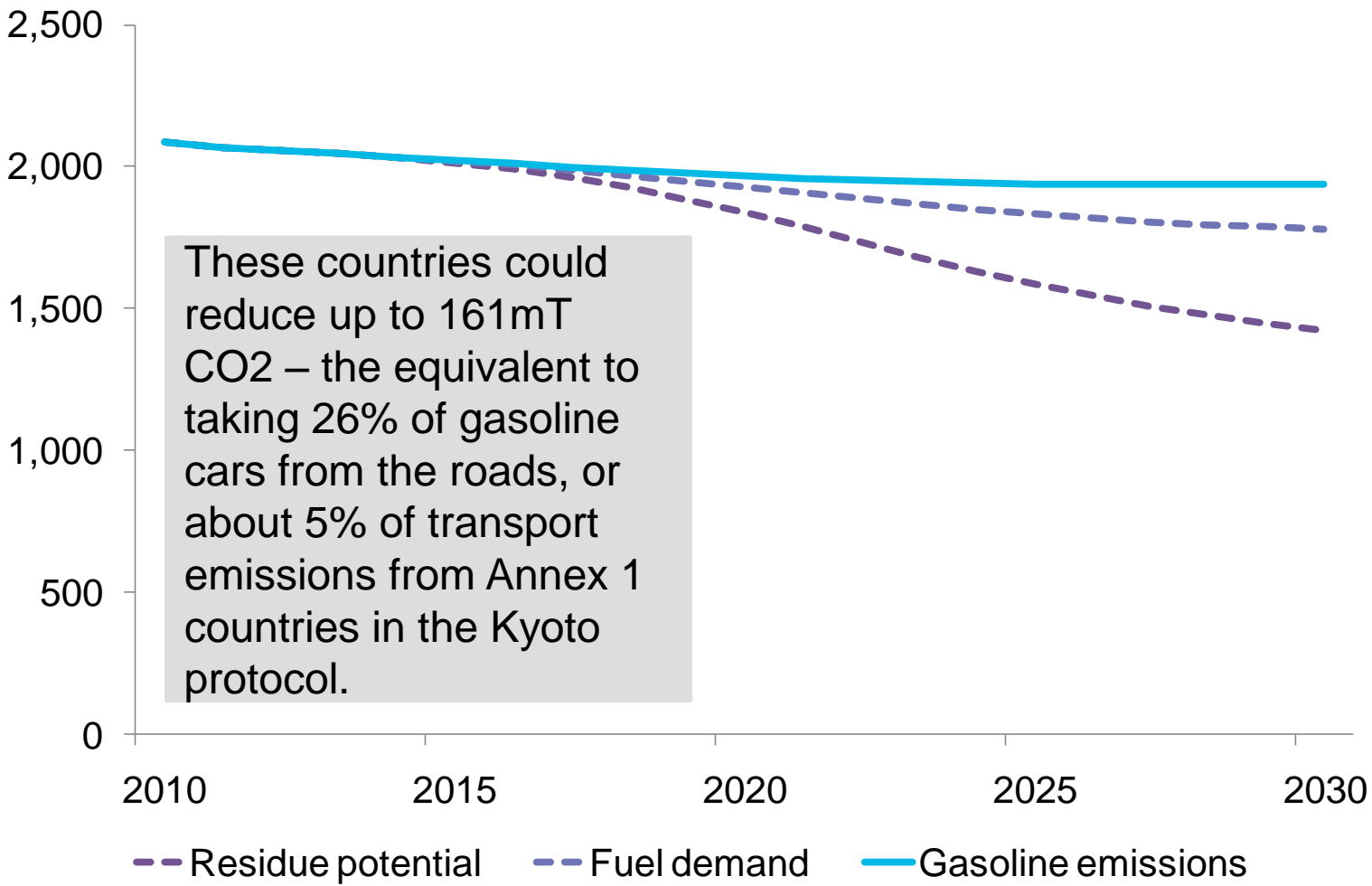


Source:

Note: Job creation, or one man-year of employment, in the bioproduct industry comes in two parts: firstly, biorefinery construction and operation jobs; and secondly, agricultural residue supply chain jobs.

Bloomberg New Energy Finance
Danish Construction Association

GASOLINE VEHICLE GHG EMISSIONS IN 8 SELECT REGIONS, 2011–2030 (MILLION TONNES CO2 EQUIVALENT)



Note: EU sustainable transport group data demonstrates a litre of gasoline has a well-to-wheel emissions footprint of 2.42kg per CO₂e. Following the RED methodology, the study assumes next-generation ethanol – using enzymatic hydrolysis – reduces GHG emissions by 80%.

Source: Bloomberg New Energy Finance

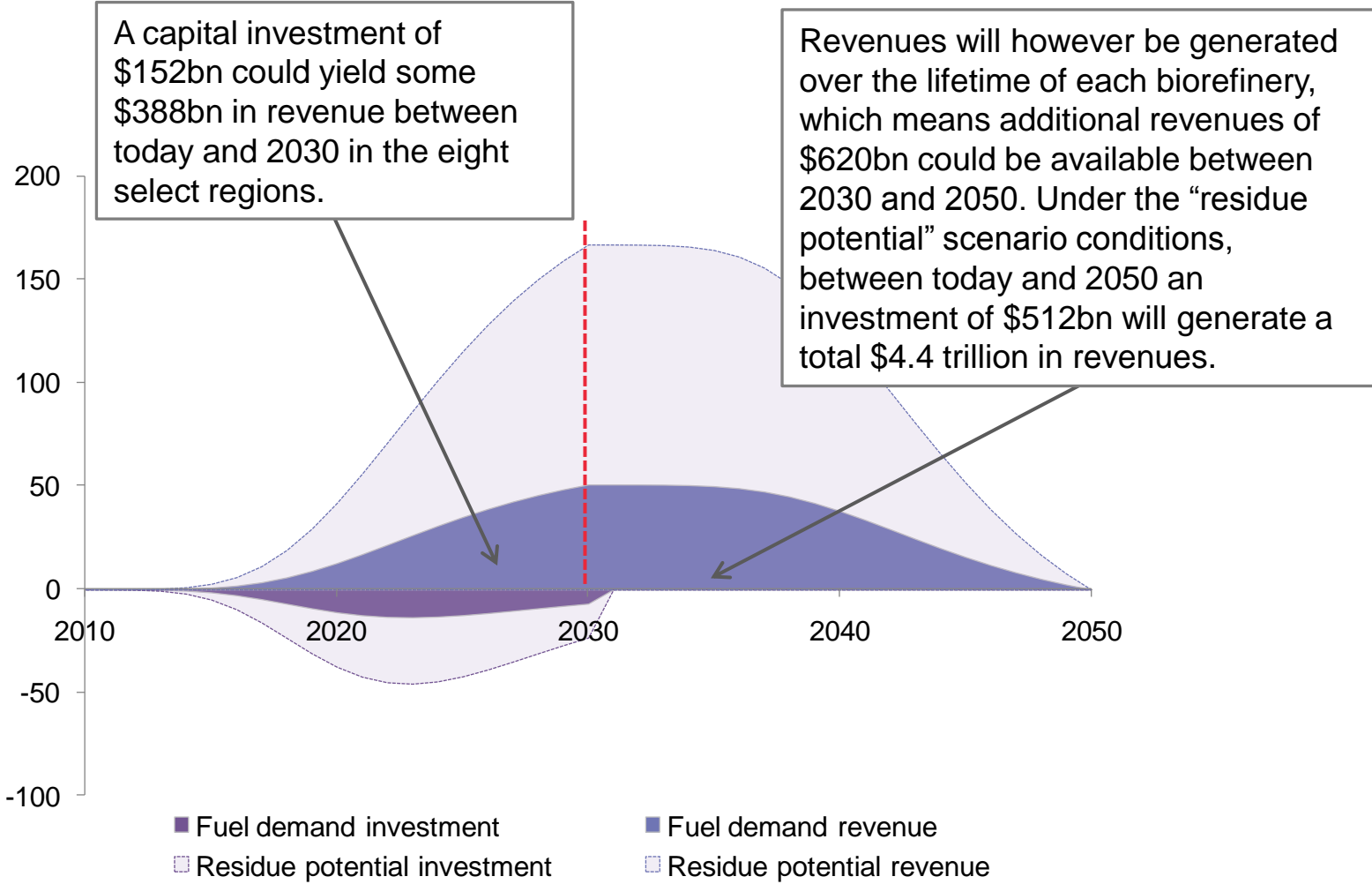
NEXT-GENERATION ETHANOL GHG SAVINGS UNDER BOTH SCENARIOS, 2030 (%)

| | Fuel demand scenario | Residue potential scenario |
|-----------|----------------------|----------------------------|
| ARGENTINA | 8 | 80 |
| AUSTRALIA | 8 | 17 |
| BRAZIL | 8 | 67 |
| CHINA | 8 | 29 |
| EU-27 | 8 | 54 |
| INDIA | 8 | 80 |
| MEXICO | 5 | 5 |
| US | 8 | 11 |

Note: EU sustainable transport group data shows a litre of gasoline has a well-to-wheel emissions footprint of 2.42kg/CO₂e. Following RED indications, the study assumes next-generation ethanol, using the enzymatic hydrolysis technology, reduces GHG emissions by 80%.

Source: Bloomberg New Energy Finance

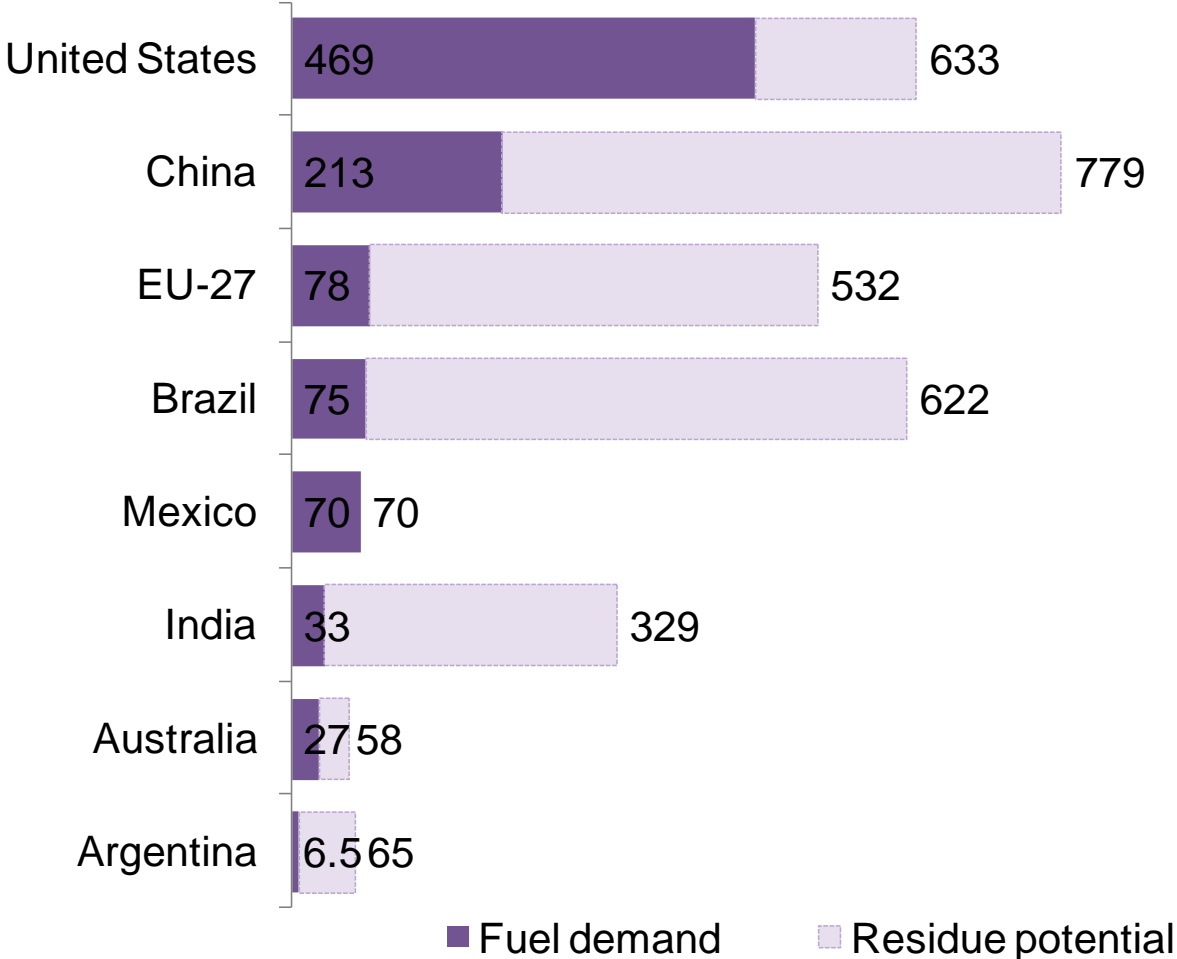
TOTAL REVENUE AND INVESTMENT, 2011–2050 (\$BN)



Note: Revenues calculated for delivered next-generation ethanol. Revenues are generated by plants throughout their 20 years lifetime with the last plant being built in 2030.

Source: Bloomberg New Energy Finance

REVENUES FROM TOTAL NEXT-GENERATION ETHANOL, 2011–2050 (\$BN)



We have assumed the ethanol price is \$0.44 per litre; the energy equivalent ethanol price when oil is at \$100 a barrel.

Note: Revenues are for delivered next-generation ethanol and are generated by plants throughout a 20-year lifetime.

Source: Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL INDUSTRY REVENUES

MARGINS

Next-generation ethanol industry margins will be heavily influenced by the development of conversion economics, crude oil price movements, financial incentives and policy.

MARGIN POT

It is impossible to determine how the value chain “margin pot” will be split between next-generation ethanol producers, farmers and blenders as global crude oil prices change.

EXPOSURE

Investing in other parts of the next-generation ethanol industry value chain will help farmers maximise their future margin exposure.

NEXT-GENERATION ETHANOL INDUSTRY METRICS UNDER “FUEL DEMAND” SCENARIO (PER CAPITA)

| | ARGENTINA | AUSTRALIA | INDIA | MEXICO |
|-------------------------------------|-----------|-----------|--------|--------|
| Man-years of employment | 0.0004 | 0.0026 | 0.0001 | 0.0014 |
| GHG savings (tCO2) | 0.009 | 0.067 | 0.001 | 0.035 |
| 2011-2030 Revenues (\$) | 92 | 70 | 16 | 368 |
| 2011-30 investment (\$) | 24 | 184 | 4 | 96 |
| 2030 installed capacity (litres) | 20 | 140 | 3 | 70 |
| 2030 agricultural residues (tonnes) | 0.045 | 0.346 | 0.004 | 0.181 |

Notes: Population figures are based on 2011 estimates. Mexico can only replace about 6% of its gasoline demand due to supply issues from the analysed feedstock group.

Source: Bloomberg New Energy Finance, UN

NEXT-GENERATION ETHANOL INDUSTRY METRICS UNDER “FUEL DEMAND” SCENARIO (PER CAPITA)

| | BRAZIL | EU-27 | CHINA | US |
|-------------------------------------|--------|--------|--------|--------|
| Man-years | 0.0079 | 0.0004 | 0.0006 | 0.0032 |
| GHG savings (tCO2) | 0.021 | 0.009 | 0.009 | 0.083 |
| 2011-2030 Revenues (\$) | 222 | 90 | 91 | 865 |
| 2011-30 Investment (\$) | 58 | 24 | 24 | 227 |
| 2030 installed capacity (litres) | 40 | 20 | 20 | 170 |
| 2030 agricultural residues (tonnes) | 0.109 | 0.044 | 0.045 | 0.426 |

Notes: 'MYE' represents man years of employment. Population figures based on 2011 estimates Mexico can only replace about 6% of its gasoline demand due to supply constraints in the analysed feedstock mix.

Source: Bloomberg New Energy Finance, UN

NEXT-GENERATION ETHANOL INDUSTRY METRICS, 2011-30 (PER CAPITA), “RESIDUE POTENTIAL” SCENARIO

| | ARGENTINA | AUSTRALIA | INDIA | MEXICO |
|-------------------------------------|-----------|-----------|--------|--------|
| Man-years | 0.0074 | 0.0055 | 0.0008 | 0.0014 |
| GHG savings (tCO2) | 0.087 | 0.142 | 0.015 | 0.035 |
| 2011-2030 Revenues (\$) | 915 | 1,500 | 158 | 368 |
| 2011-30 Investment (\$) | 239 | 390 | 41 | 96 |
| 2030 installed capacity (litres) | 180 | 290 | 30 | 70 |
| 2030 agricultural residues (tonnes) | 0.790 | 0.733 | 0.091 | 0.181 |

Notes: 'MYE' represents man years of employment. Population in 2011. Mexico can only replace about 6% of its gasoline demand due to supply constraints in the analysed feedstock mix.

Source: Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL INDUSTRY METRICS, 2011-30 (PER CAPITA), “RESIDUE POTENTIAL” SCENARIO

| | BRAZIL | EU-27 | CHINA | US |
|-------------------------------------|--------|--------|--------|--------|
| Man-years | 0.0046 | 0.0018 | 0.0021 | 0.0043 |
| GHG savings (tCO2) | 0.123 | 0.038 | 0.032 | 0.110 |
| 2011-2030 Revenues (\$) | 1,850 | 430 | 335 | 1,165 |
| 2011-30 Investment (\$) | 339 | 105 | 87 | 302 |
| 2030 installed capacity (litres) | 250 | 80 | 70 | 230 |
| 2030 agricultural residues (tonnes) | 0.637 | 0.283 | 0.163 | 0.568 |

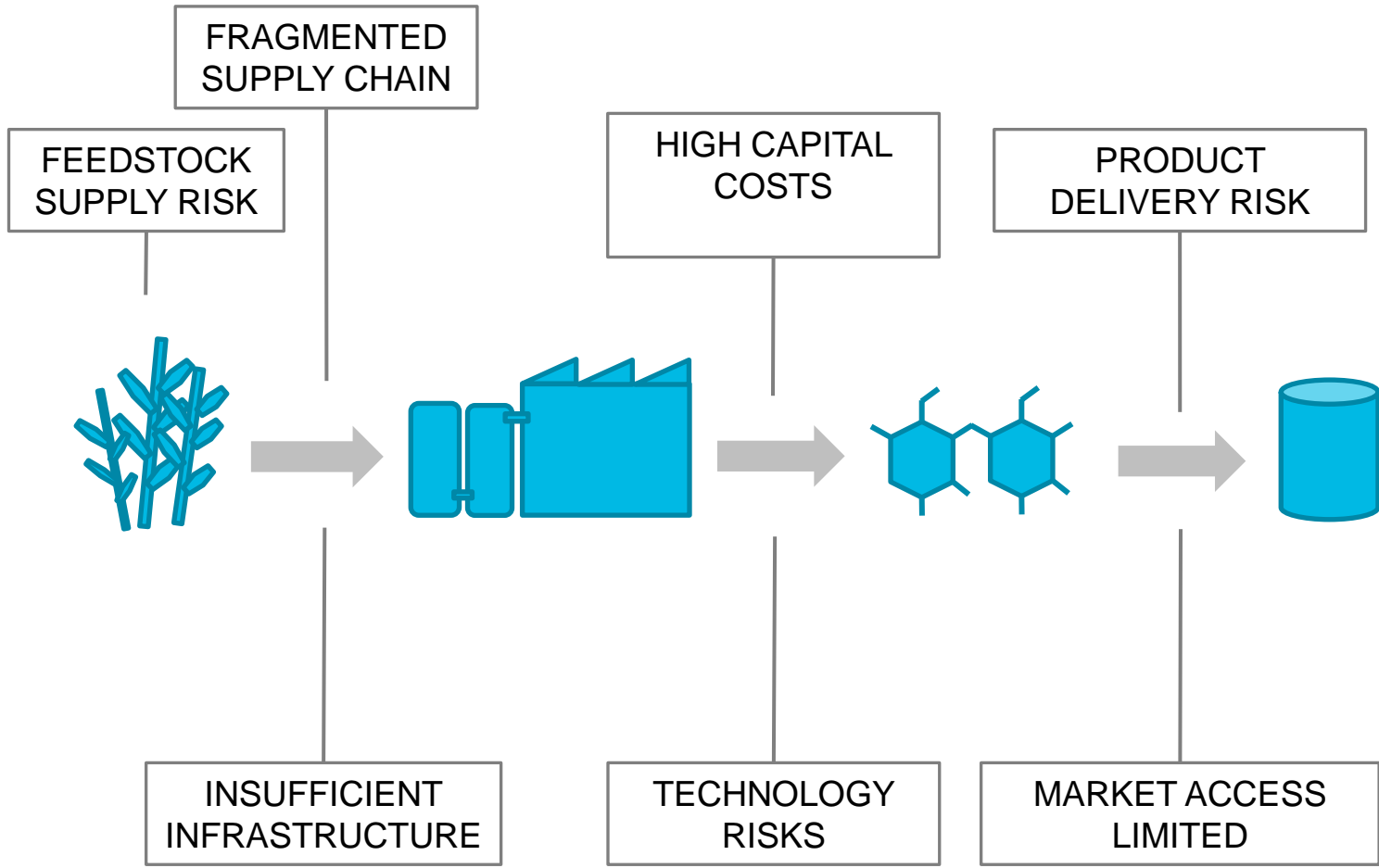
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RISKS ACROSS THE NEXT-GENERATION ETHANOL VALUE CHAIN



Source: Bloomberg New Energy Finance

PERCEIVED INVESTMENT RISKS

EXTERNAL RISKS

There are external risks relating to bioenergy feedstock supply and final product demand – principally determined by policy. These issues currently appear more pressing than perceived technology risks.

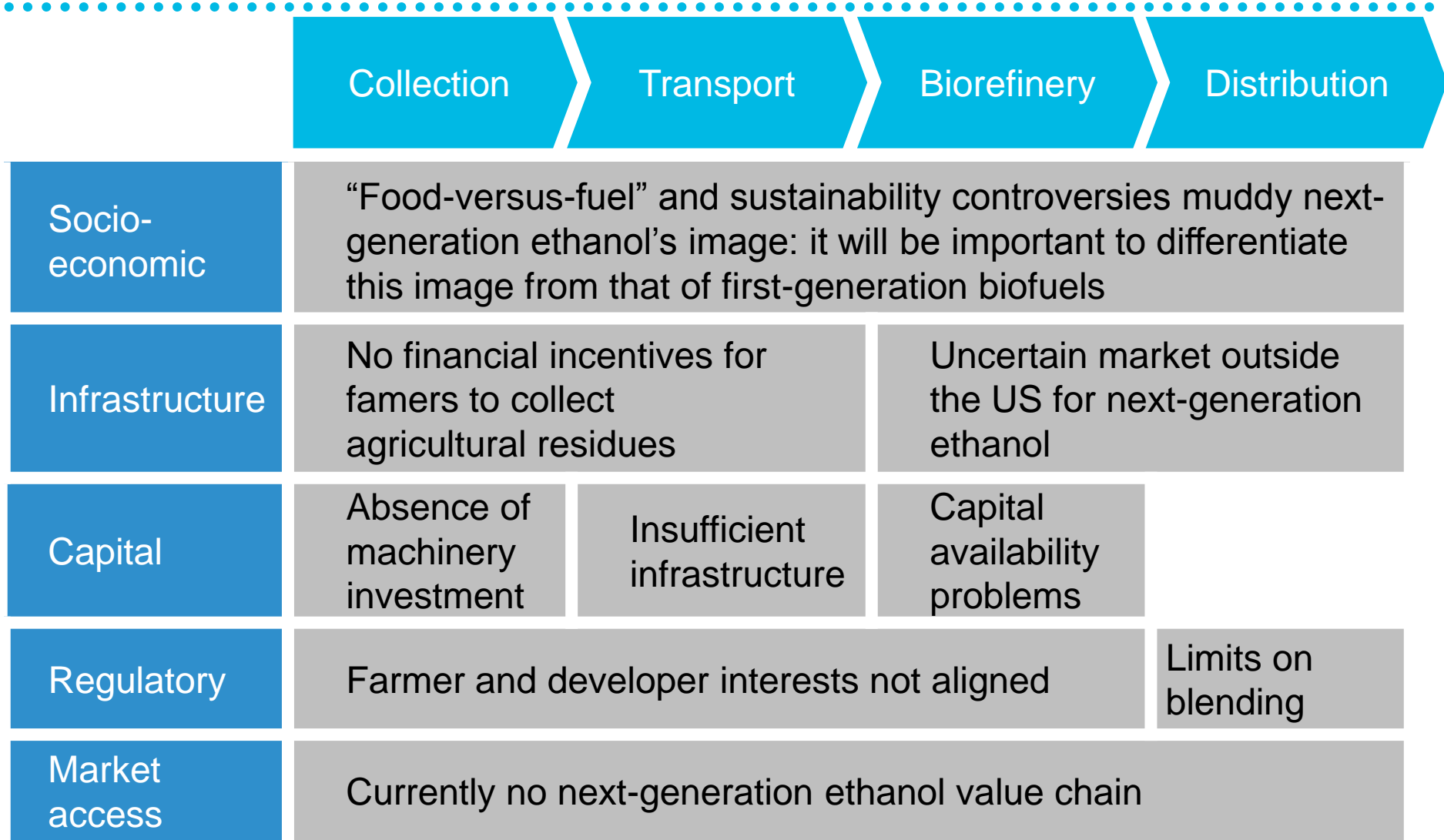
INDUSTRY KNOWLEDGE

There is an absence of operational and investor knowledge in terms of understanding of potential business models and investment cases.

BUSINESS CASES

Potential investors require business cases and investment proposals that “fit” – in terms of development stage and risk profile – across the entire value chain.

NEXT-GENERATION ETHANOL INDUSTRY CHALLENGES



Source: Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL: THE CURRENT STATUS

| | ARGENTINA | AUSTRALIA | BRAZIL | CHINA |
|----------------|-----------|-----------|--------|-------|
| Socio-economic | ○ ● ○ | ○ ● ○ | ○ ● ○ | ○ ○ ● |
| Infrastructure | ○ ○ ● | ○ ○ ● | ○ ● ○ | ● ○ ○ |
| Capital | ● ○ ○ | ● ○ ○ | ○ ○ ● | ○ ○ ● |
| Regulation | ○ ● ○ | ● ○ ○ | ○ ○ ● | ○ ● ○ |
| Market access | ○ ● ○ | ○ ● ○ | ○ ○ ● | ○ ● ○ |

Source: Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL: THE CURRENT STATUS

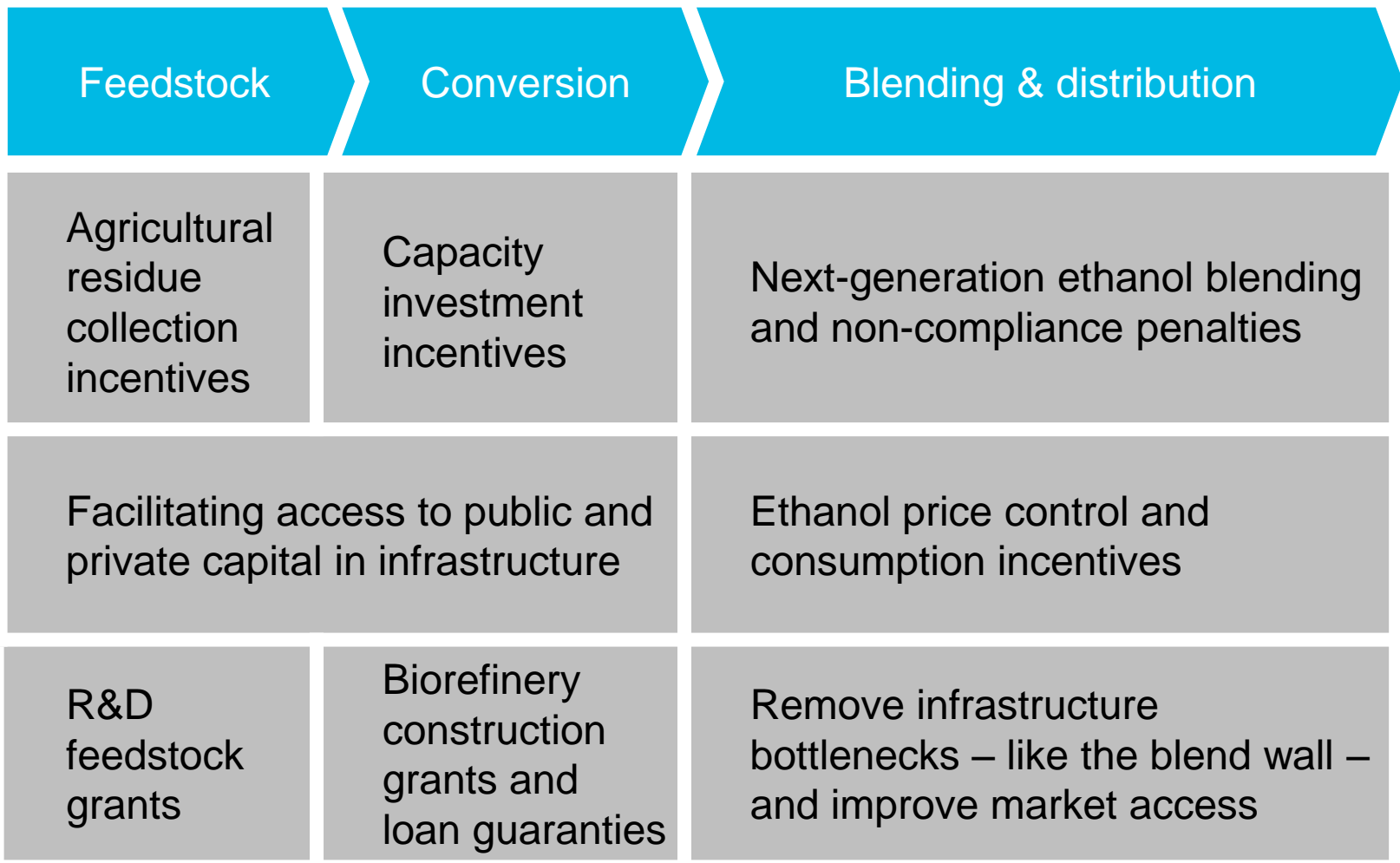
| | EU-27 | INDIA | MEXICO | US |
|----------------|-------|-------|--------|-------|
| Socio-economic | ○ ● ○ | ● ○ ○ | ● ○ ○ | ○ ● ○ |
| Infrastructure | ○ ○ ● | ● ○ ○ | ○ ● ○ | ○ ○ ● |
| Capital | ○ ● ○ | ○ ● ○ | ● ○ ○ | ○ ○ ● |
| Regulation | ○ ● ○ | ○ ● ○ | ○ ● ○ | ○ ○ ● |
| Market access | ○ ● ○ | ○ ● ○ | ○ ● ○ | ● ○ ○ |

Source: Bloomberg New Energy Finance

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

1. Introduction
2. What is the resource?
3. Agricultural residue collection economics
4. Ethanol potential and investment
5. Societal benefits
6. Industry barriers
7. Roadmap to next-generation ethanol

POLICY OPTIONS FOR PROMOTING A NEXT-GENERATION ETHANOL INDUSTRY



























REGIONAL REGULATORY POSITION, 2011

| | ARGENTINA | AUSTRALIA | BRAZIL | CHINA |
|----------------------------------|-----------|-----------|--------|-------|
| Next-generation ethanol blending | ● ○ ○ | ○ ● ○ | ● ○ ○ | ○ ● ○ |
| Non-compliance penalties | ● ○ ○ | ● ○ ○ | ○ ○ ● | ○ ○ ● |
| Ethanol price control | ○ ○ ● | ● ○ ○ | ○ ○ ● | ○ ○ ● |
| Investment incentives | ● ○ ○ | ● ○ ○ | ○ ○ ● | ○ ○ ● |
| Ethanol consumption incentives | ● ○ ○ | ● ○ ○ | ● ○ ○ | ● ○ ○ |
| Market access | ● ○ ○ | ● ○ ○ | ○ ○ ● | ○ ○ ● |

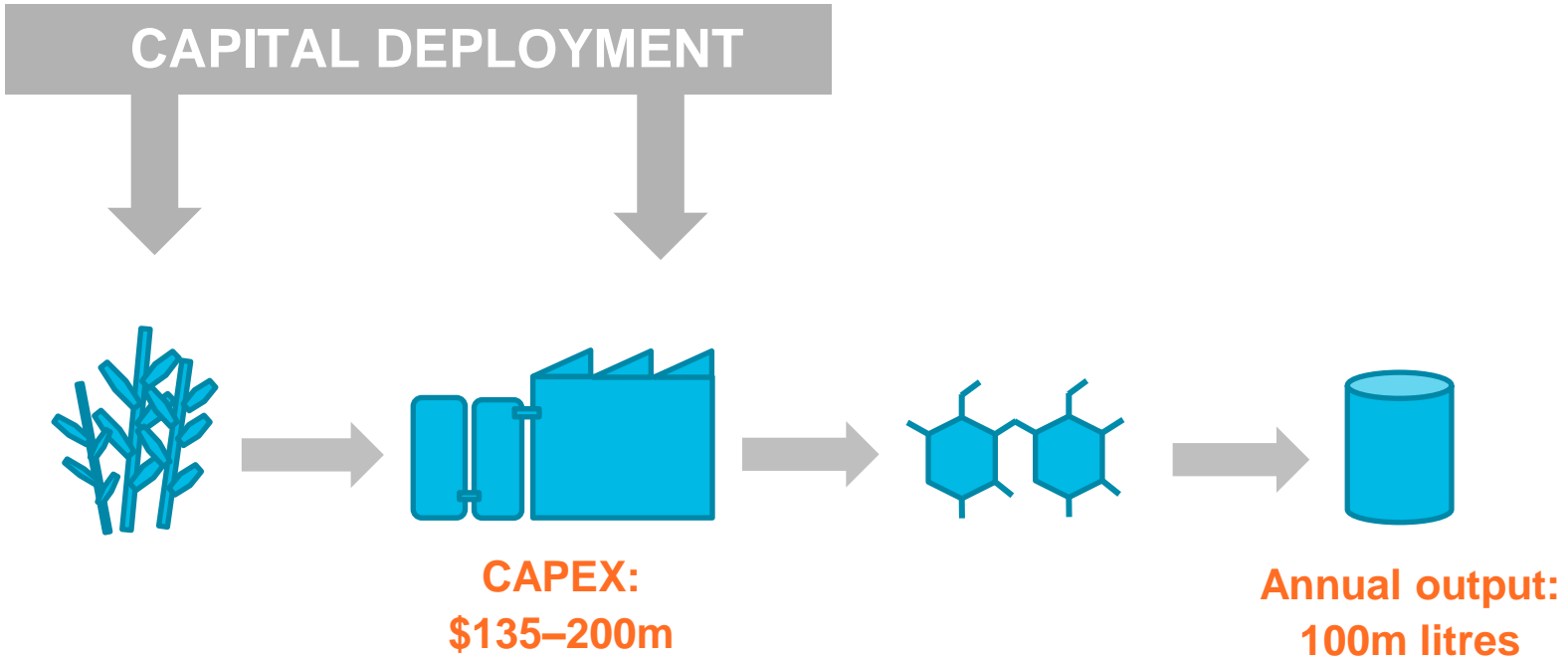
Note: RED circles indicate a lack of regulation; YELLOW circles indicate regulation is planned but not yet implemented; GREEN circles indicate regulation has been implemented.

REGIONAL REGULATORY POSITION, 2011

| | EU-27 | INDIA | MEXICO | US |
|----------------------------------|---|--|---|---|
| Next-generation ethanol blending |  |  |  |  |
| Non-compliance penalties |  |  |  |  |
| Ethanol price control |  |  |  |  |
| Investment incentives |  |  |  |  |
| Ethanol consumption incentives |  |  |  |  |
| Market access |  |  |  |  |

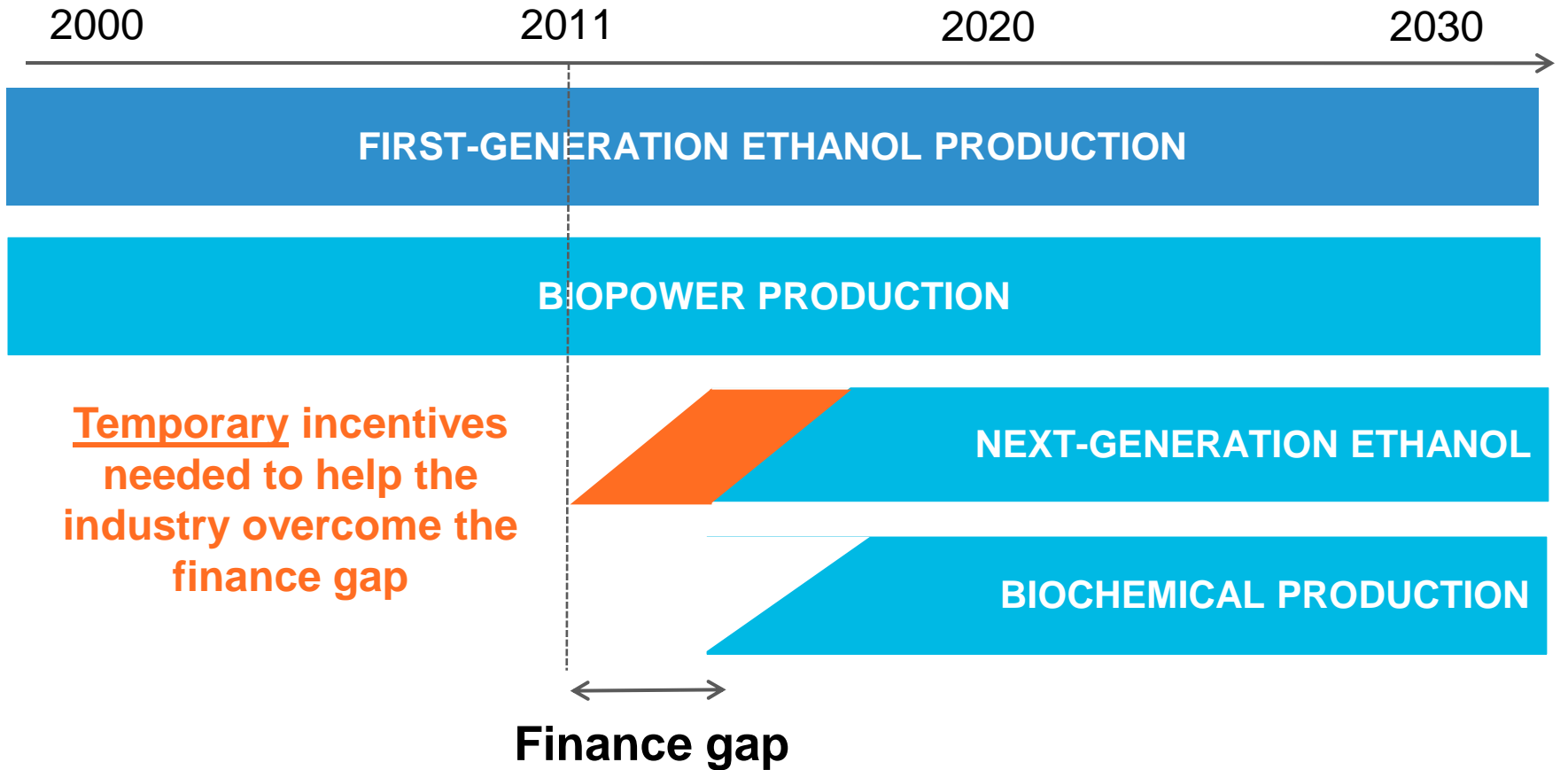
Note: RED circles indicate a lack of regulation; YELLOW circles indicate regulation is planned but not yet implemented; GREEN circles indicate regulation has been implemented

BUILDING THE NEXT-GENERATION ETHANOL VALUE CHAIN



Note: Next-generation biorefinery construction costs – or CAPEX – are based on current estimates for a commercial scale next-generation ethanol facility using enzymatic hydrolysis. Source: Bloomberg New Energy Finance

CURRENT STATE OF BIOPRODUCT INDUSTRY DEVELOPMENT , 2000-2030

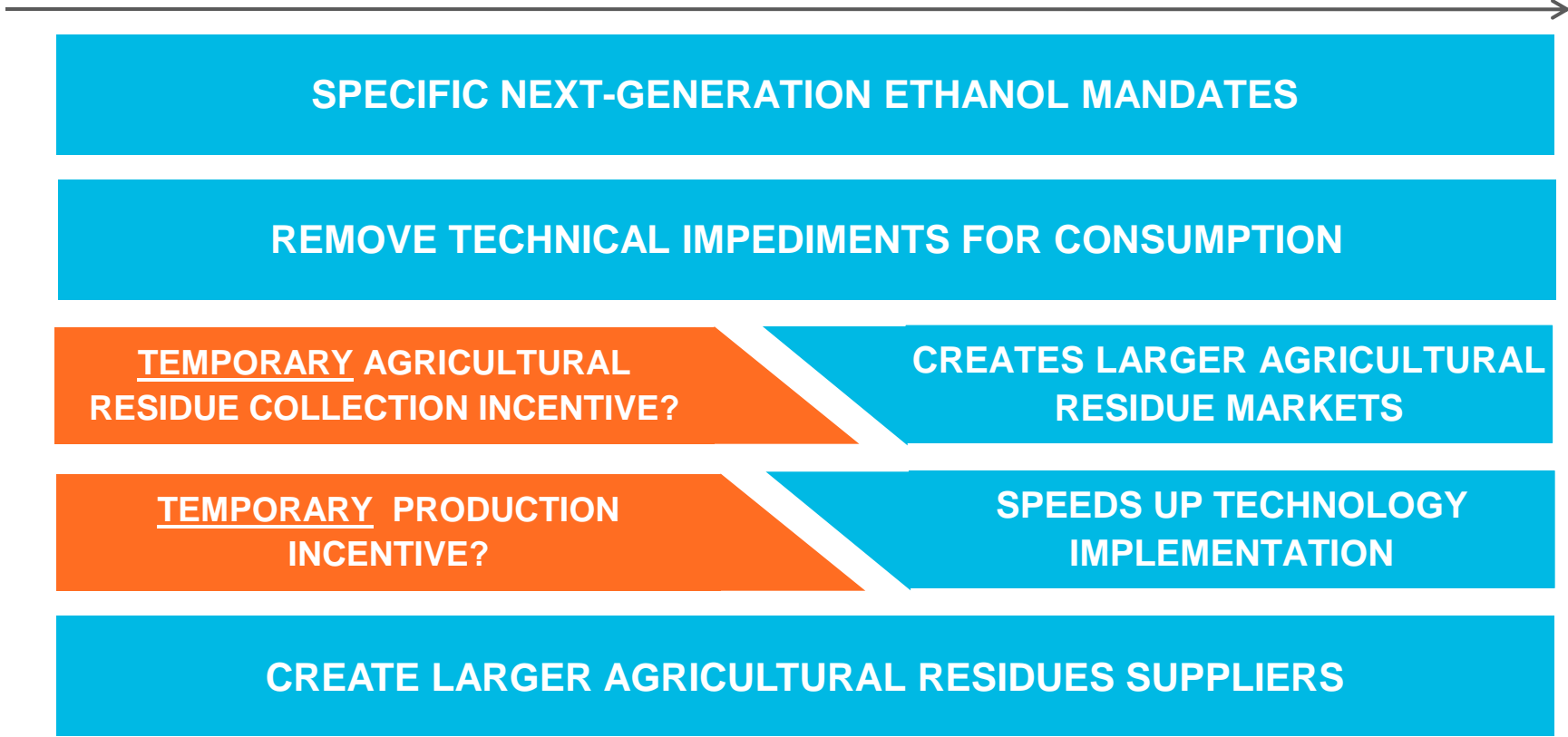


Source: Bloomberg New Energy Finance

TIMELINES AND OUTCOMES FOR BIOPRODUCT INDUSTRY POLICY IMPLEMENTATION, 2011–20

2011

2020



Source: Bloomberg New Energy Finance

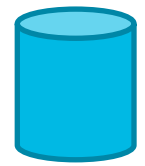
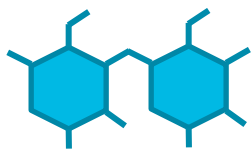
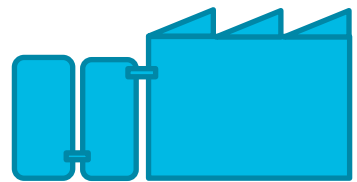
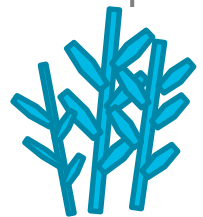
POLICY SUGGESTIONS FOR THE NEXT-GENERATION ETHANOL VALUE CHAIN

FEEDSTOCK SUPPLY RISK:
Short-term Incentives for farmers to collect agricultural residue which will facilitate the development of a next-generation ethanol value chain.

FRAGMENTED SUPPLY CHAIN:
Creating a large agricultural residue suppliers that can aggregate different feedstock streams could reduce supply risks enough to be trustworthy in the eyes of capital providers.

HIGH CAPITAL COSTS:
Government support in the form of loan guarantees and R&D grants is vital to reduce the industries' capital cost

PRODUCT DELIVERY RISK:
Provides stable demand to attract capital to farming and next-generation ethanol sector investment; while also giving the financial community a long-term market, helping drive debt and equity investment.



INSUFFICIENT INFRASTRUCTURE:
Investment in rural roads to fields and orchards will facilitate efficient agricultural residue transport and reduce costs.

TECHNOLOGY RISKS:
The incentive should be locked in for the lifetime of the plant, giving a premium for those that come online first. Investors will then become more comfortable with project risk while reducing the attractiveness of "wait and see" strategies.

MARKET ACCESS LIMITED:
Allows ethanol, both first and next-generation, to replace more than 10% of the fossil gasoline supply and removes the "blending wall" that impedes industry growth, promote fuel flexible vehicles and encourage long-term off-take agreements.

Source: Bloomberg New Energy Finance



AGRICULTURAL RESIDUE AVAILABILITY – SLIDE 14 DATA, 1989–2030 (MILLION DRY TONNES)

| | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 |
|--------------------|------|------|------|------|------|------|------|------|------|------|------|
| Wheat residues | 200 | 204 | 208 | 212 | 216 | 220 | 223 | 227 | 231 | 235 | 239 |
| Sugarcane residues | 170 | 173 | 175 | 178 | 180 | 183 | 186 | 188 | 191 | 193 | 196 |
| Maize residues | 133 | 136 | 140 | 144 | 148 | 152 | 155 | 159 | 163 | 167 | 171 |
| Rice residues | 77 | 79 | 80 | 81 | 83 | 84 | 85 | 87 | 88 | 90 | 91 |
| Soybeans residues | 67 | 68 | 70 | 72 | 73 | 75 | 76 | 78 | 80 | 81 | 83 |
| Other residues | 67 | 68 | 70 | 72 | 73 | 75 | 76 | 78 | 80 | 81 | 83 |

TOTAL JOB CREATION IN EIGHT SELECT REGIONS – SLIDE 32

DATA, 2011–2030 (FULL-TIME EQUIVALENT JOBS; THOUSANDS)

| | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 |
|-------------------|------|------|------|------|------|------|------|------|------|------|------|
| Construction | 0 | 6 | 25 | 62 | 99 | 118 | 117 | 102 | 82 | 62 | 0 |
| Collection | 0 | 0 | 0 | 1 | 3 | 7 | 13 | 17 | 23 | 26 | 30 |
| Transport | 0 | 0 | 0 | 1 | 3 | 9 | 15 | 21 | 26 | 31 | 34 |
| Operational | 0 | 0 | 0 | 3 | 9 | 22 | 37 | 52 | 65 | 77 | 85 |
| Fuel demand total | 0 | 6 | 26 | 67 | 116 | 156 | 181 | 193 | 196 | 196 | 149 |

Note: data from “Fuel demand” scenario

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TOTAL JOB CREATION IN EIGHT SELECT REGIONS – SLIDE 32

DATA, 2011–2030 (FULL-TIME EQUIVALENT JOBS; THOUSANDS)

| | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 |
|-------------------------|------|------|------|------|------|------|------|------|------|------|------|
| Construction | 1 | 18 | 84 | 204 | 326 | 391 | 387 | 337 | 270 | 203 | 0 |
| Collection | 0 | 0 | 1 | 3 | 11 | 24 | 41 | 59 | 75 | 87 | 96 |
| Transport | 0 | 0 | 1 | 5 | 13 | 29 | 49 | 70 | 88 | 103 | 116 |
| Operational | 0 | 0 | 1 | 10 | 32 | 71 | 119 | 171 | 216 | 254 | 281 |
| Residue Potential total | 1 | 18 | 86 | 222 | 382 | 515 | 597 | 636 | 649 | 647 | 494 |

Note: data from “Residue potential” scenario

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GASOLINE VEHICLE GHG EMISSIONS IN 8 SELECT REGIONS – SLIDE 34 DATA, 2011–2030 (MILLION TONNES CO2 EQUIVALENT)

| | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 |
|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Fuel demand | 0 | 0 | 1 | 5 | 18 | 39 | 66 | 94 | 119 | 139 | 155 |
| Residue potential | 0 | 0 | 3 | 17 | 54 | 119 | 202 | 288 | 365 | 427 | 475 |
| Gasoline emissions | 2,088 | 2,057 | 2,034 | 2,010 | 1,987 | 1,966 | 1,953 | 1,941 | 1,937 | 1,936 | 1,936 |

TOTAL REVENUE AND INVESTMENT – SLIDE 36 DATA, 2011–2050 (\$BN)

| INVESTMENT | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 |
|-------------------|------|------|------|------|------|------|------|------|------|------|------|
| Fuel demand | 0 | 0 | 1 | 5 | 17 | 38 | 65 | 92 | 117 | 137 | 152 |
| Residue potential | 0 | 0 | 3 | 17 | 53 | 117 | 199 | 282 | 357 | 419 | 466 |

| REVENUES | 2010 | 2012 | 2014 | 2016 | 2018 | 2020 | 2022 | 2024 | 2026 | 2028 | 2030 |
|-------------------|------|------|------|------|------|------|-------|-------|-------|-------|-------|
| Fuel demand | 0 | 0 | 6 | 35 | 115 | 253 | 429 | 611 | 774 | 907 | 1,009 |
| Residue potential | 0 | 1 | 19 | 109 | 353 | 776 | 1,315 | 1,871 | 2,371 | 2,779 | 3,090 |

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A NEXT-GENERATION ETHANOL ECONOMY

FINAL STUDY, WEDNESDAY 14 DECEMBER

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Carbon Markets

Energy Smart Technologies

Renewable Energy Certificates

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Power

Water

Nuclear

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