MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

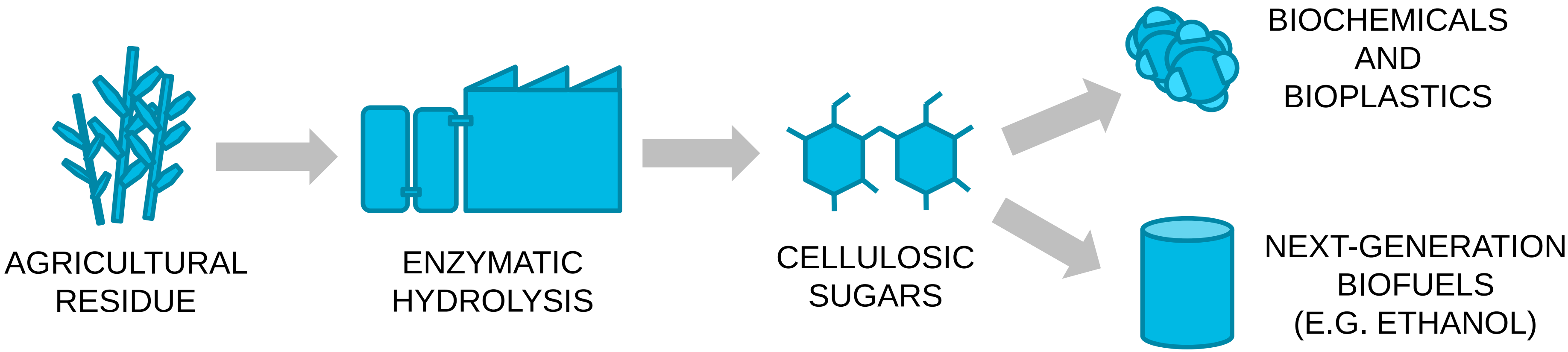
FINAL STUDY

WEDNESDAY 11 JANUARY 2012

Bloomberg
NEW ENERGY FINANCE

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

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.

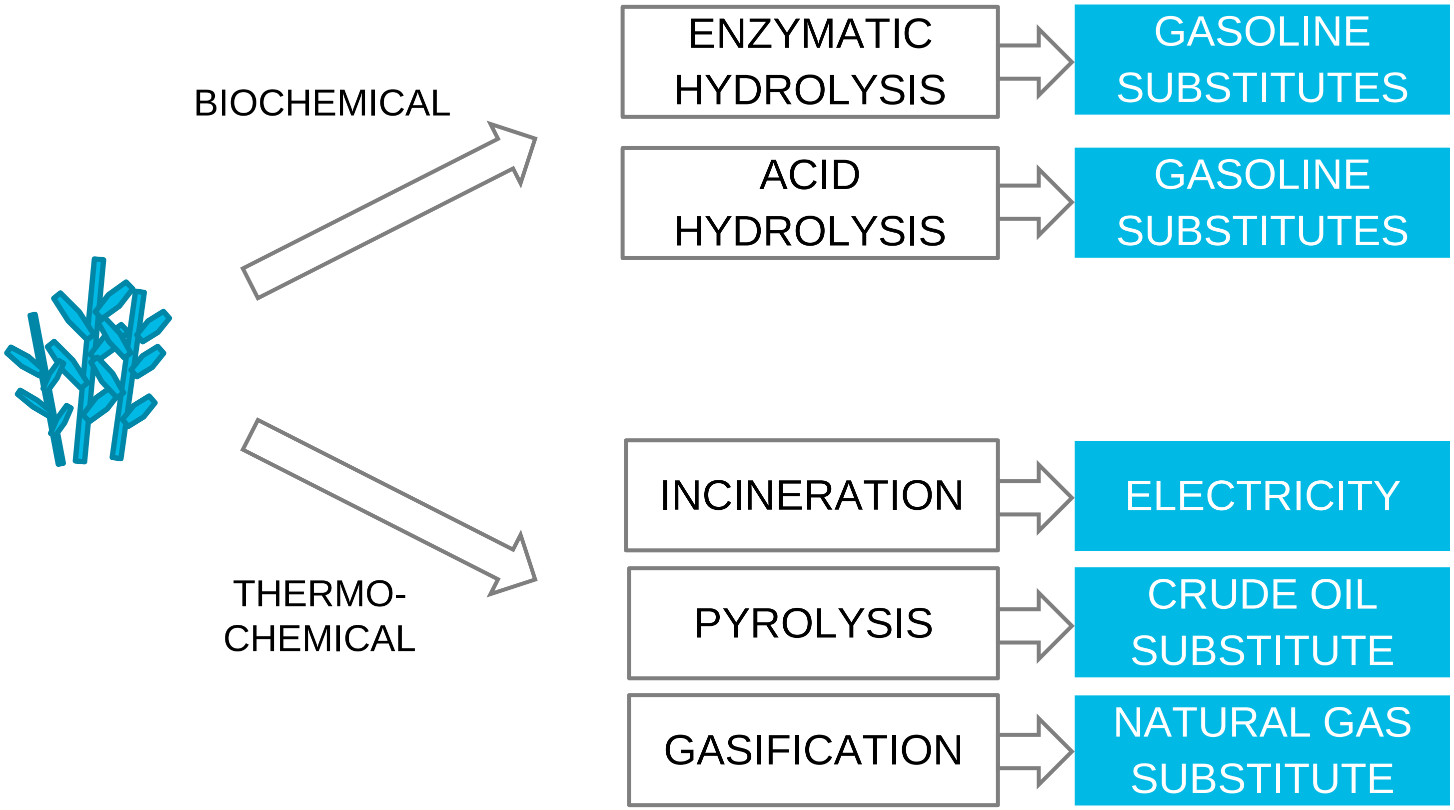
"RESIDUE POTENTIAL" SCENARIO

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.

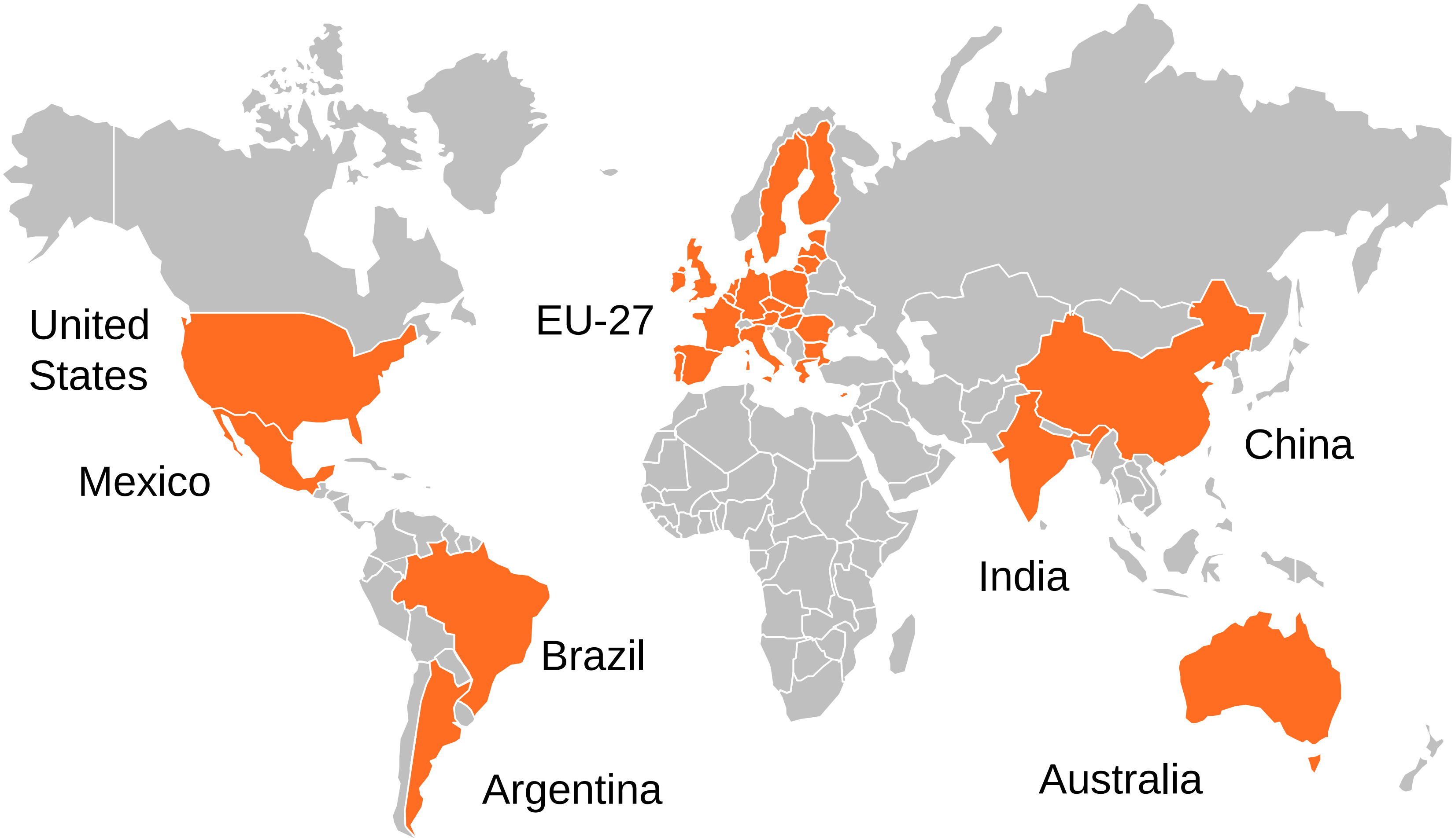
SCENARIOS

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.

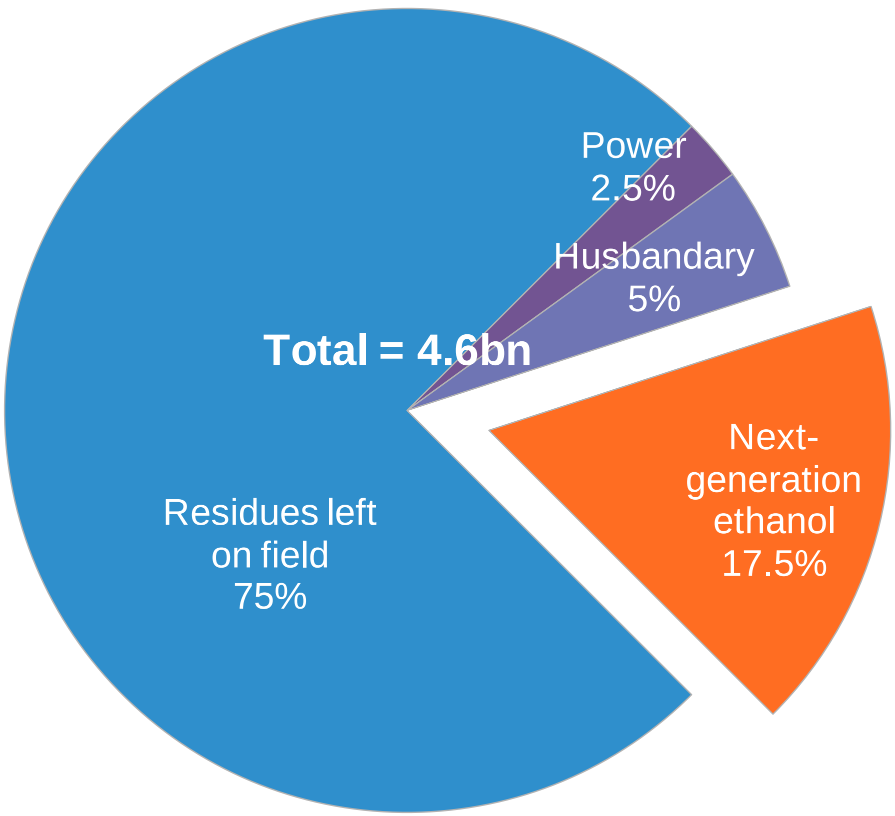
SCENARIO	Blending target	Annual total (2030)
"Residue potential"	N / A	351bn litres
"Fuel demand"	10%	115bn litres

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

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.

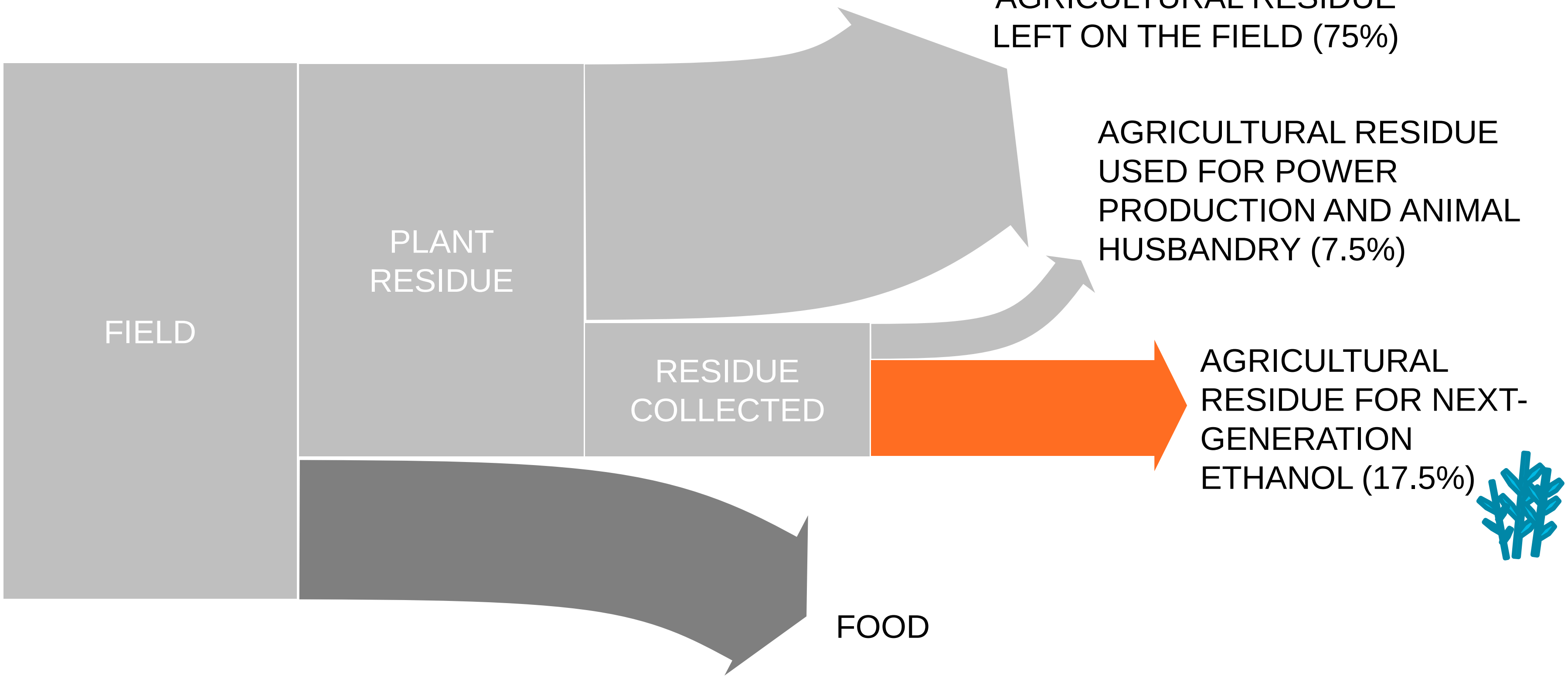
YIELD GROWTH

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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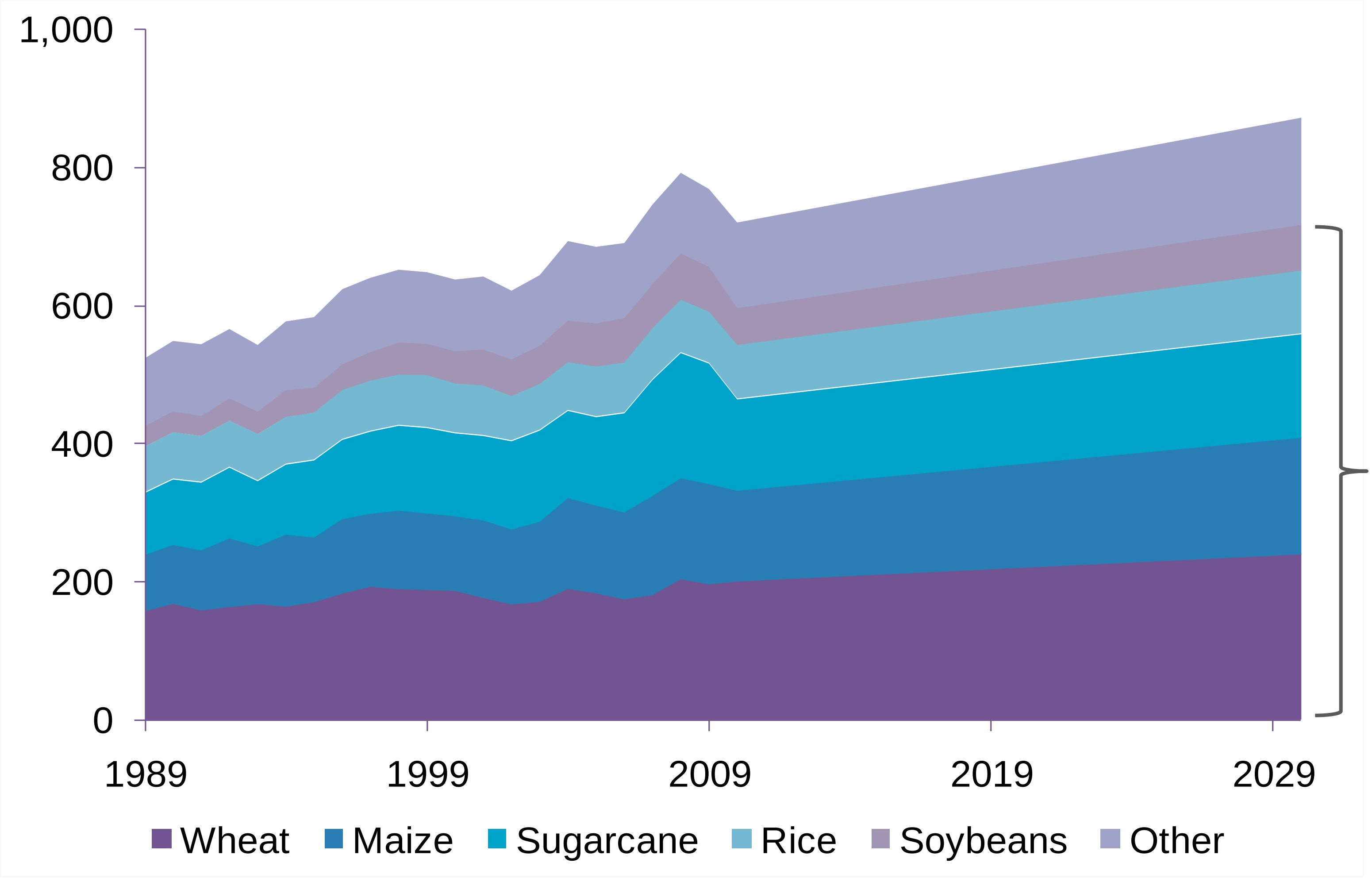
BAGASSE

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.

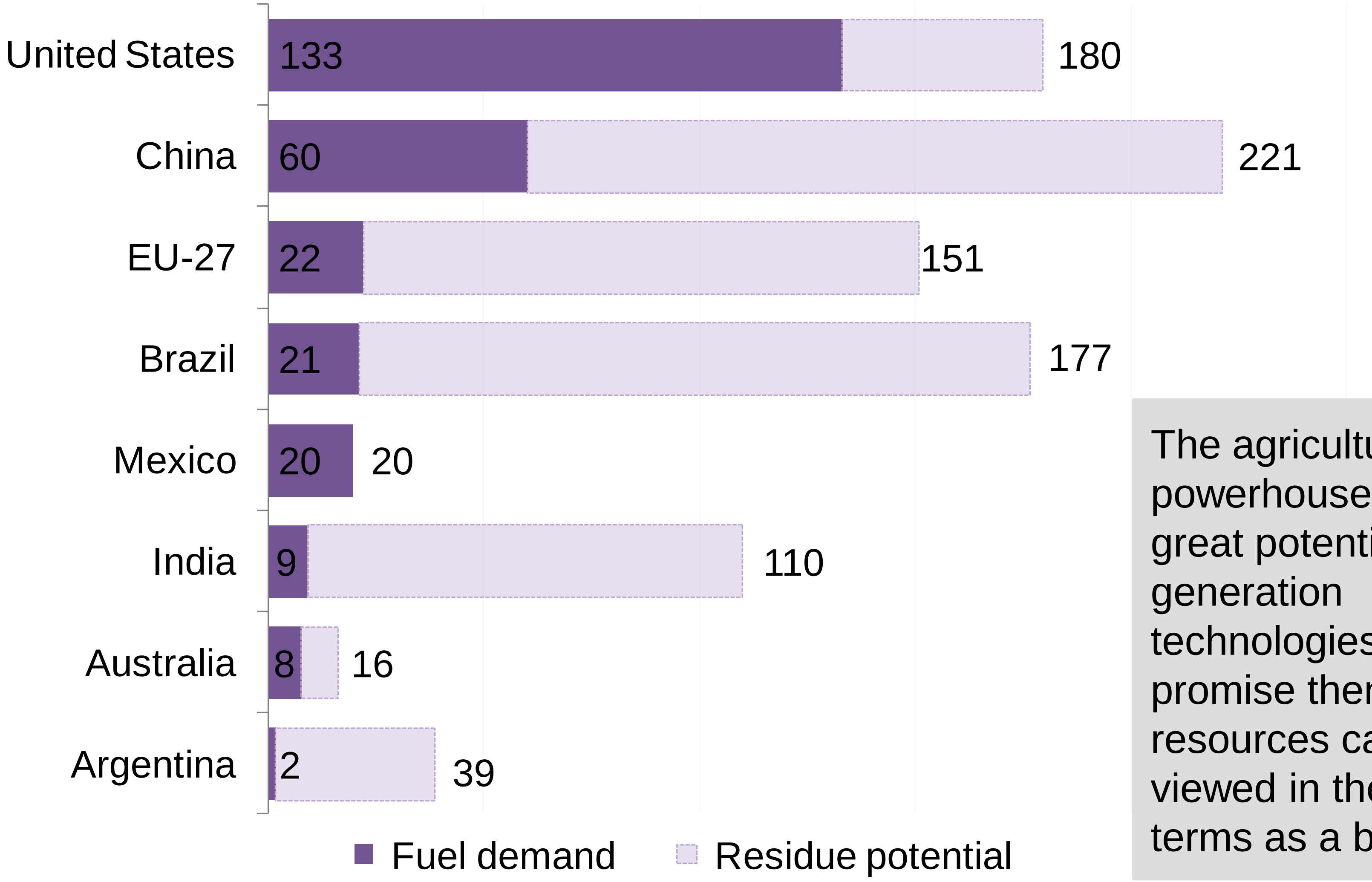
SAMPLE PLOTS

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)

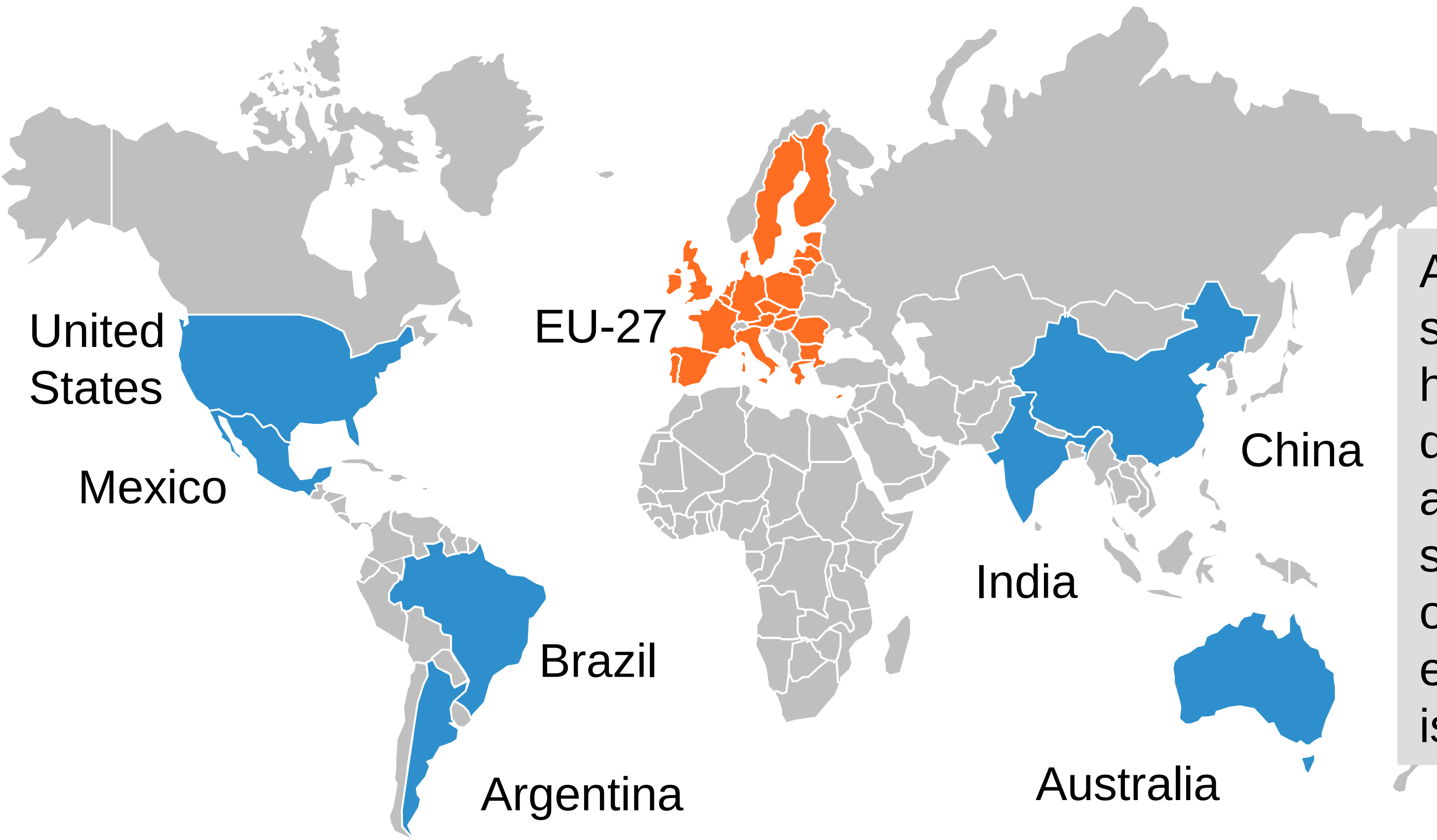


The agricultural powerhouses still hold great potential. If next-generation technologies fulfil their promise then these resources can be viewed in the same terms as a barrel of oil.

Source: Bloomberg New Energy Finance, FAO

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

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.

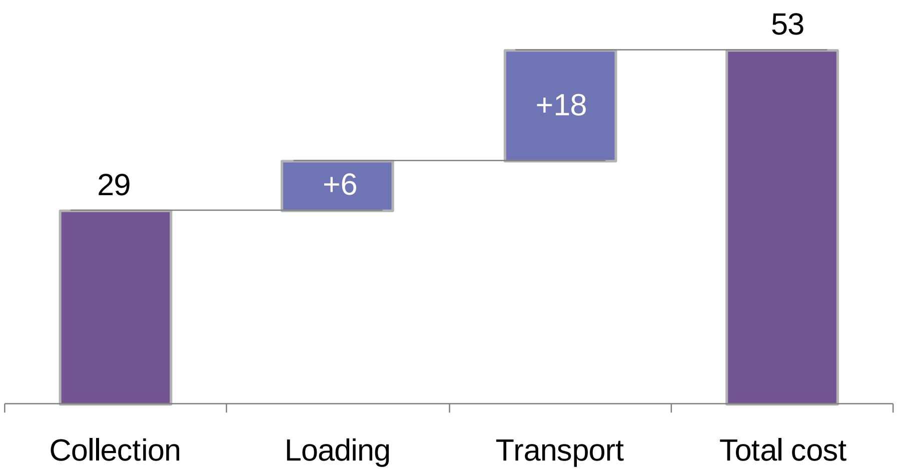
EU-27 AGRICULTURAL RESIDUE SUPPLY COST METHODOLOGY

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



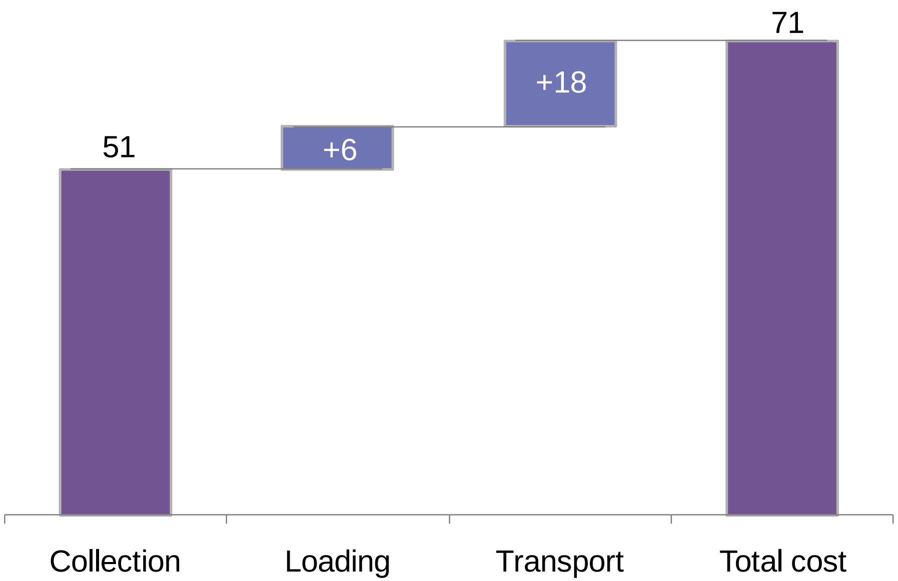
Note: Costs have been levelised to a common $ per dry tonne metric to allow cost comparisons between different agricultural residue types.

- 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.

Source: Bloomberg New Energy Finance

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

PROCESS COST BREAKDOWN

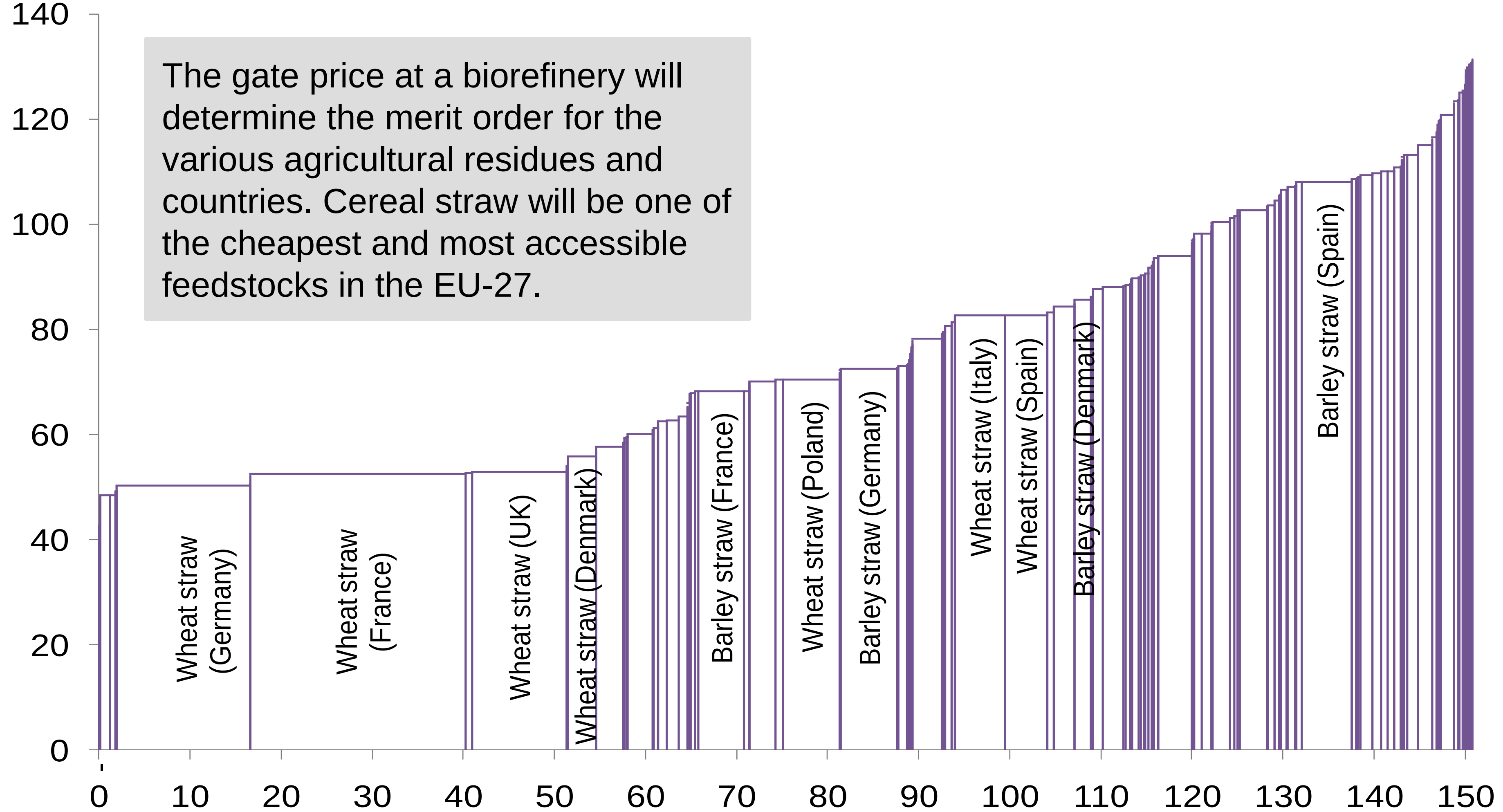


Note: Costs have been levelised to a common $ per dry tonne metric to allow cost comparisons between different agricultural residue types.

- 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.

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

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

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

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

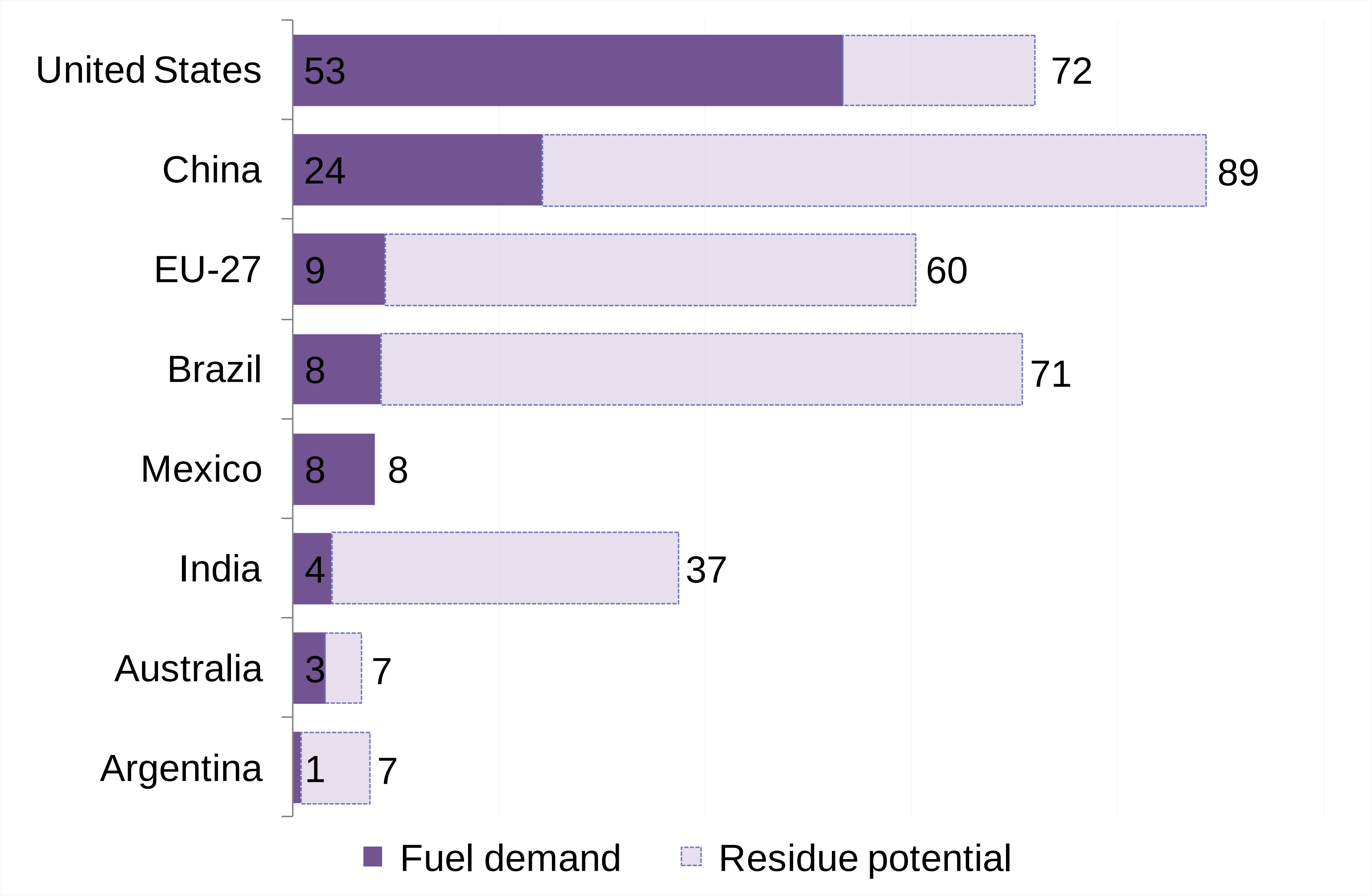
ETHANOL REVENUES

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%

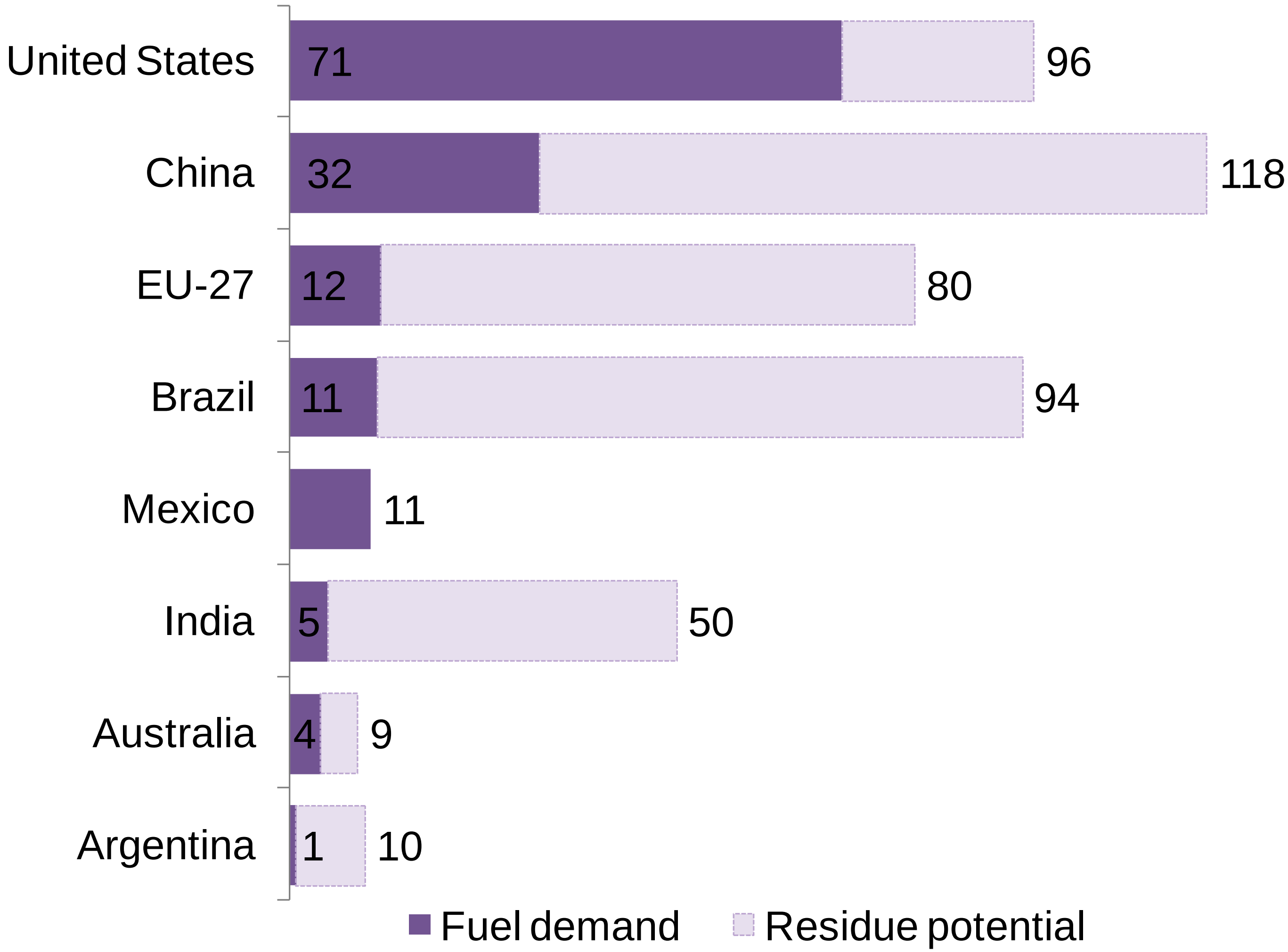
NEXT-GENERATION ETHANOL INSTALLED CAPACITY IN 2030 (BN LITRES)



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)

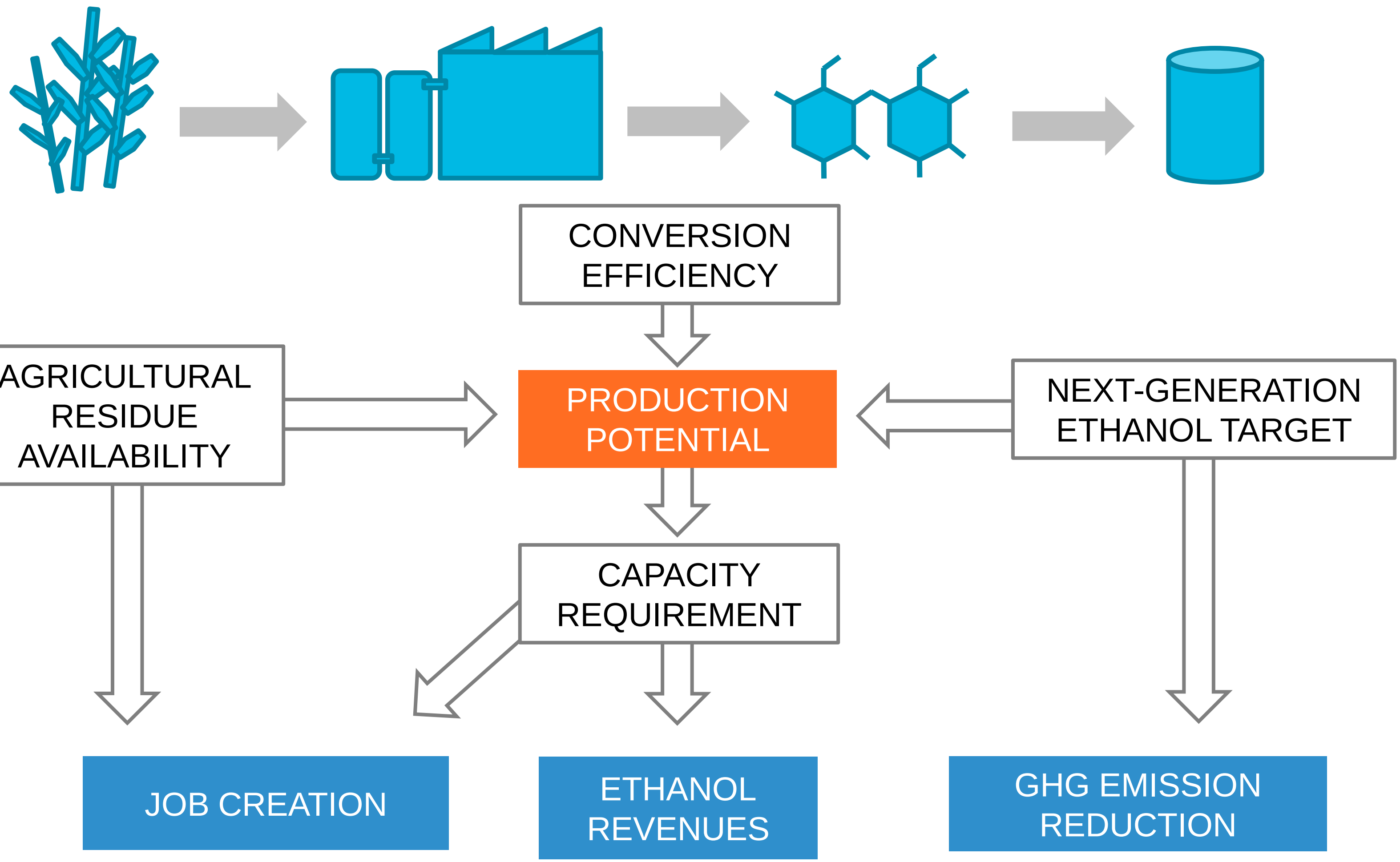


Note: We assume total facility costs for a next-generation ethanol refinery will be approximately USD 1.50 per litre of annual capacity.

Source: Bloomberg New Energy Finance

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

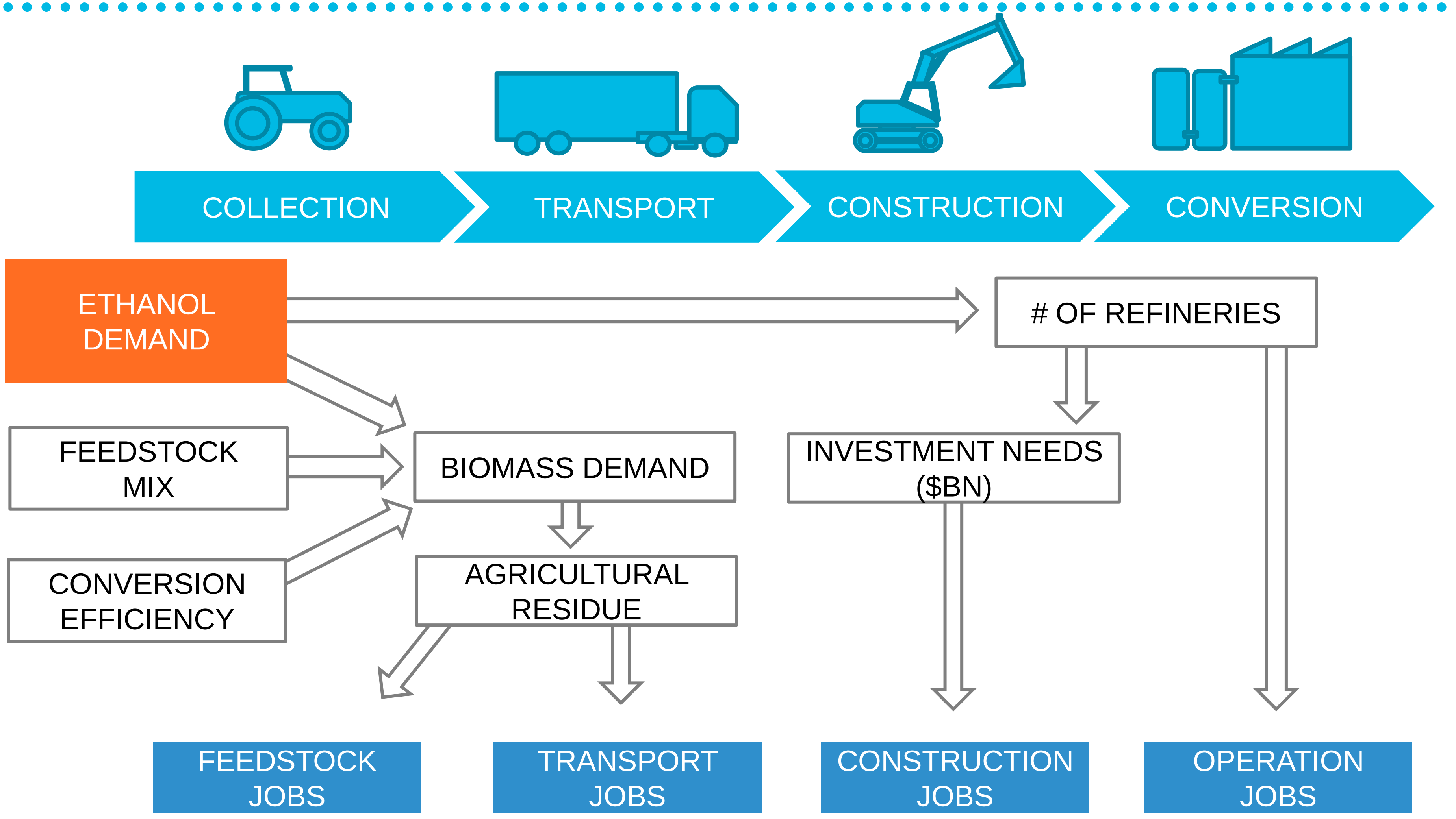
BENEFITS ACROSS THE NEXT-GENERATION ETHANOL VALUE CHAIN



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

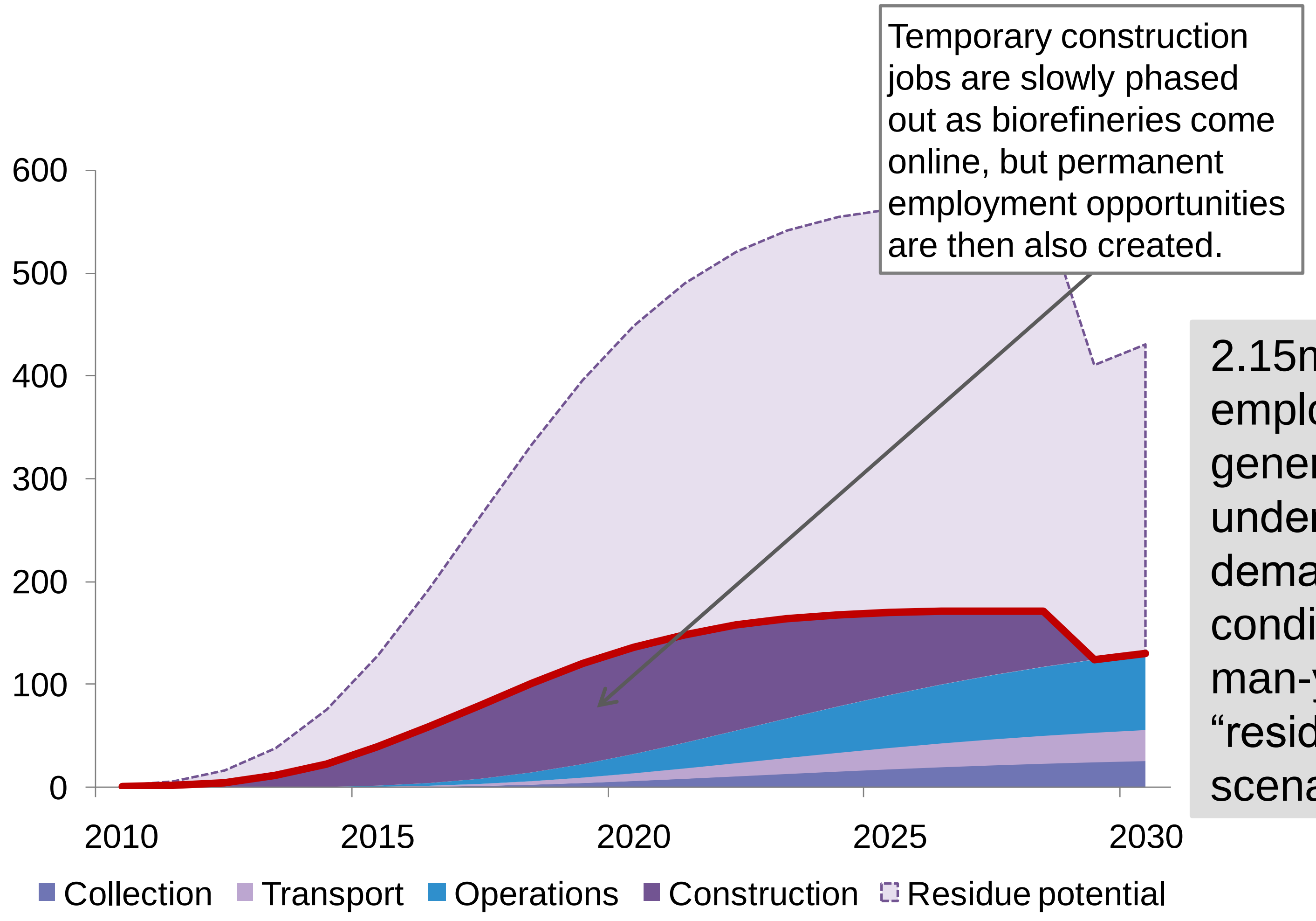
Source: Bloomberg New Energy Finance

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)

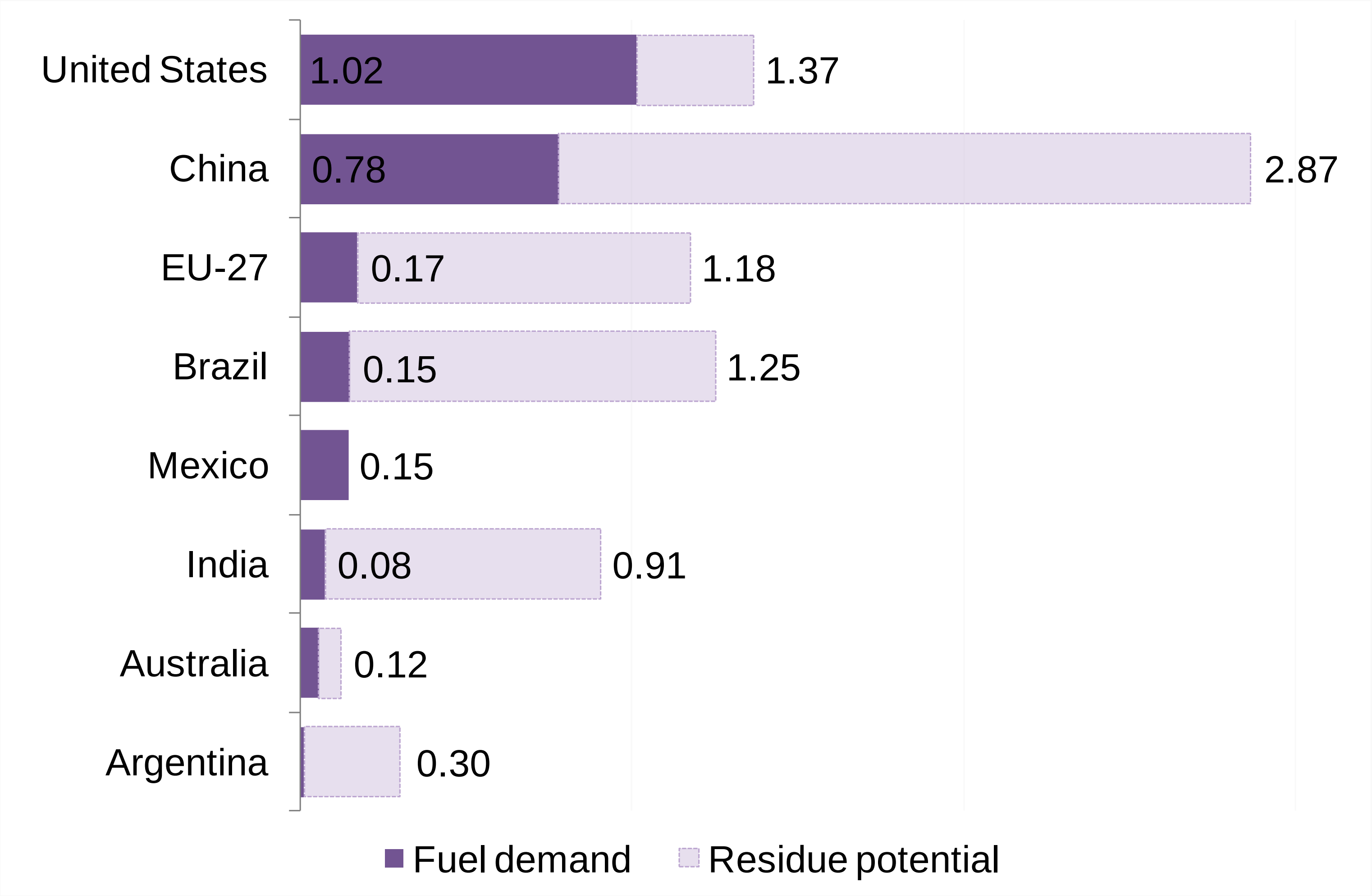


2.15m man-years of employment could be generated by 2030 under the “fuel demand” scenario conditions; with 7.1m man-years in the “residue potential” scenario

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

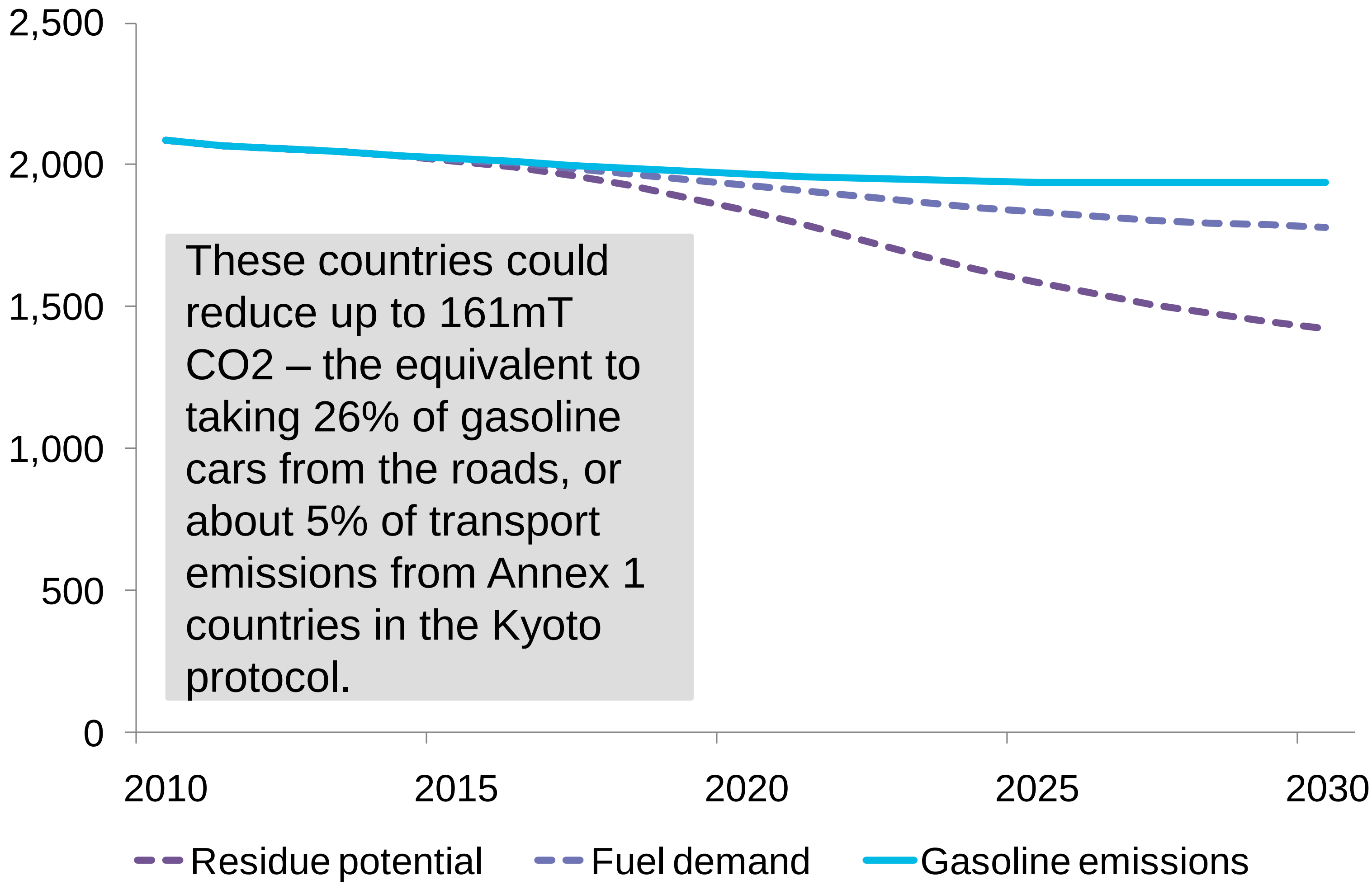
JOB CREATION BY REGION IN BOTH SCENARIOS, 2011–2030 (MAN-YEARS OF EMPLOYMENT; MILLIONS)



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.

Source:
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

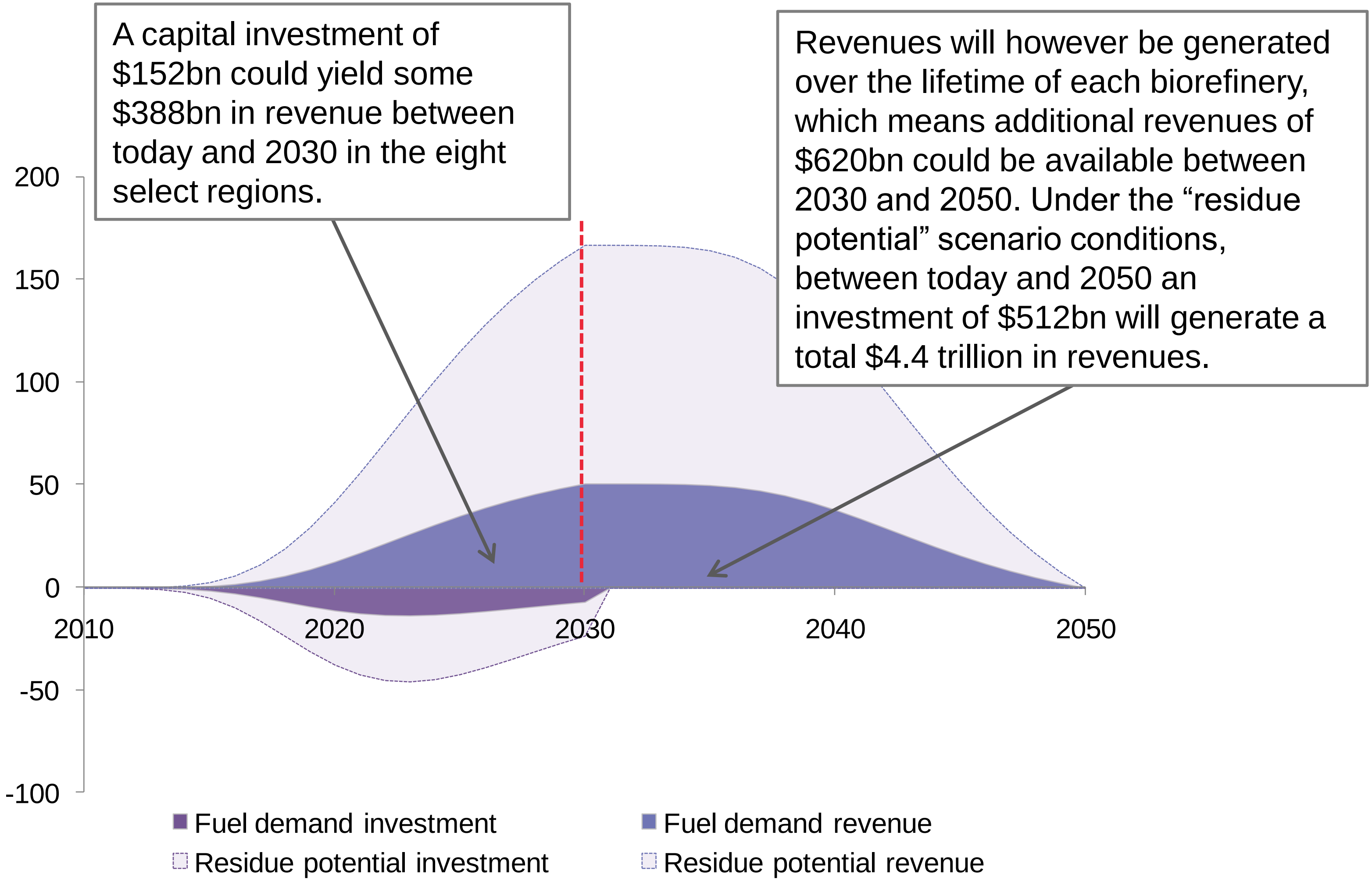
NEXT-GENERATION ETHANOL GHG SAVINGS UNDER BOTH SCENARIOS, 2030 (%)

	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

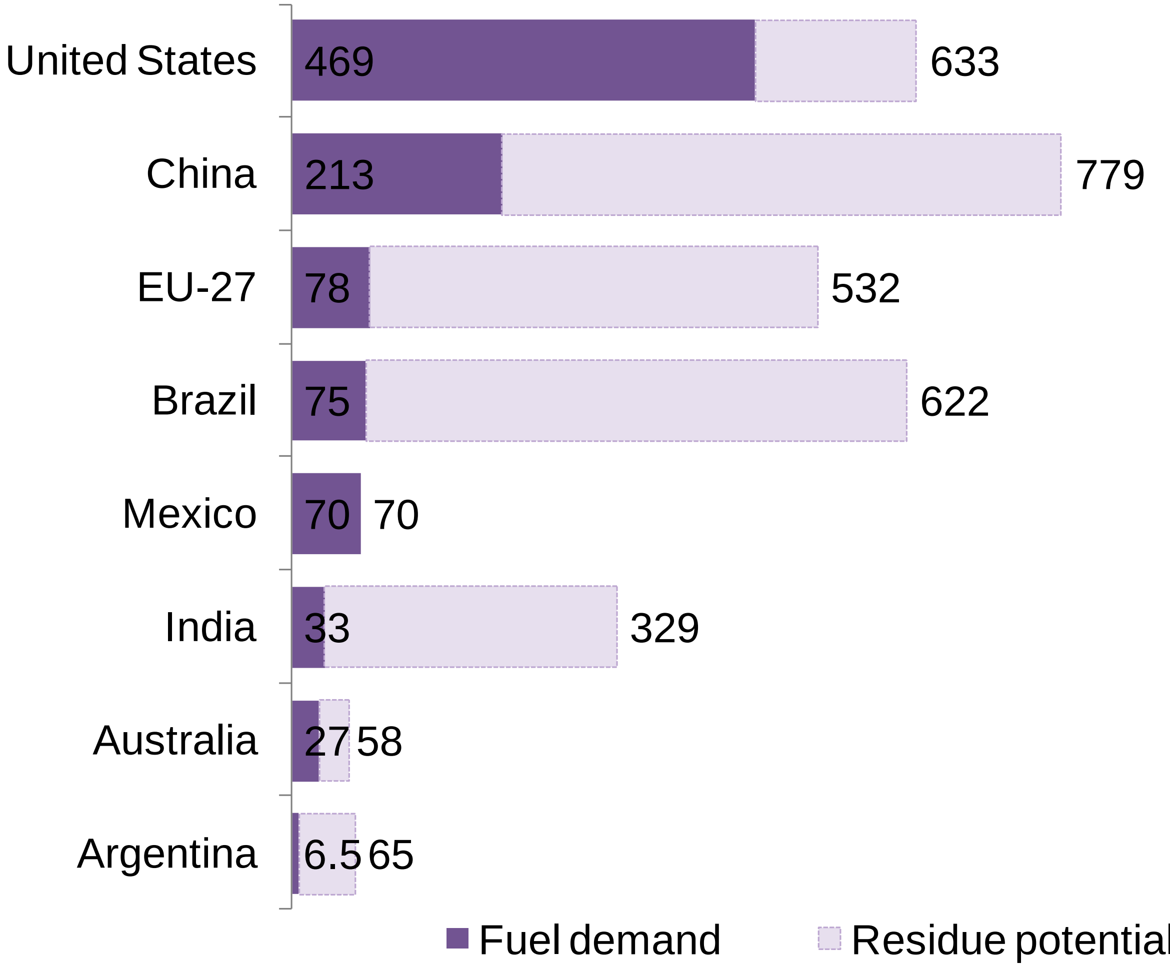
TOTAL REVENUE AND INVESTMENT, 2011–2050 ($BN)



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	0142	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

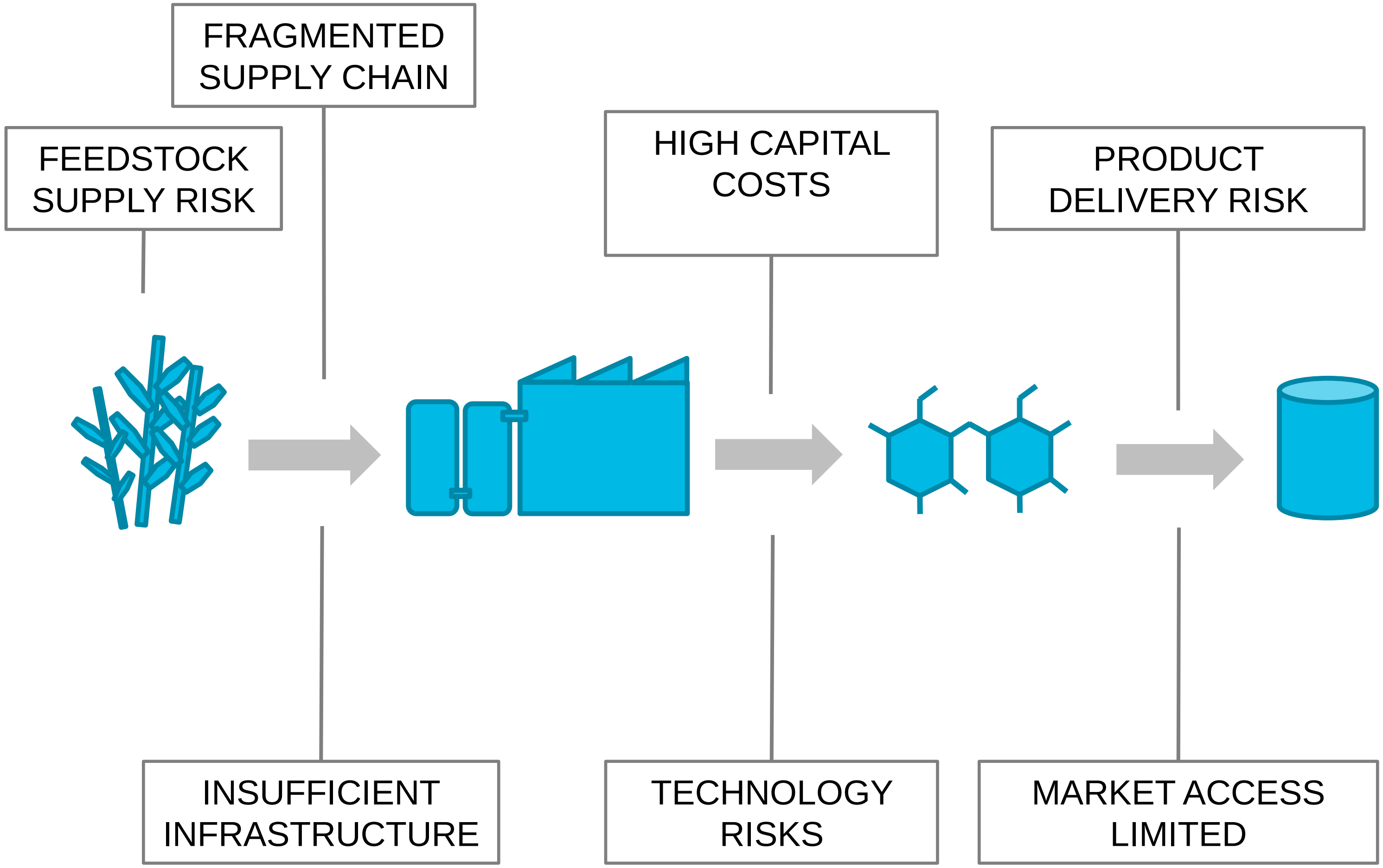
Notes: 'MYE' represents man years of employment. Population in 2011.

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

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

	Collection	Transport	Biorefinery	Distribution
Socio-economic	"Food-versus-fuel" and sustainability controversies muddy next-generation ethanol's image: it will be important to differentiate this image from that of first-generation biofuels			
Infrastructure	No financial incentives for famers to collect agricultural residues		Uncertain market outside the US for next-generation ethanol	
Capital	Absence of machinery investment	Insufficient infrastructure	Capital availability problems	
Regulatory	Farmer and developer interests not aligned			Limits on blending
Market access	Currently no next-generation ethanol value chain			

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	○ ● ○ (yellow)	● ○ ○ (red)	● ○ ○ (red)	○ ● ○ (yellow)
Infrastructure	○ ○ ● (green)	● ○ ○ (red)	○ ● ○ (yellow)	○ ○ ● (green)
Capital	○ ● ○ (yellow)	○ ● ○ (yellow)	● ○ ○ (red)	○ ○ ● (green)
Regulation	○ ● ○ (yellow)	○ ● ○ (yellow)	○ ● ○ (yellow)	○ ○ ● (green)
Market access	○ ● ○ (yellow)	○ ● ○ (yellow)	○ ● ○ (yellow)	● ○ ○ (red)

Source: Bloomberg New Energy Finance

MOVING TOWARDS A NEXT-GENERATION ETHANOL ECONOMY

POLICY OPTIONS FOR PROMOTING A NEXT-GENERATION ETHANOL INDUSTRY

Feedstock	Conversion	Blending & distribution
Agricultural residue collection incentives	Capacity investment incentives	Next-generation ethanol blending and non-compliance penalties
Facilitating access to public and private capital in infrastructure		Ethanol price control and consumption incentives
R&D feedstock grants	Biorefinery construction grants and loan guaranties	Remove infrastructure bottlenecks – like the blend wall – and improve market access

REGIONAL REGULATORY POSITION, 2011

	ARGENTINA	AUSTRALIA	BRAZIL	CHINA
Next-generation ethanol blending	Red	Yellow	Red	Yellow
Non-compliance penalties	Red	Red	Green	Green
Ethanol price control	Green	Red	Green	Green
Investment incentives	Red	Red	Green	Green
Ethanol consumption incentives	Red	Red	Red	Red
Market access	Red	Red	Green	Green

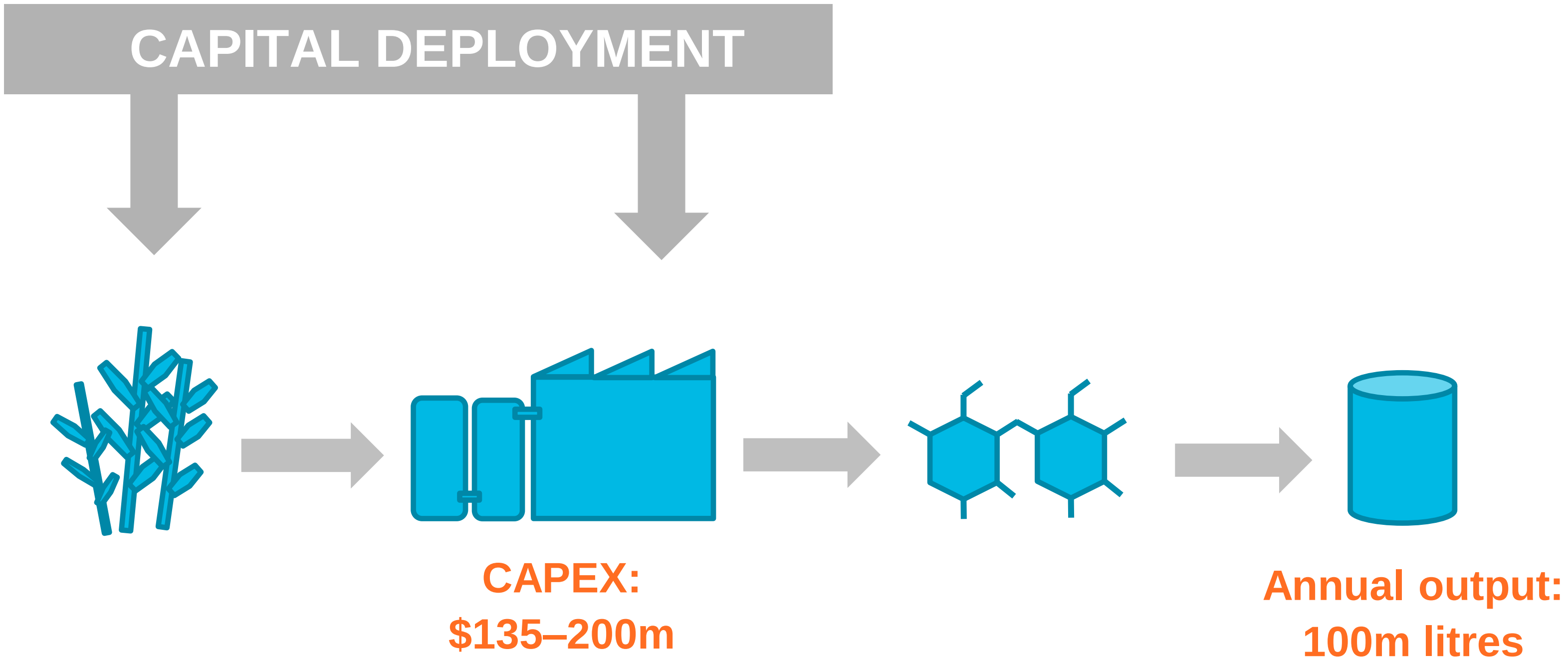
Note: RED circles indicate a lack or regulation; YELLOW circles indicate regulation is planned but not yet implemented; GREEN circles indicate regulation has been implemented.

REGIONAL REGULATORY POSITION, 2011

	EU-27	INDIA	MEXICO	US
Next-generation ethanol blending	○ ● (yellow) ○	● (red) ○ ○	● (red) ○ ○	○ ○ ● (green)
Non-compliance penalties	○ ○ ● (green)	○ ● (yellow) ○	● (red) ○ ○	○ ○ ● (green)
Ethanol price control	● (red) ○ ○	○ ○ ● (green)	○ ○ ● (green)	● (red) ○ ○
Investment incentives	○ ○ ● (green)	● (red) ○ ○	● (red) ○ ○	○ ○ ● (green)
Ethanol consumption incentives	○ ○ ● (green)	○ ○ ● (green)	● (red) ○ ○	○ ○ ● (green)
Market access	○ ○ ● (green)	● (red) ○ ○	● (red) ○ ○	○ ○ ● (green)

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

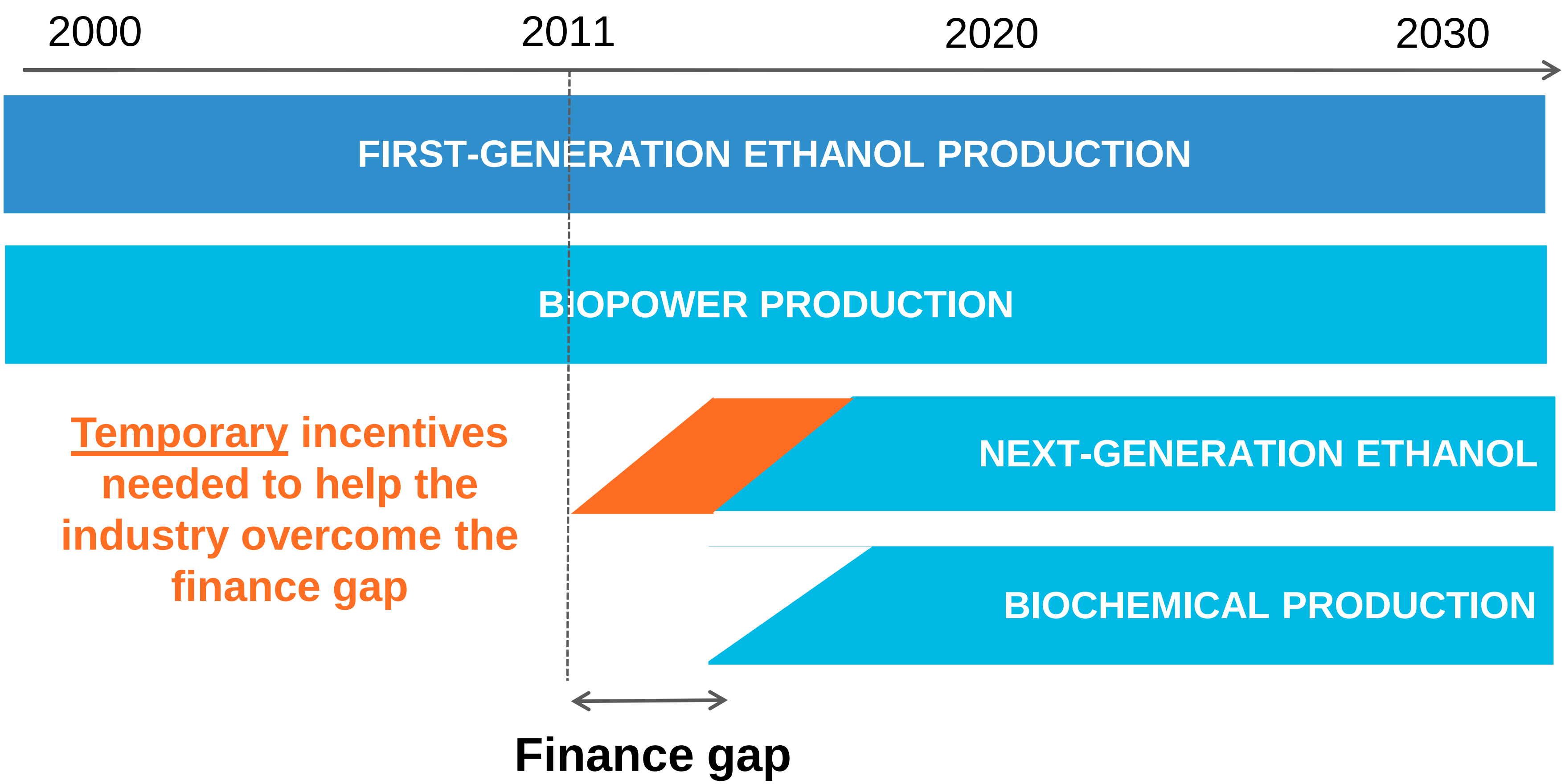
BUILDING THE NEXT-GENERATION ETHANOL VALUE CHAIN



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

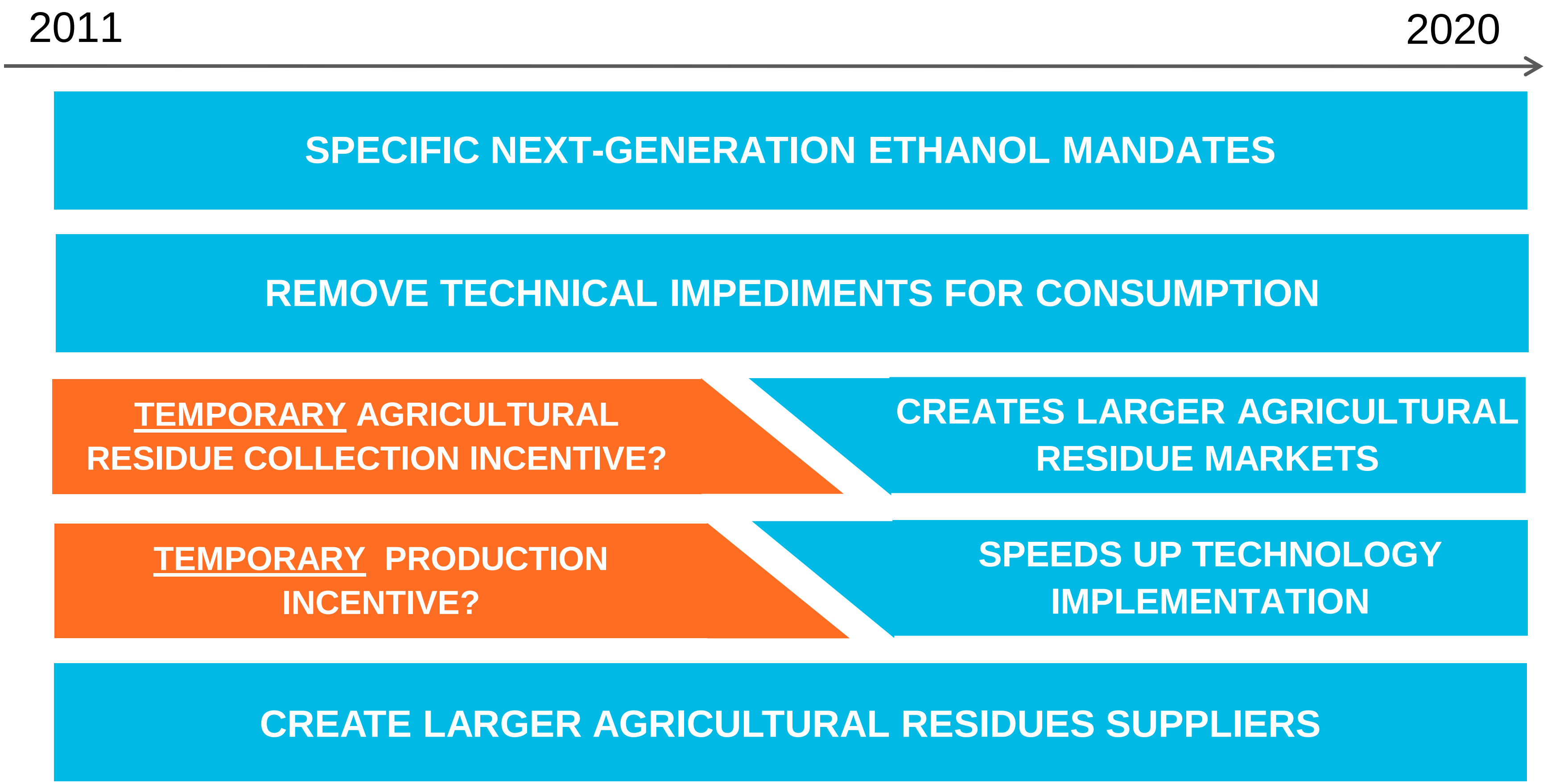
Source: Bloomberg New Energy Finance

CURRENT STATE OF BIOPRODUCT INDUSTRY DEVELOPMENT , 2000-2030



Source: Bloomberg New Energy Finance

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



Source: Bloomberg New Energy Finance

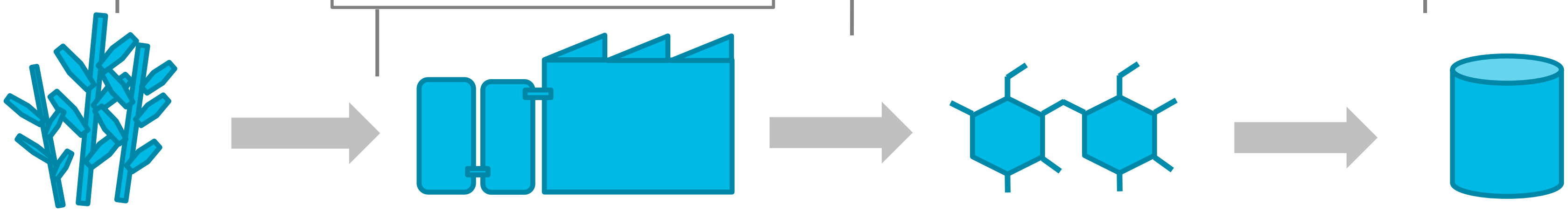
POLICY SUGGESTIONS FOR THE NEXT-GENERATION ETHANOL VALUE CHAIN

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 stream could reduce supply risks enough to be trustworthy in the eyes of capital providers.

HIGH CAPITAL COSTS:
Government support in the form of loan guaranties 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

APPENDIX

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

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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	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