

BIOPRODUCTS: DIVERSIFYING FARMERS' INCOME

**HOW A BIOPRODUCT INDUSTRY WILL AFFECT
THE EU27 AGRICULTURAL SECTOR**

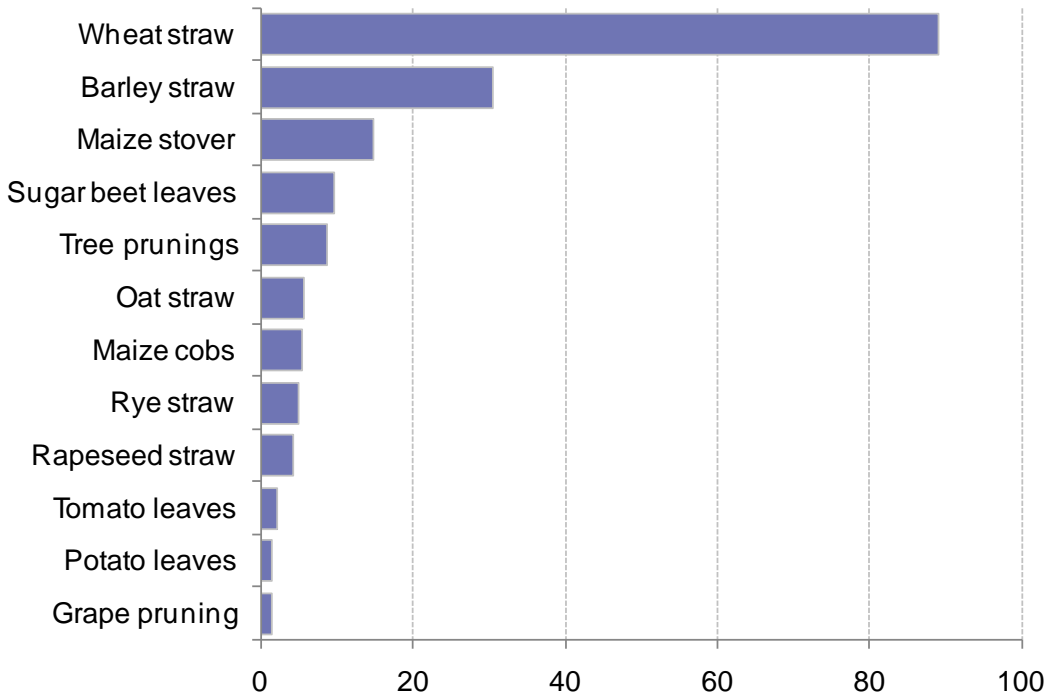
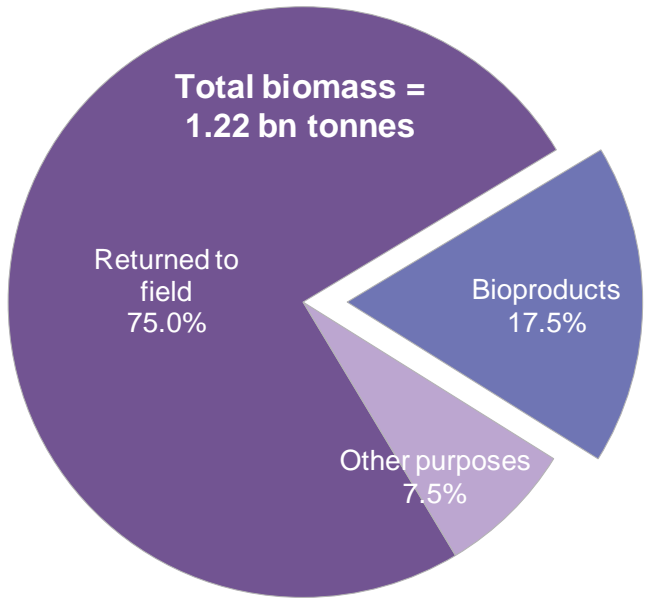
25 MARCH 2011



BIOPRODUCTS: DIVERSIFYING FARMERS' INCOME

1. What is the resource?
2. Agricultural residue collection costs
3. Potential farmers' margins (2015)
4. Investment demands
5. Industry barriers (2011)
6. Rural community benefits (2011-20)
7. Roadmap

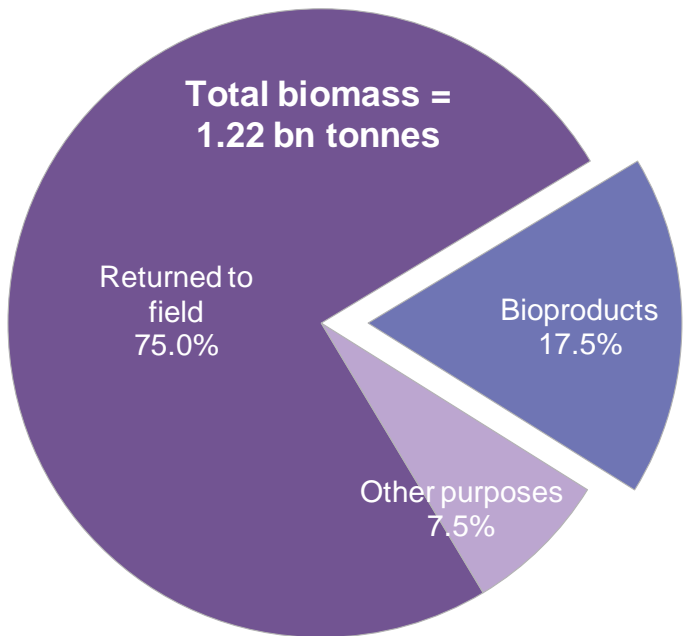
EU27 AGRICULTURAL RESIDUE AVAILABILITY, 2015 (MILLION TONNES)



Note: "Other purposes" are animal husbandry and power production.
 Source: Bloomberg New Energy Finance, FAO

Note: "Tree prunings" are residues from olive and apple trees.
 Source: Bloomberg New Energy Finance, FAO

EU27 AGRICULTURAL RESIDUE AVAILABILITY, 2015 (MILLION TONNES)



From the EU27 agricultural residue total, we assume a maximum of 17.5% will be available for bioenergy product conversion.



It is a conservative estimate, which purposefully aims to preserve soil quality.

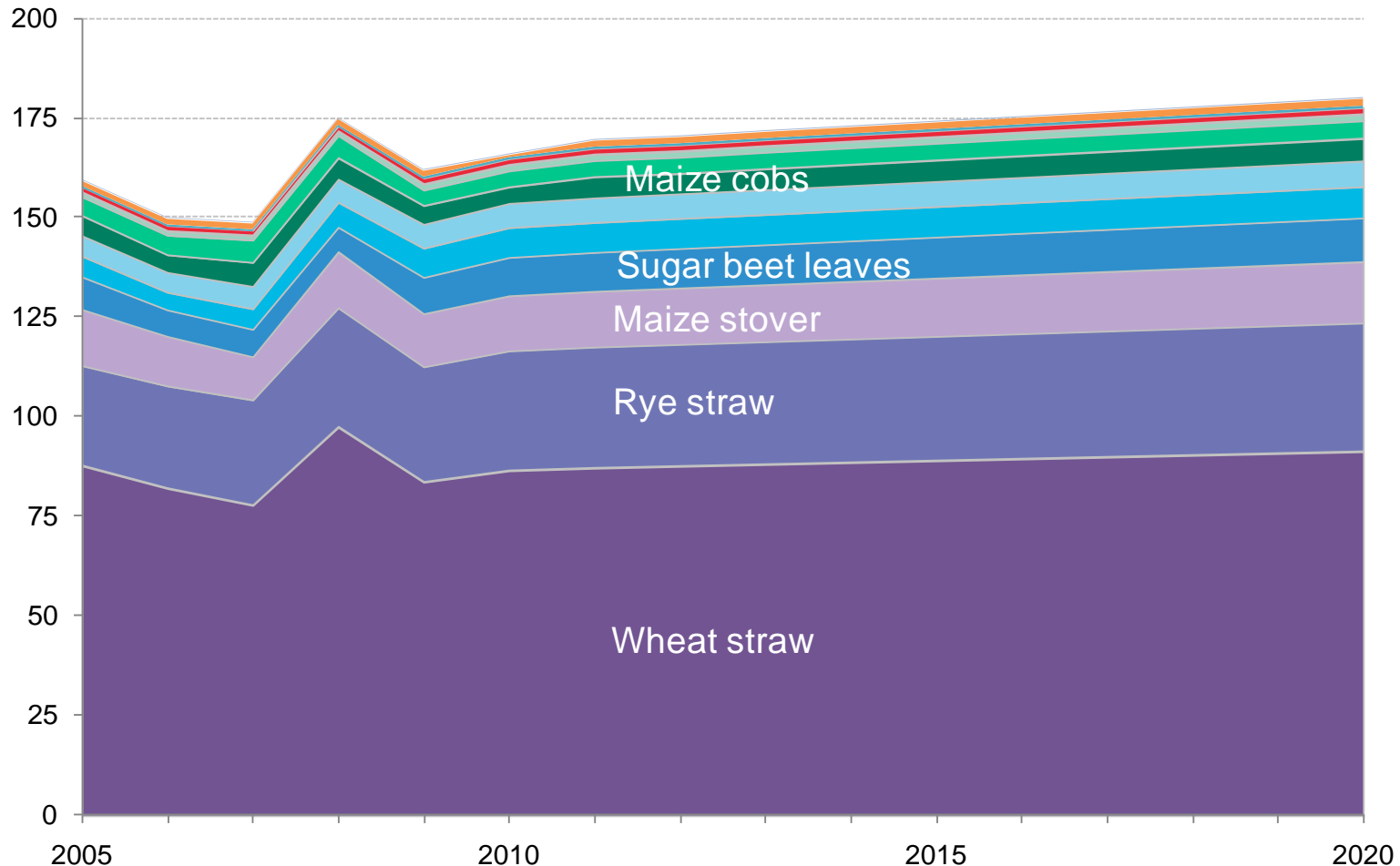


Collection, loading and transport costs, and the expected gate price, will determine how much is converted.

Note: "Other purposes" are animal husbandry and power production.
Source: Bloomberg New Energy Finance, FAO

AGRICULTURAL RESIDUE AVAILABILITY, 2005–20

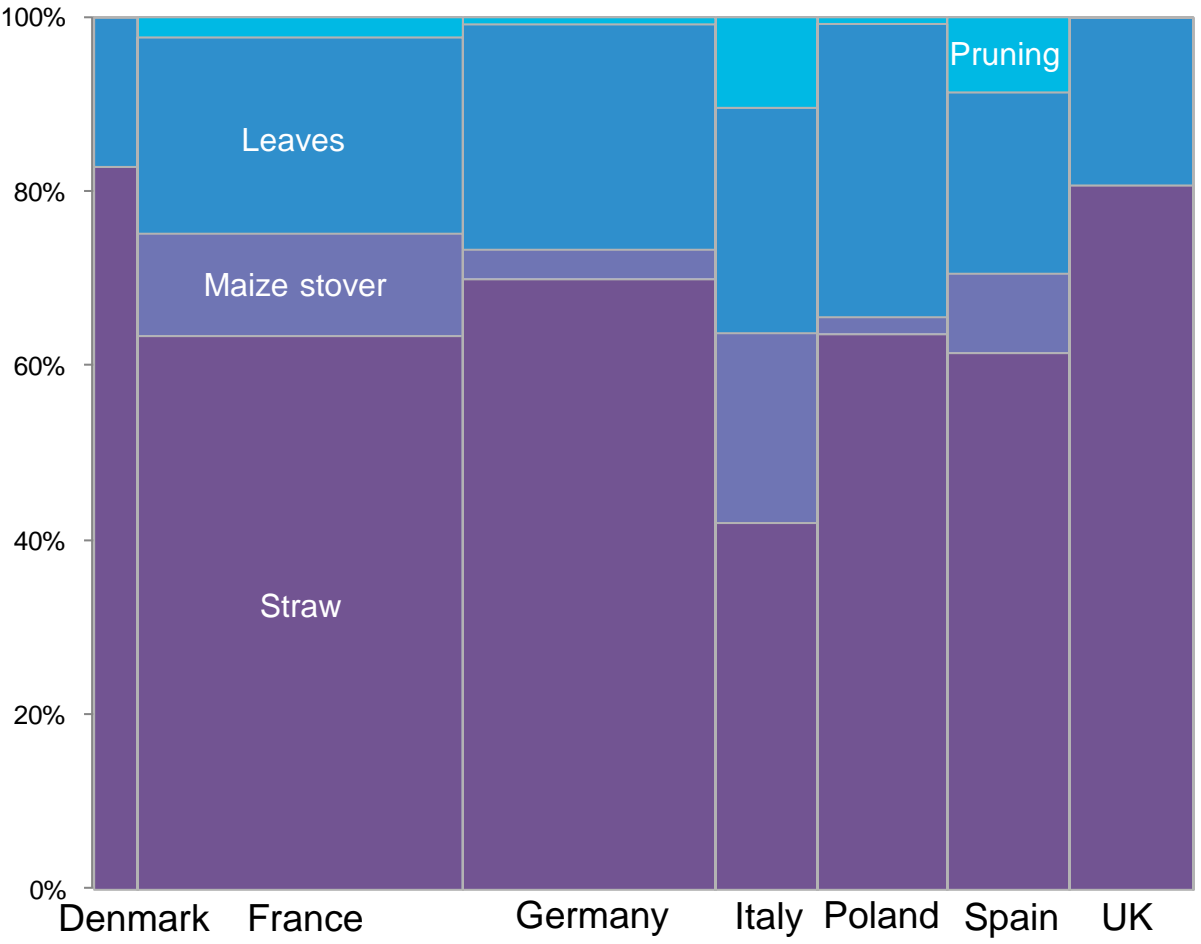
(MILLION DRY TONNES)



Note: Residue projections are based on food yield projections.

Source: Bloomberg New Energy Finance, FAO

SELECT COUNTRY BIOMASS RESIDUE AVAILABILITY BY TYPE, 2015 (% AND TONNES)



- Straw-type residues are the dominant biomass resource, particularly in Denmark and the UK.
- Germany and France have the biggest agricultural residue resources.
- Tree prunings may become of regional importance in southern EU countries.

Note: Column width indicates total biomass potential in each country; column height represents the proportion of different biomass types, namely: straw (barley, oats, rapeseed, rye, wheat); leaves (sugar beet, potato, tomato); pruning (apple, grapes, maize cobs, olives); and maize stover.

Source: Bloomberg New Energy Finance, FAO

SUSTAINABILITY: WHAT ARE OUR ASSUMPTIONS?

LAND USE CHANGE

In this study we assume **land use patterns will not change** before 2020; 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 or **moderate yield growth** rates, based on historic data between 1990 and 2010.

ENERGY CROPS

We **excluded energy crops** and project there will be no change in existing soil productivity. Growing energy crops on marginal land will however increase total biomass availability.

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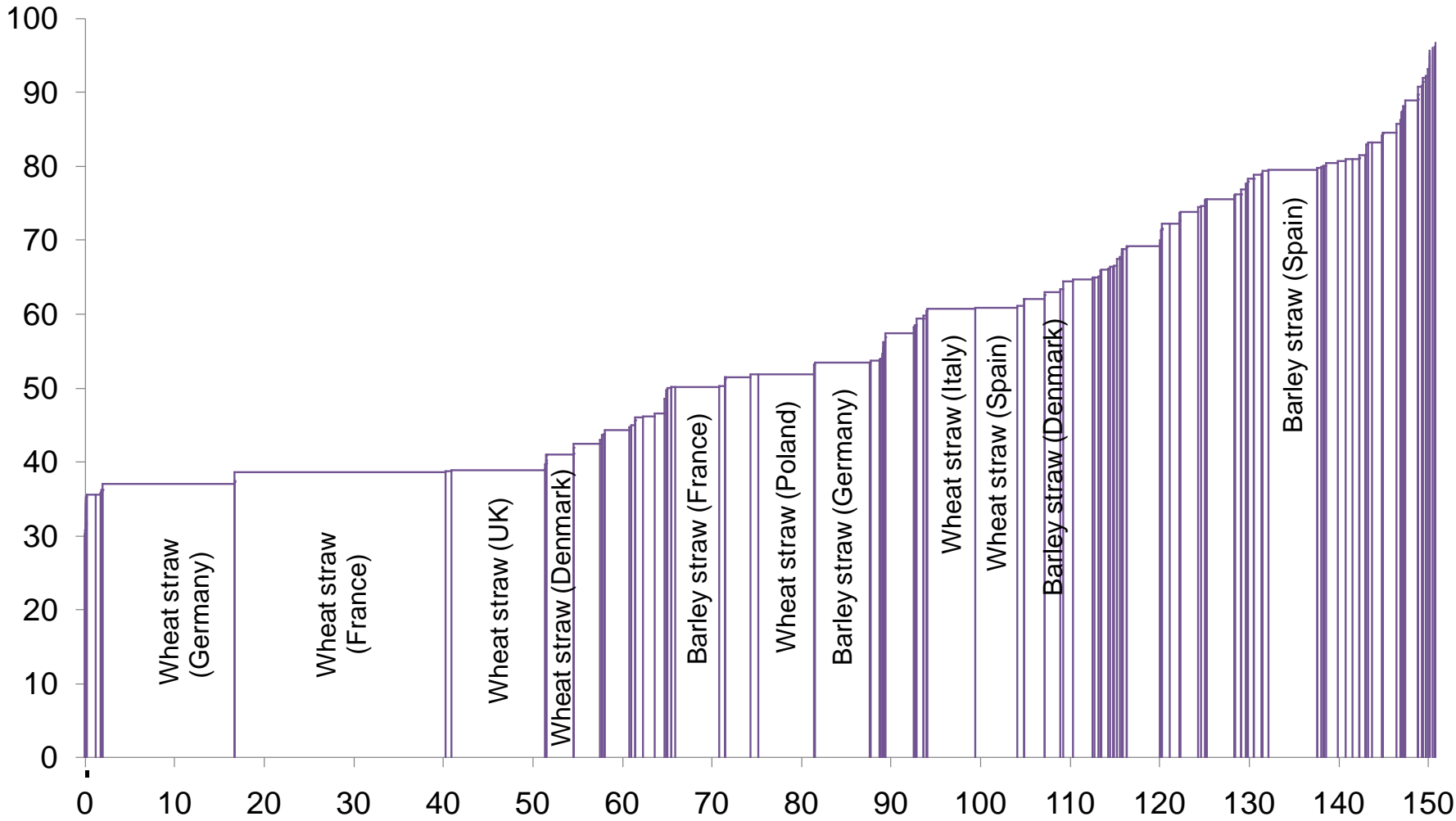
7. Roadmap

AGRICULTURAL RESIDUE SUPPLY COST METHODOLOGY

COLLECTION	LOADING	TRANSPORT
<ul style="list-style-type: none">• Optimal machine utilisation and operating times, calculated on a crop-by-crop basis.• National projections for yields, labour costs and fuel prices in 2015.	<ul style="list-style-type: none">• Optimal machine utilisation and operating times, calculated on a crop-by-crop basis.	<ul style="list-style-type: none">• 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

EU27 AGRICULTURAL RESIDUE SUPPLY COST CURVE, 2015 (EUR/TONNE; MILLION DRY TONNES)



Note: Supply costs represent the sum of all the collecting, transporting and loading agricultural residue costs; although, the EU27 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

AGRICULTURAL RESIDUE COLLECTION COST METHODOLOGY, 2015 (EUR/TONNE)

	Collection		Loading		Transport	
Machinery costs	Tractor (110kW)	1.02	Telescopic handler (75kW)	2.43	Flatbed truck	2.92
	Big baler	13.41				
Fuel costs	Fuel	3.32	Fuel	1.19	Fuel	3.59
Labour costs	Driver	0.52	Driver	1.07	Driver	3.98
Notes	Assumes a maximum baler capacity of 40 bales per hour under optimal conditions.		Assumes a maximum loading capacity of 20 bales per hour.		Assumes a total distance of 100km is travelled including an empty run back, 24 bales per truck and waiting time.	

Notes: Calculations are based on the collection, loading and delivery of French wheat straw in 2015. Costs have not been adjusted for dry matter content and they represent national minimum cost estimates. We assume wheat straw yield projections of 5.37 tonnes per hectare; labour cost projections of EUR 11.17 per hour; fuel cost projections of EUR 1.24 per litre. Fixed machinery costs are calculated using an interest rate of 3.75%; fixed capital rate of 60%; and residual value of 10%. Added are further variable repair costs and a 10% risk premium.

Source: Bloomberg New Energy Finance, Forschungsanstalt Agroscope Reckenholz-Tänikon

AGRICULTURAL RESIDUE COLLECTION COST METHODOLOGY, 2015 (EUR/TONNE)

	Collection		Loading		Transport	
Machinery costs	Tractor (110kW)	1.00	Telescopic handler (75kW)	2.43	Flatbed truck	2.92
	Big baler	13.06				
Fuel costs	Fuel	3.38	Fuel	1.24	Fuel	3.75
Labour costs	Driver	0.70	Driver	1.48	Driver	5.54
Notes	Assumes a maximum baler capacity of 40 bales per hour under optimal conditions.		Assumes a maximum loading capacity of 20 bales per hour.		Assumes a total distance of 100km is travelled including an empty run back, 24 bales per truck and waiting time.	

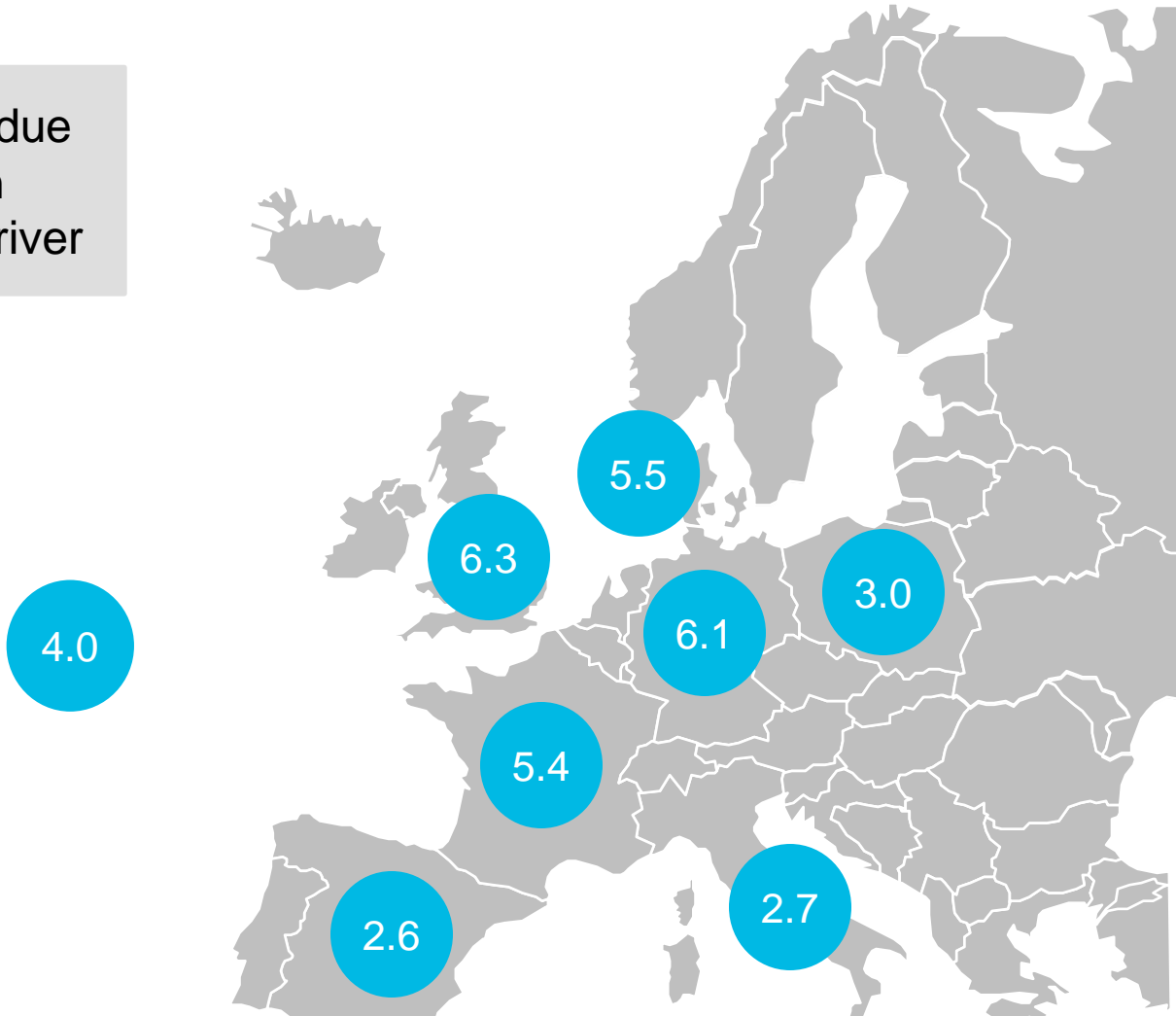
Notes: Calculations are based on the collection, loading and delivery of Danish wheat straw in 2015. Costs have not been adjusted for dry matter content and they represent national minimum cost estimates. We assume wheat straw yield projections of 5.52 tonnes per hectare; labour cost projections of EUR 15.52 per hour; fuel cost projections of EUR 1.30 per litre. Fixed machinery costs are calculated using an interest rate of 3.75%; fixed capital rate of 60%; and residual value of 10%. Added are further variable repair costs and a 10% risk premium.

Source: Bloomberg New Energy Finance, Forschungsanstalt Agroscope Reckenholz-Tänikon

SELECT COUNTRY AVERAGE WHEAT STRAW YIELDS, 2011–20 (TONNES/HECTARE)

Agricultural residue yields are an important cost driver

European wheat straw average yields



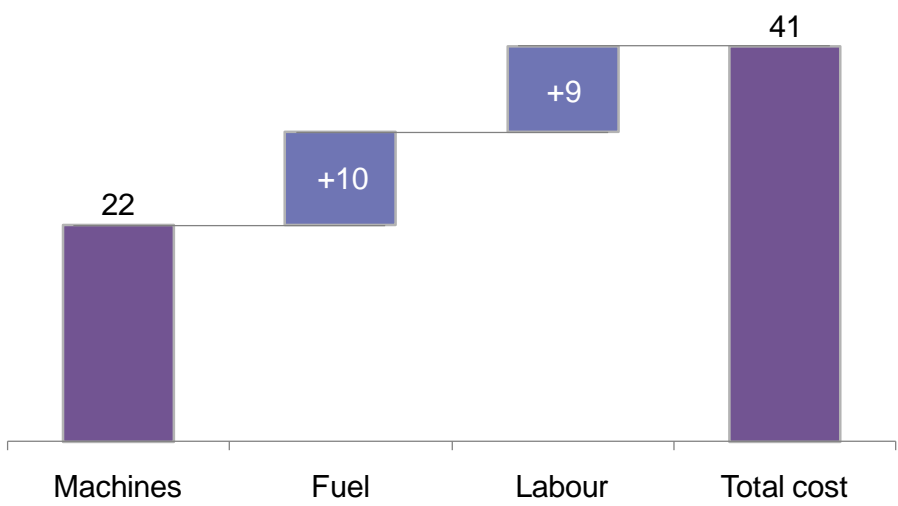
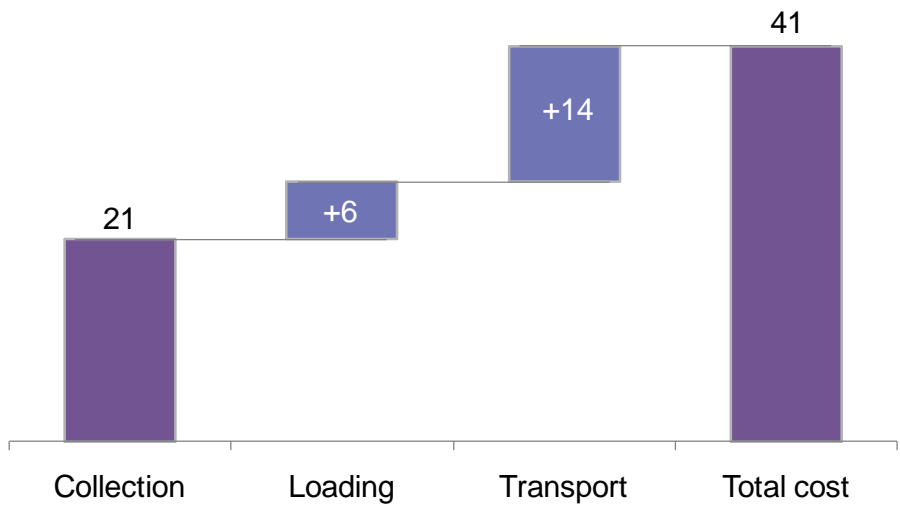
Note: Agricultural residue yields are based on food yield projections.

Source: Bloomberg New Energy Finance, FAO

DANISH WHEAT STRAW SUPPLY COSTS BY PROCESS AND FACTOR INPUT, 2015 (EUR/DRY TONNE)

PROCESS

FACTOR INPUT



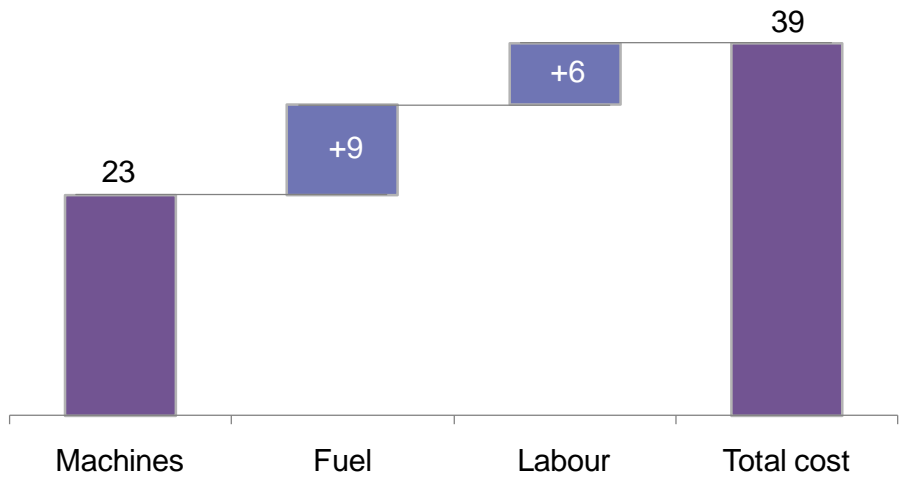
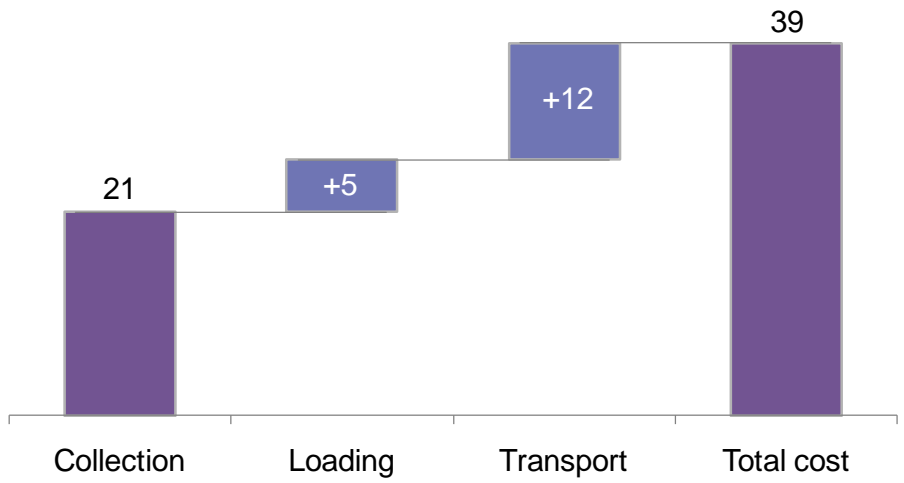
Note: Costs have been levelised to a common EUR per dry tonne metric to allow cost comparisons between different agricultural residue types.

Source: Bloomberg New Energy Finance

FRENCH WHEAT STRAW SUPPLY COSTS BY PROCESS AND FACTOR INPUT, 2015 (EUR/DRY TONNE)

PROCESS

FACTOR INPUT

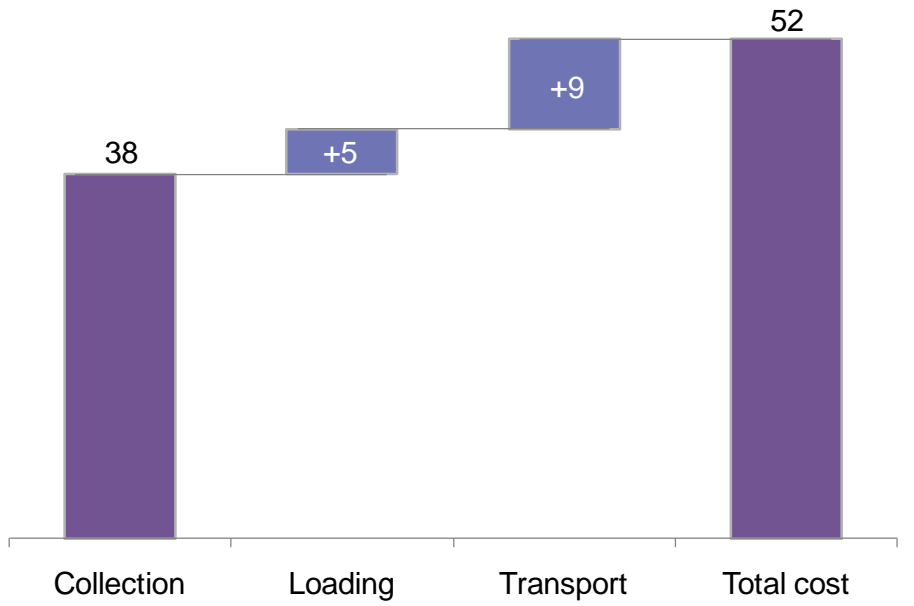


Note: Costs have been levelised to a common EUR per dry tonne metric to allow cost comparisons between different agricultural residue types.

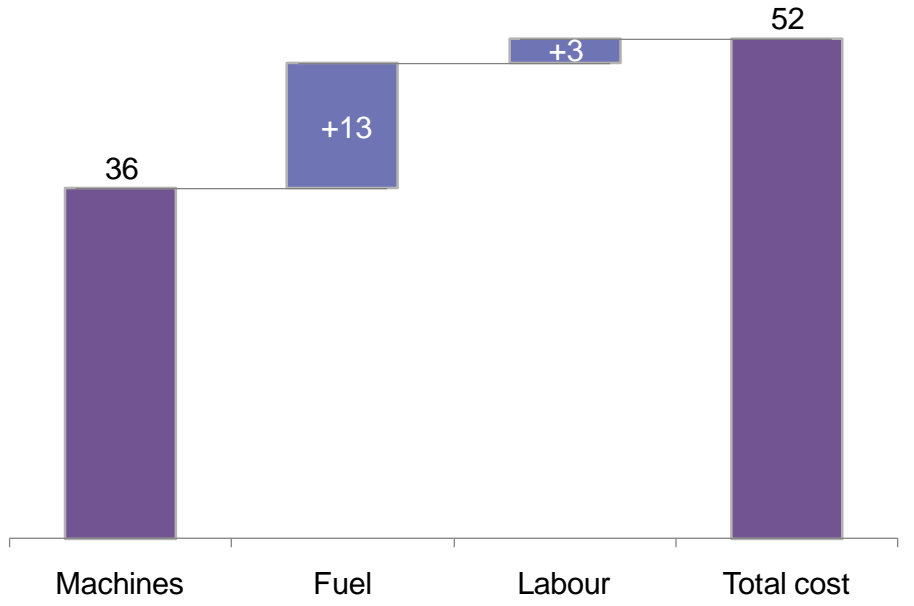
Source: Bloomberg New Energy Finance

POLISH WHEAT STRAW SUPPLY COSTS BY PROCESS AND FACTOR INPUT, 2015 (EUR/DRY TONNE)

PROCESS



FACTOR INPUT



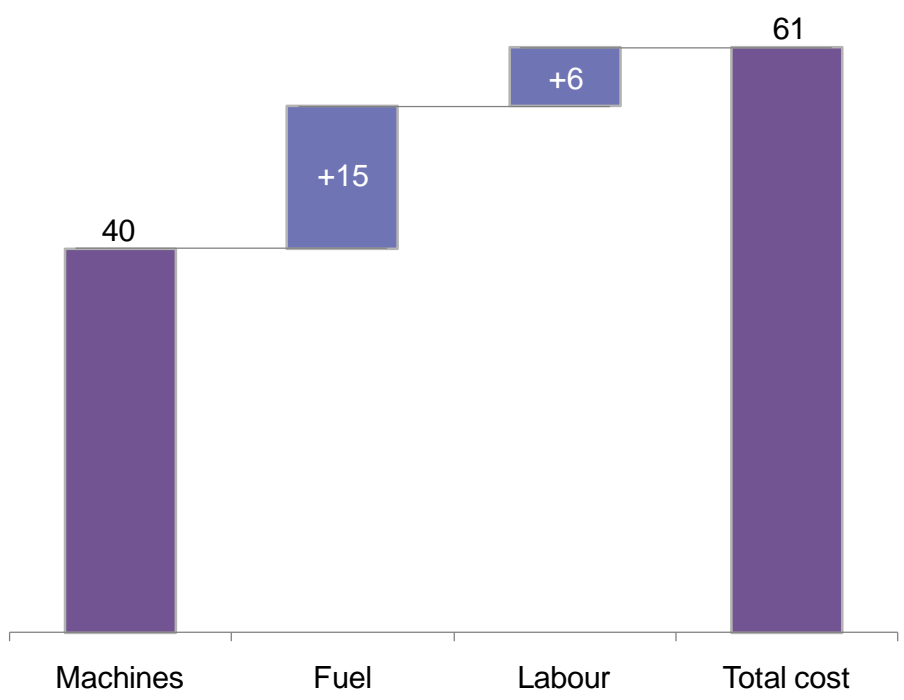
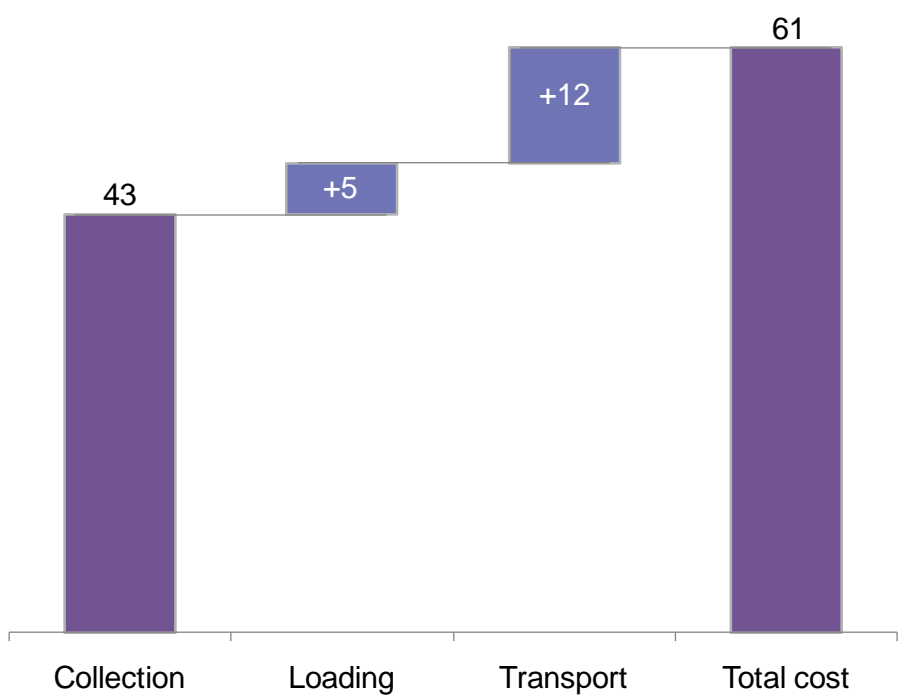
Note: Costs have been levelised to a common EUR per dry tonne metric to allow cost comparisons between different agricultural residue types.

Source: Bloomberg New Energy Finance

ITALIAN WHEAT STRAW SUPPLY COSTS BY PROCESS AND FACTOR INPUT, 2015 (EUR/DRY TONNE)

PROCESS

FACTOR INPUT



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

Source: Bloomberg New Energy Finance

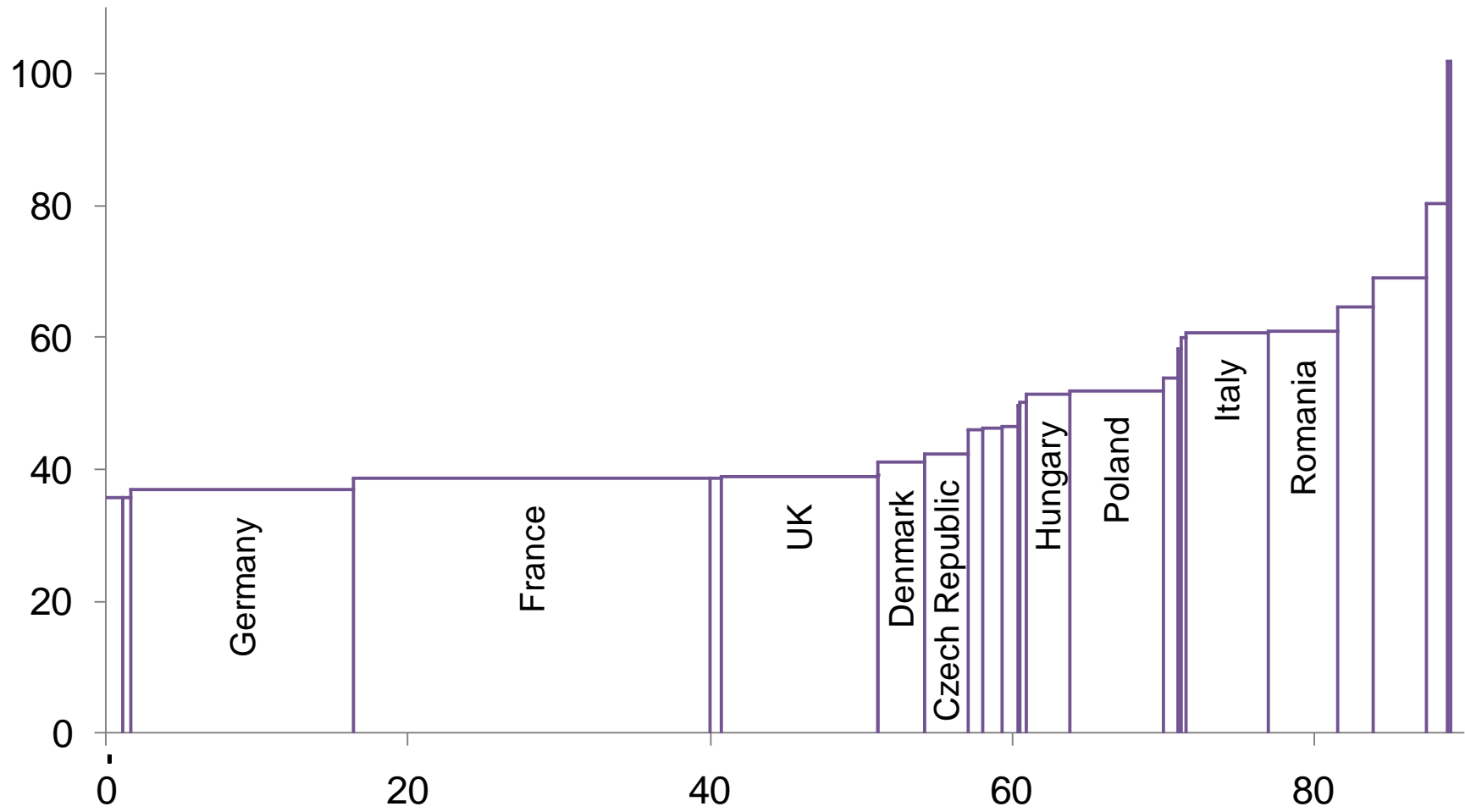
WHEAT STRAW SUPPLY COSTS FOR SELECT COUNTRIES, 2015 (EUR/HECTARE)

COUNTRY	YIELD	COLLECTION	LOADING	TRANSPORT	TOTAL COSTS
Denmark	5.52	116	33	78	227
France	5.37	114	29	65	208
Germany	6.12	116	34	77	226
Italy	2.66	115	14	32	162
Poland	2.97	112	14	28	154
Spain	2.55	113	13	29	155
United Kingdom	6.25	119	37	87	243

Note: Agricultural residue yield projections are based on food yield projections.

Source: Bloomberg New Energy Finance, FAO

EU27 WHEAT STRAW SUPPLY CURVE, 2015 (EUR/DRY TONNE; MILLION DRY TONNES)



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BIOREFINERY GATE PRICES DRIVE FARMERS' MARGINS

FARMERS' MARGINS 2015

Gate price

- Collection cost
- Loading cost
- Transport cost
- = **Farmers' margin**



Gate prices will be heavily influenced by biofuel production costs and the crude oil price.



High gate prices help more farmers achieve positive margins; therefore, more agricultural residue becomes economical to collect.

AGRICULTURAL RESIDUE DELIVERED GATE PRICES



Industry consensus suggests agricultural residue delivered gate prices will be between **EUR 50 and EUR 100 per dry tonne**.

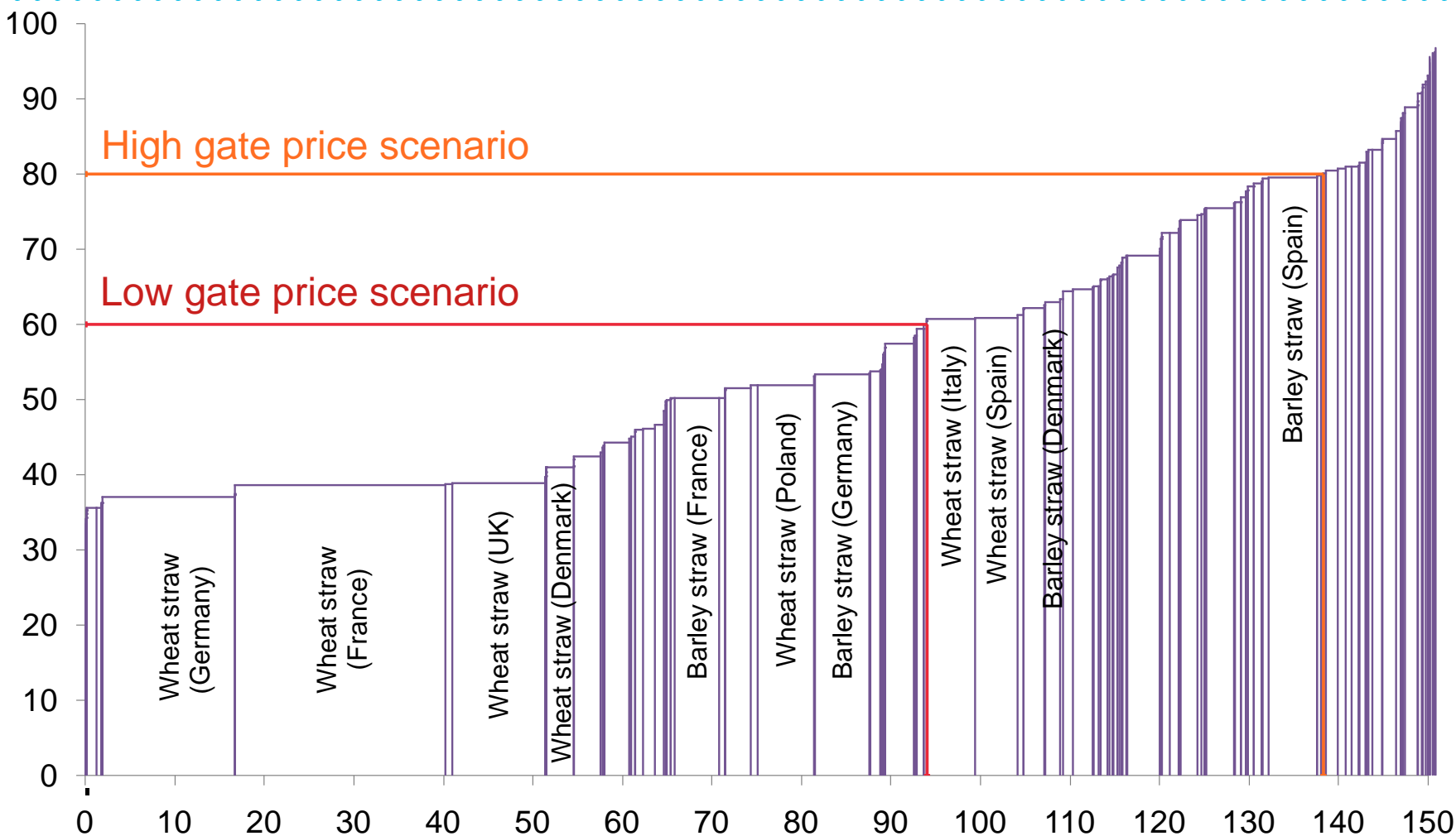


We selected two illustrative delivered gate price scenarios to demonstrate the potential supply of agricultural residues under differing price conditions.



SCENARIO	GATE PRICE	POTENTIAL
Low gate price	EUR 60/tonne	94m dry tonnes
High gate price	EUR 80/tonne	138m dry tonnes

EU27 RESIDUE SUPPLY COST CURVE UNDER TWO PRICE SCENARIOS, 2015 (EUR/TONNE; MILLION DRY TONNES)



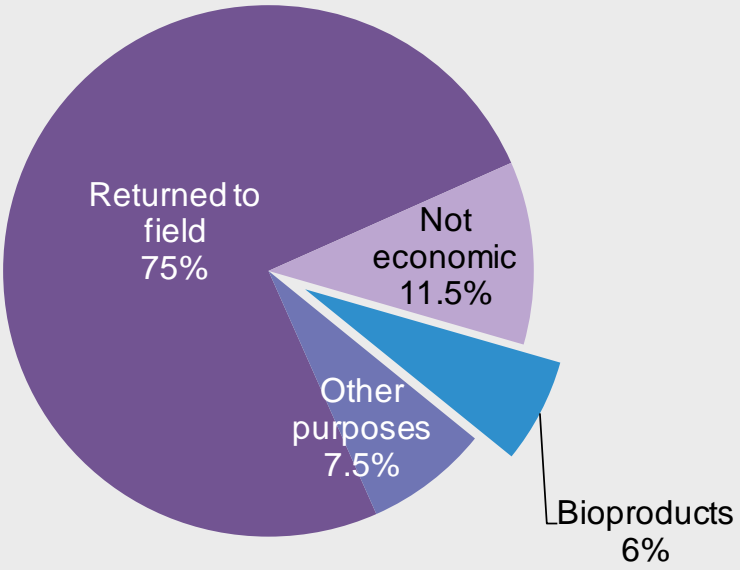
Note: Supply costs represent the sum of all the collecting, transporting and loading agricultural residue costs; although, the EU27 2020 agricultural residues potential amounts to approximately 175m dry tonnes we had to limit our x-axis supply cost curve to 150m dry tonnes.

Source: Bloomberg New Energy Finance

AGRICULTURAL RESIDUE AVAILABILITY FOR BIOENERGY PRODUCTS, 2015

LOW GATE PRICE SCENARIO

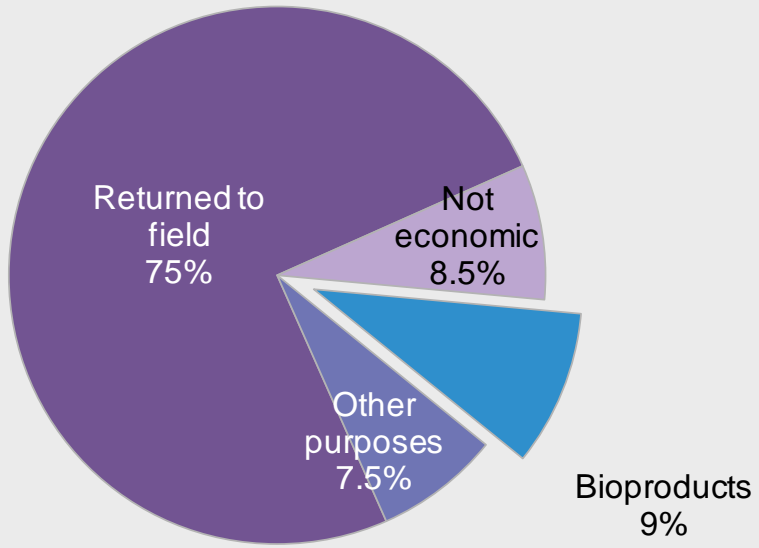
- A gate price of EUR 60 per dry tonne means **94m dry tonnes** (6% of all residue) will be economic to collect.



Note: "Other purposes" includes animal husbandry (5%) and power production (2.5%). Bioenergy includes all bioenergy products (e.g. next-generation ethanol).

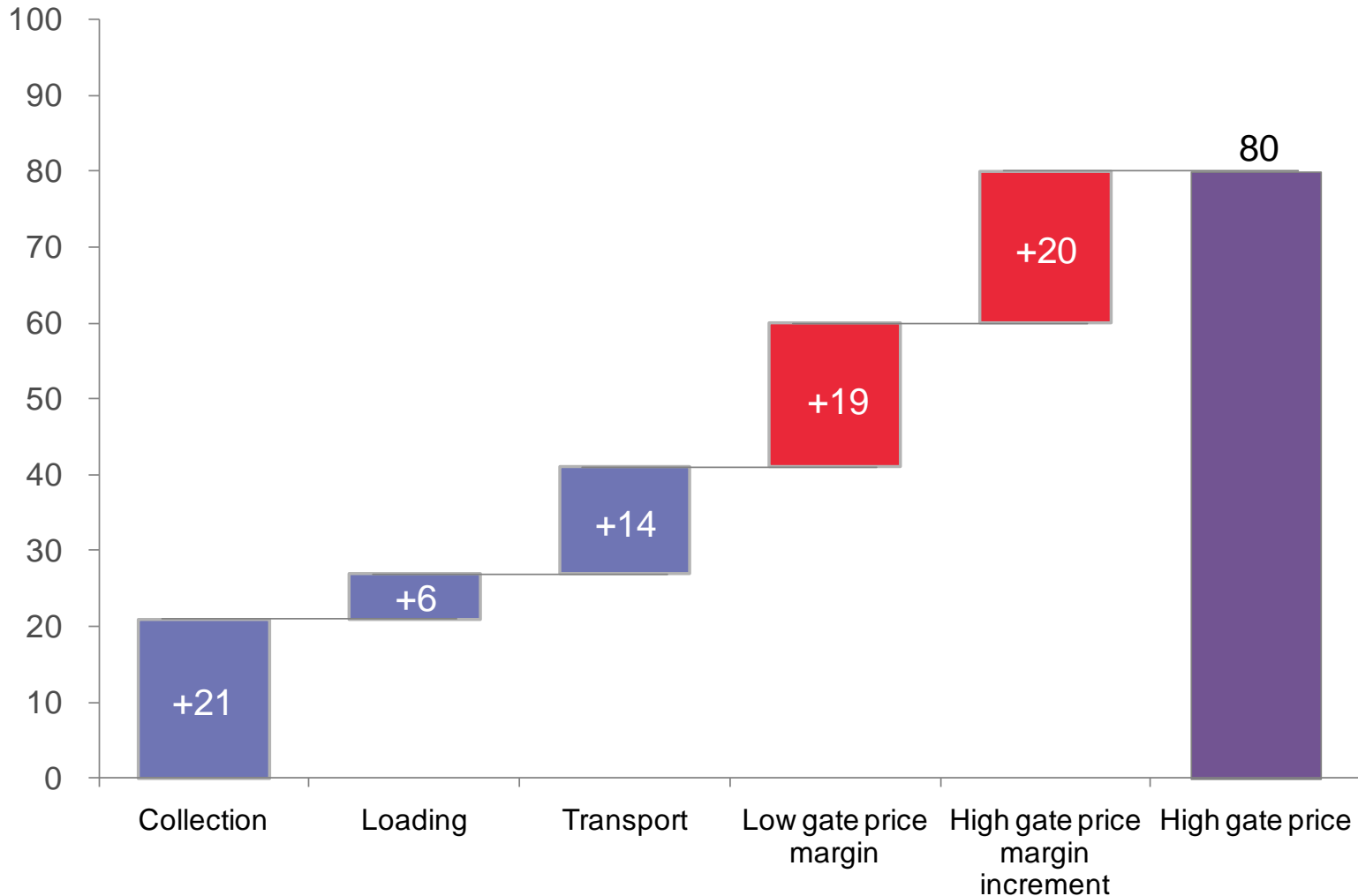
HIGH GATE PRICE SCENARIO

- A gate price of EUR 80 per dry tonne means **138m dry tonnes** (9% of all residue) will be economic to collect.



Source: Bloomberg New Energy Finance

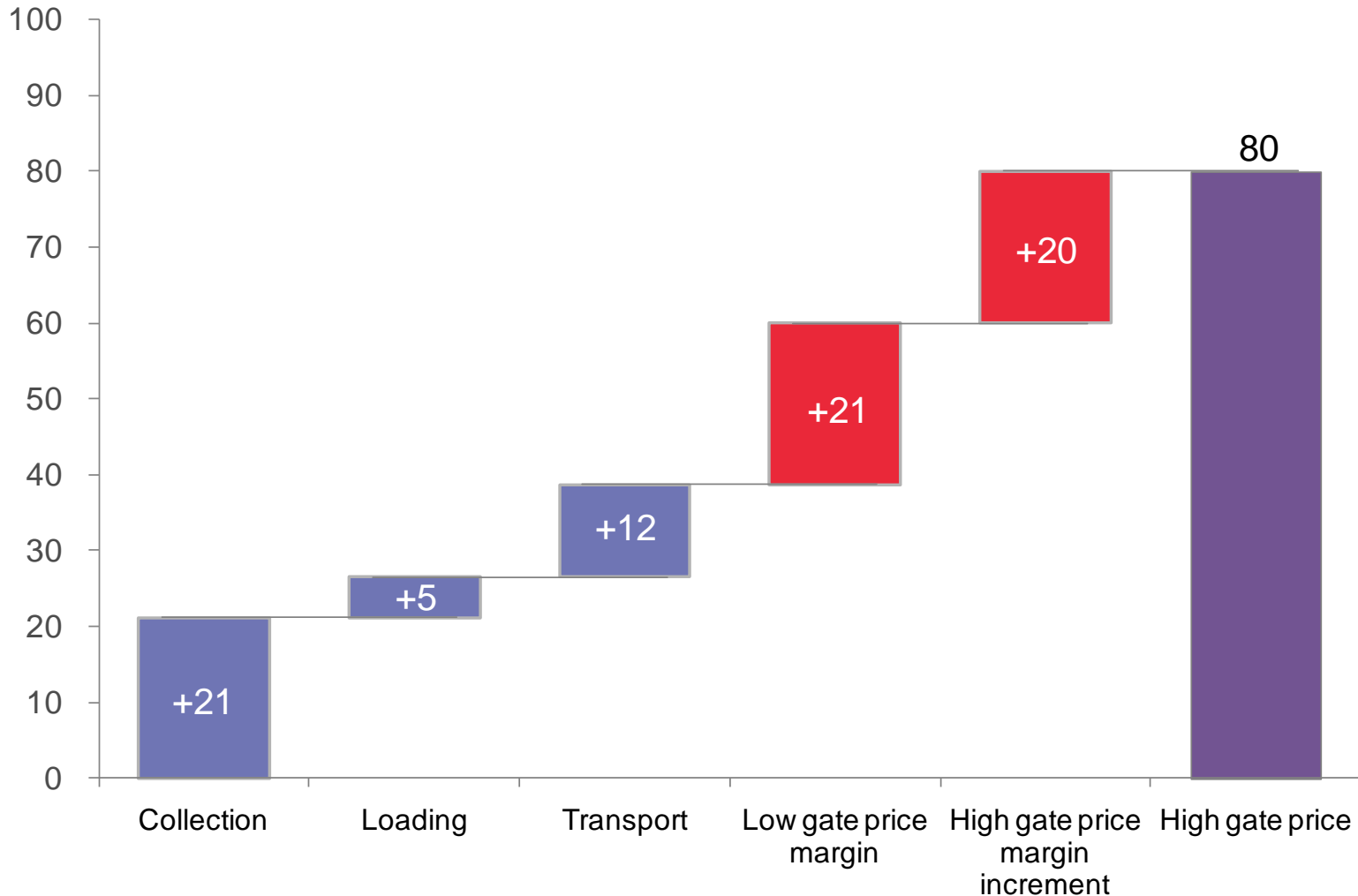
DANISH WHEAT STRAW FARMERS' MARGINS, 2015 (EUR/DRY TONNE)



Note: High price scenario margin represents the increment on the low price scenario.

Source: Bloomberg New Energy Finance

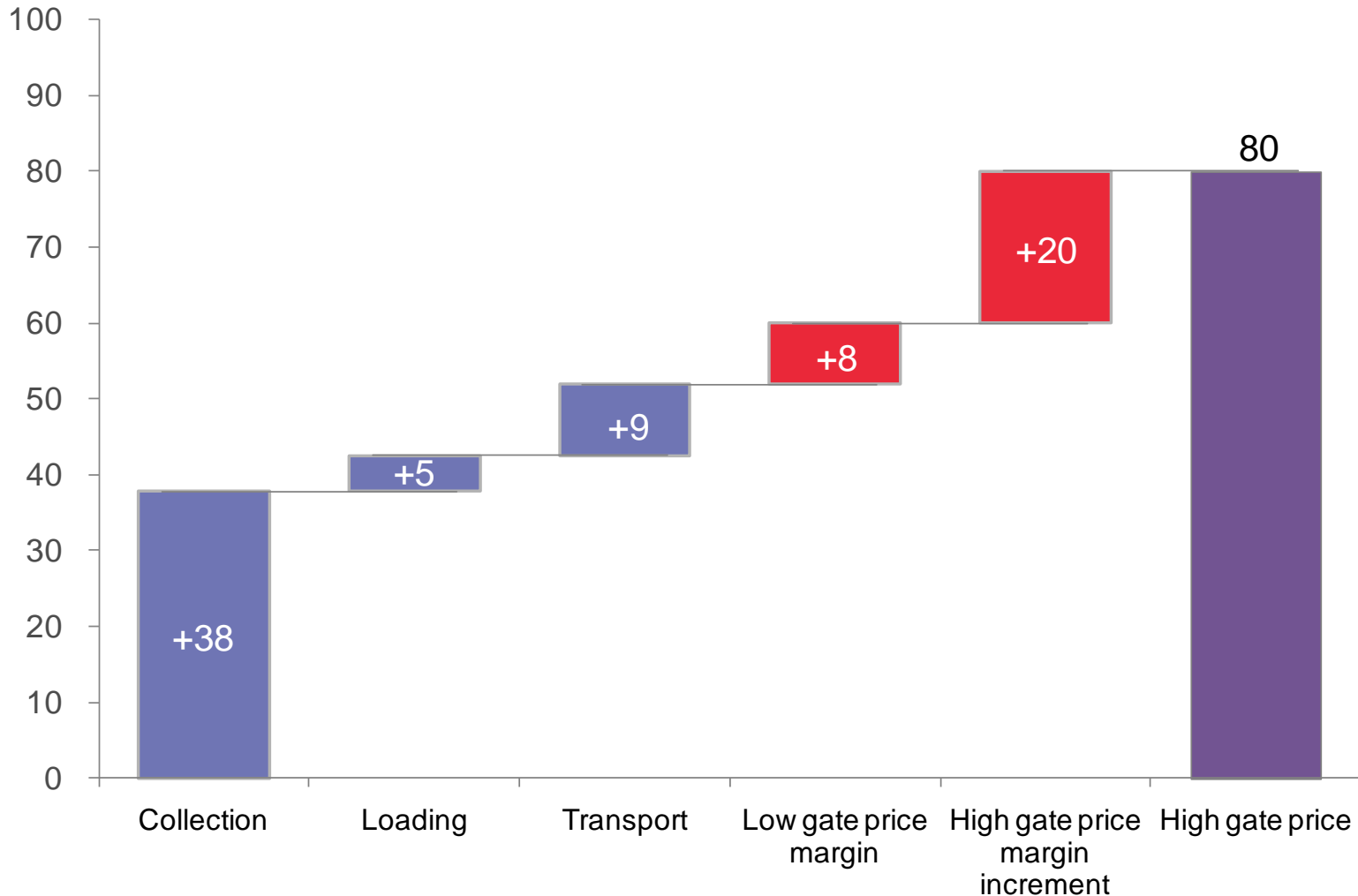
FRENCH WHEAT STRAW FARMERS' MARGINS, 2015 (EUR/DRY TONNE)



Note: High price scenario margin represents the increment on the low price scenario.

Source: Bloomberg New Energy Finance

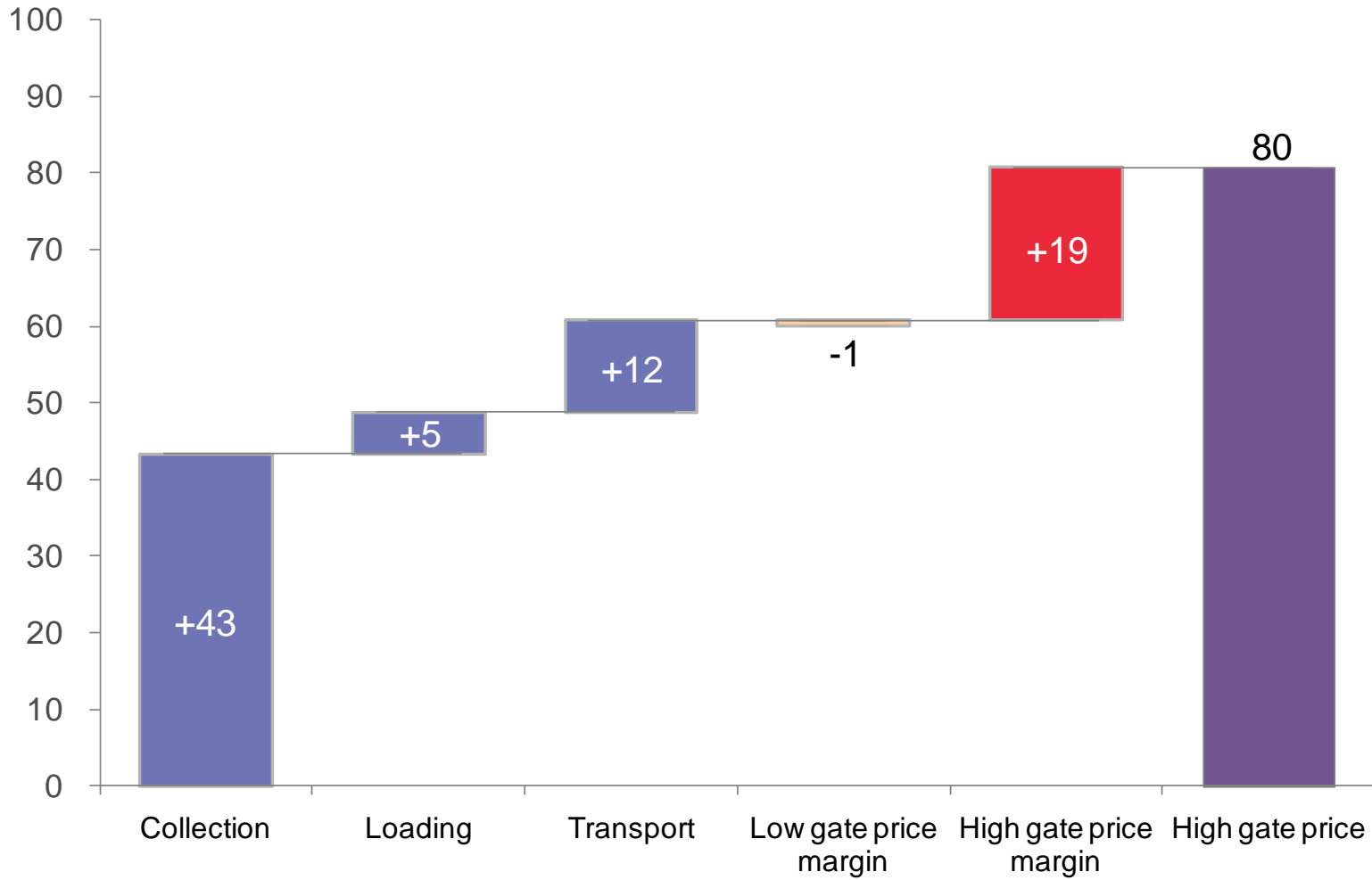
POLISH WHEAT STRAW FARMERS' MARGINS, 2015 (EUR/DRY TONNE)



Note: High price scenario margin represents the increment on the low price scenario.

Source: Bloomberg New Energy Finance

ITALIAN WHEAT STRAW FARMERS' MARGINS, 2015 (EUR/DRY TONNE)



Source: Bloomberg New Energy Finance

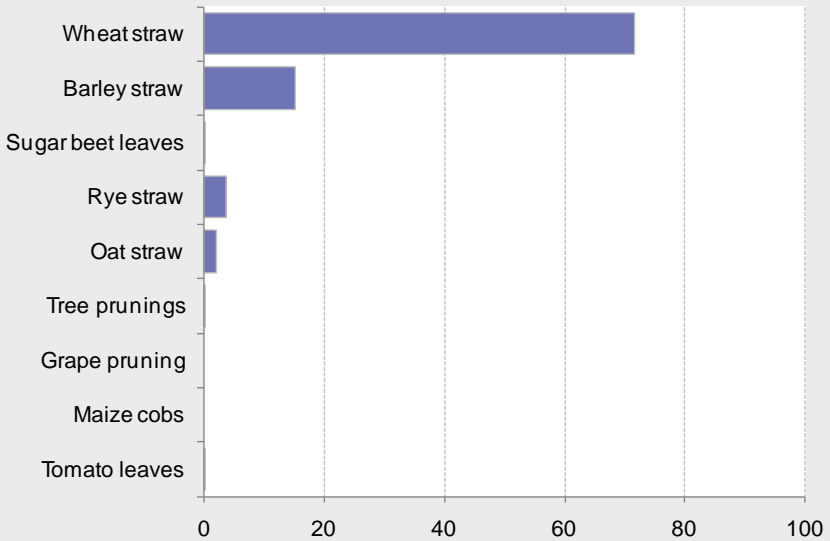
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AGRICULTURAL RESIDUE AVAILABILITY FOR BIOENERGY PRODUCTS, 2015 (MILLION DRY TONNES)

LOW GATE PRICE SCENARIO

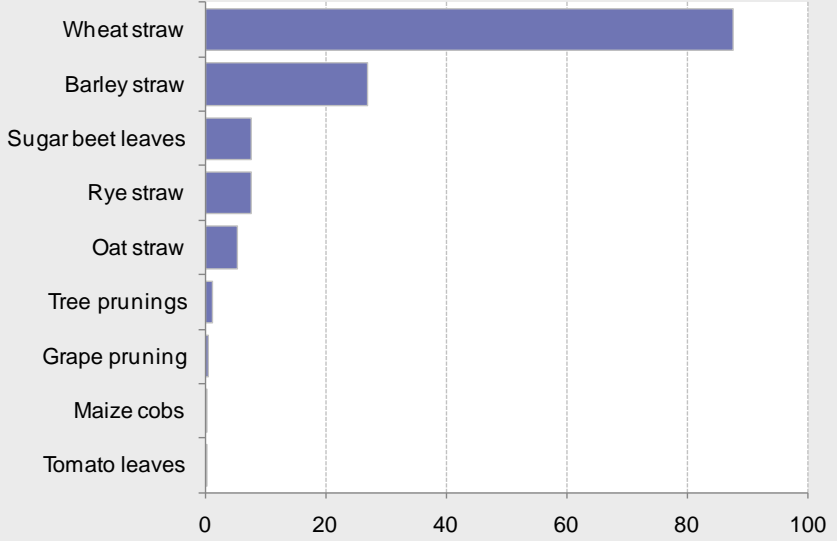
- 99% of the EU27 potential agricultural residue will be straw; tomato leaves are the only other contributor.



Note: "Tree prunings" includes residues from apple and olive tree harvests; potato haulm has not been included.

HIGH GATE PRICE SCENARIO

- 93% of the EU27 potential agricultural residue will be straw; sugar beet leaves are the biggest other contributor with 6%.



Source: Bloomberg New Energy Finance, FAO

EU27 ANNUALISED INVESTMENT IN AGRICULTURAL RESIDUE HARVESTING EQUIPMENT, 2015

LOW GATE PRICE SCENARIO

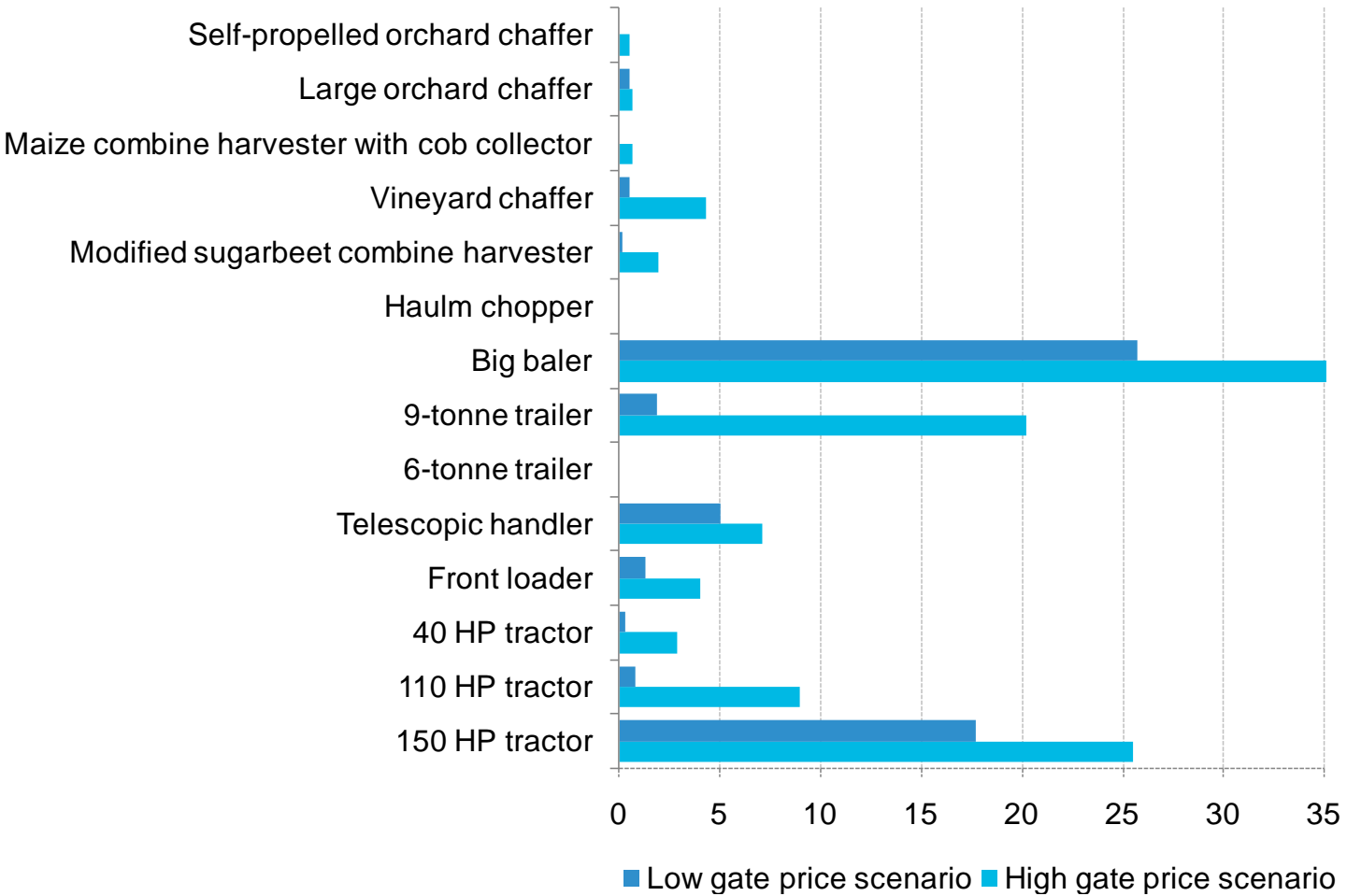
- The study calculates how much additional machinery will be required to harvest and load all the agricultural residues required.
- An additional **annual investment of EUR 430m** would be required in 2015 to harvest 94m dry tonnes of agricultural residues.

HIGH GATE PRICE SCENARIO

- An additional **annual investment of EUR 760m** would be required in 2015 to harvest 138m dry tonnes of agricultural residues.
- Sugar beet leaves and tree prunings become economical to collect in some EU27 countries under the high gate price scenario. New and additional investment will be needed to start collecting these agricultural residues.
- Maize cobs, although only contributing 334,000 tonnes (0.24%) to the agricultural residue availability total, could become of localised importance.

Source: Bloomberg New Energy Finance

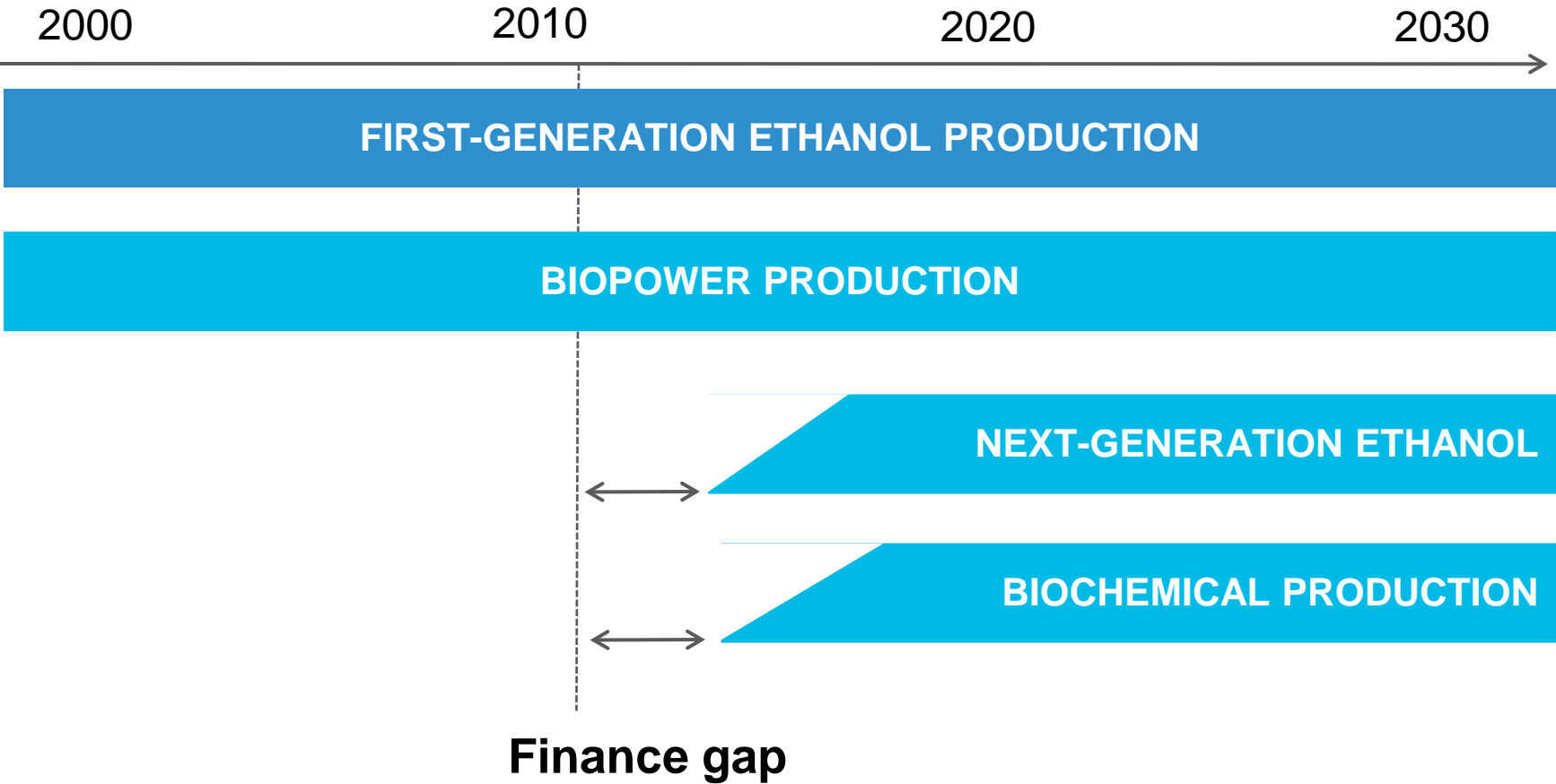
AMOUNT AND TYPE OF ADDITIONAL MACHINERY REQUIRED BY 2015 (1000 VEHICLES)



Note: "HP" refers to horsepower. The largest increases in the number of additional vehicles required, under both scenarios, will be for straw harvesting and loading.

Source: Bloomberg New Energy Finance
Forschungsanstalt Agroscope Reckenholz-Tänikon

BIOPRODUCT INDUSTRY DEVELOPMENT, 2000-2030



Source: Bloomberg New Energy Finance

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BIOPRODUCT INDUSTRY CHALLENGES FOR AGRICULTURAL SECTOR, 2011

HARVESTING SUBSIDIES

There is no financial incentive for farmers to harvest and collect agricultural residues.

There are limited funds (eg, grants) available to invest in machinery for harvesting, loading and transporting agricultural residues to the biorefinery gate.

POLICY

There are no clear EU27 guidelines on how much agricultural residues can safely be removed from the field.

The current EU27 next-generation biofuels blending mandate is not large enough to drive investment into the bioproduct industry.

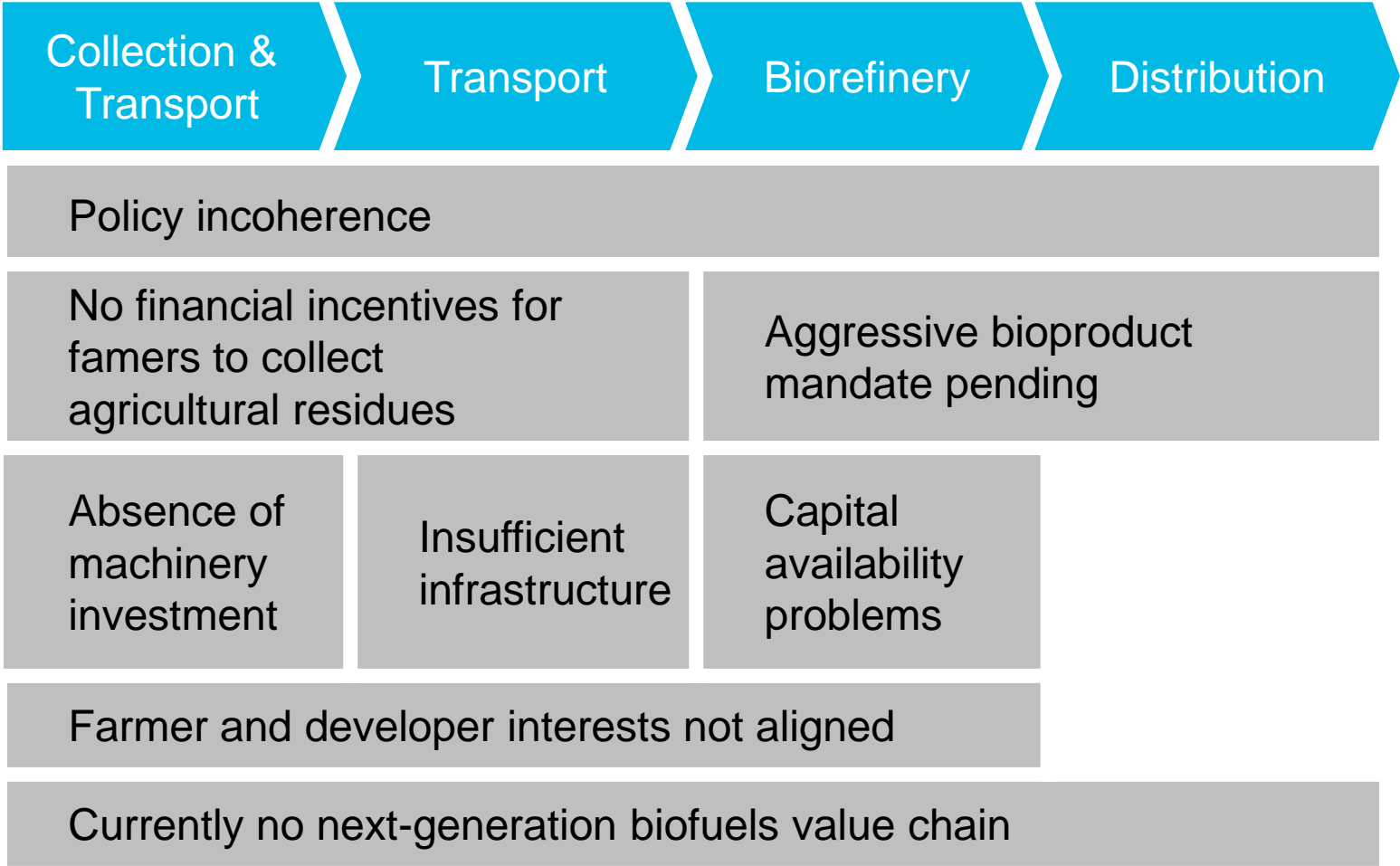
INFRASTRUCTURE

Rural roads are ill-equipped to facilitate the transportation of large agricultural residue quantities to biorefineries.

SOCIO-ECONOMIC

The farming community will be reluctant to harvest, load and transport agricultural residues until a long-term market is in evidence.

BIOPRODUCT INDUSTRY CHALLENGES, 2011



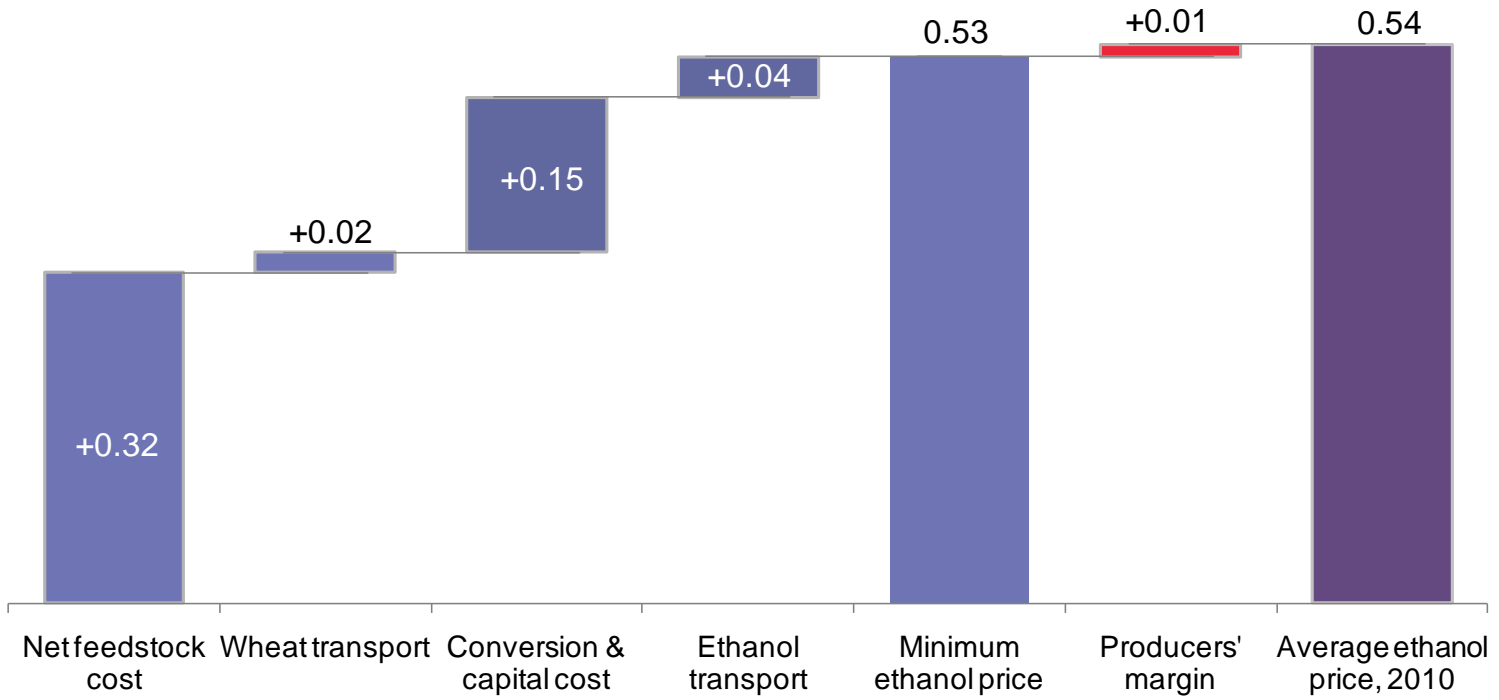
Source: Bloomberg New Energy Finance



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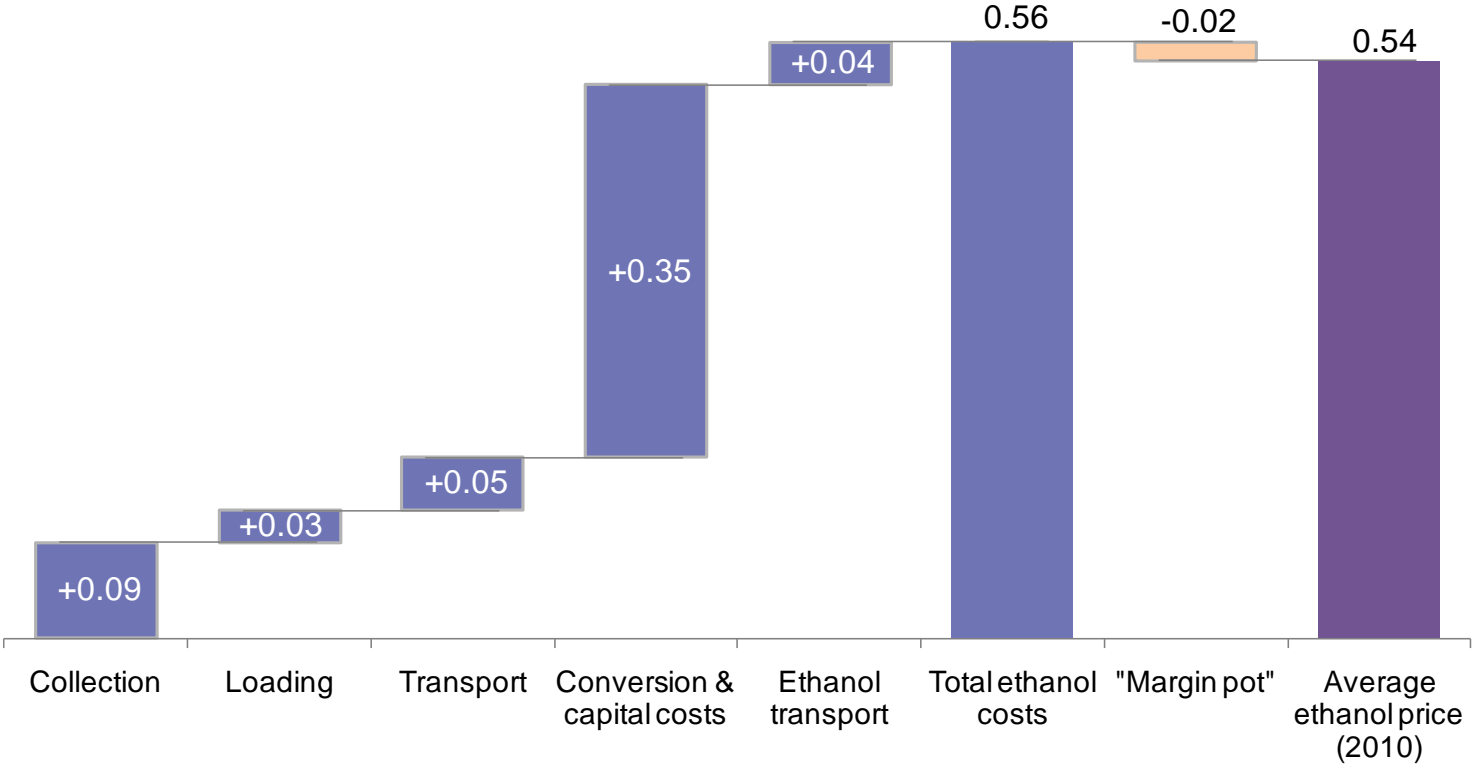
FIRST-GENERATION ETHANOL VALUE CHAIN ANALYSIS, 2010 (EUR/LITRE)



Note: "Net feedstock cost" includes revenues generated from distillers' grains sales (a by-product) while also representing average 2010 wheat prices; "Conversion & capital cost" includes a 10% IRR. Subsidies have not been accounted for. Average ethanol European spot prices use FOB ARA T2 data and assume either EU origin or all duties paid.

Source: Bloomberg and Bloomberg New Energy Finance

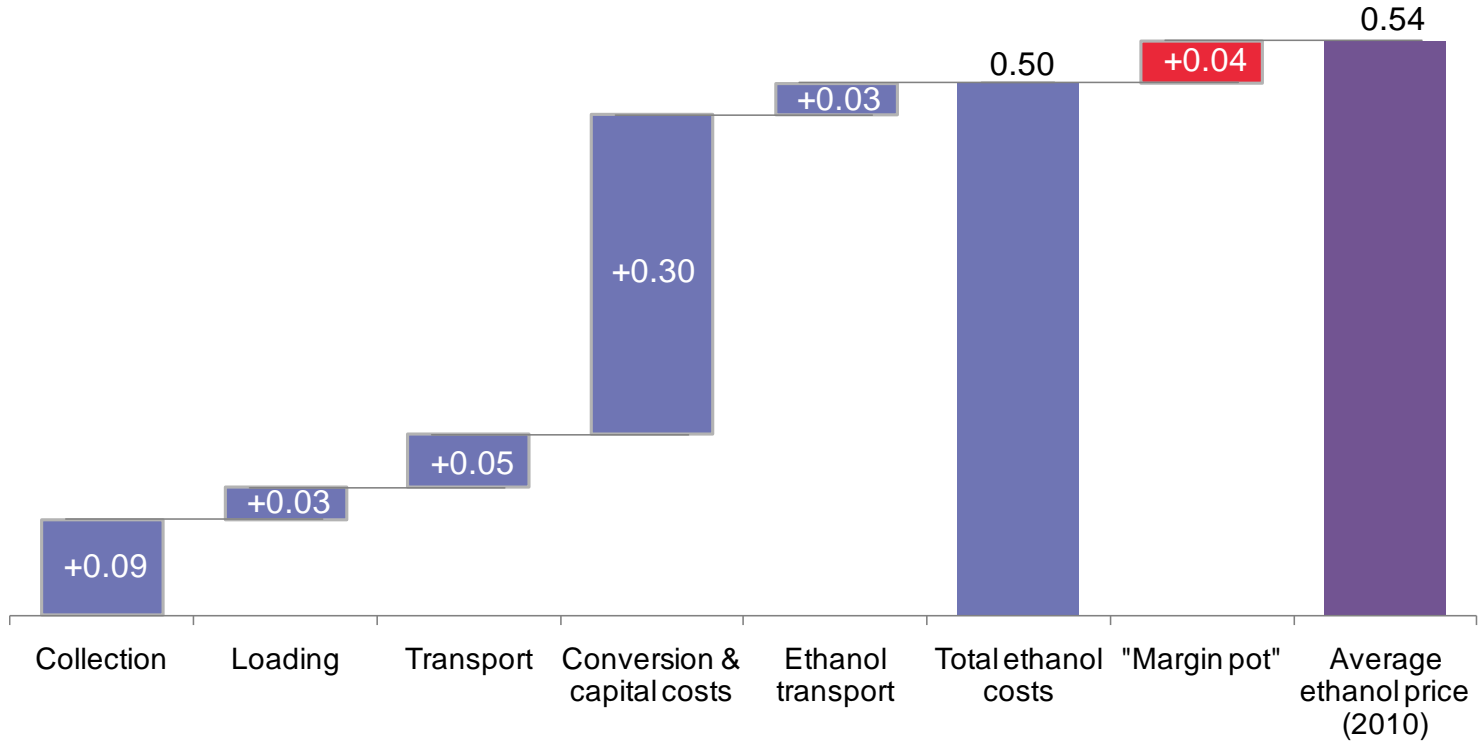
NEXT-GENERATION ETHANOL VALUE CHAIN ANALYSIS, 2011 (EUR/LITRE)



Note: We have used an agricultural residue gate price of EUR 60 per dry tonne to calculate the costs for French wheat straw; "Conversion & capital costs" include notional capital charges, yielding a 10% IRR for debt providers. Average ethanol European spot prices use FOB ARA T2 data and assume either EU origin or all duties paid.

Source: Bloomberg and Bloomberg New Energy Finance

POTENTIAL NEXT-GENERATION ETHANOL VALUE CHAIN, 2015 (EUR/LITRE)




Note: We have used an agricultural residue gate price of EUR 60 per dry tonne to calculate the costs for French wheat straw; The projected "Conversion & capital costs" include notional capital charges, yielding a 10% IRR for debt providers. Average ethanol European spot prices use FOB ARA T2 data and assume either EU origin or all duties paid. Subsidies have not been accounted for.

Source: Bloomberg and Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL INDUSTRY MARGINS



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

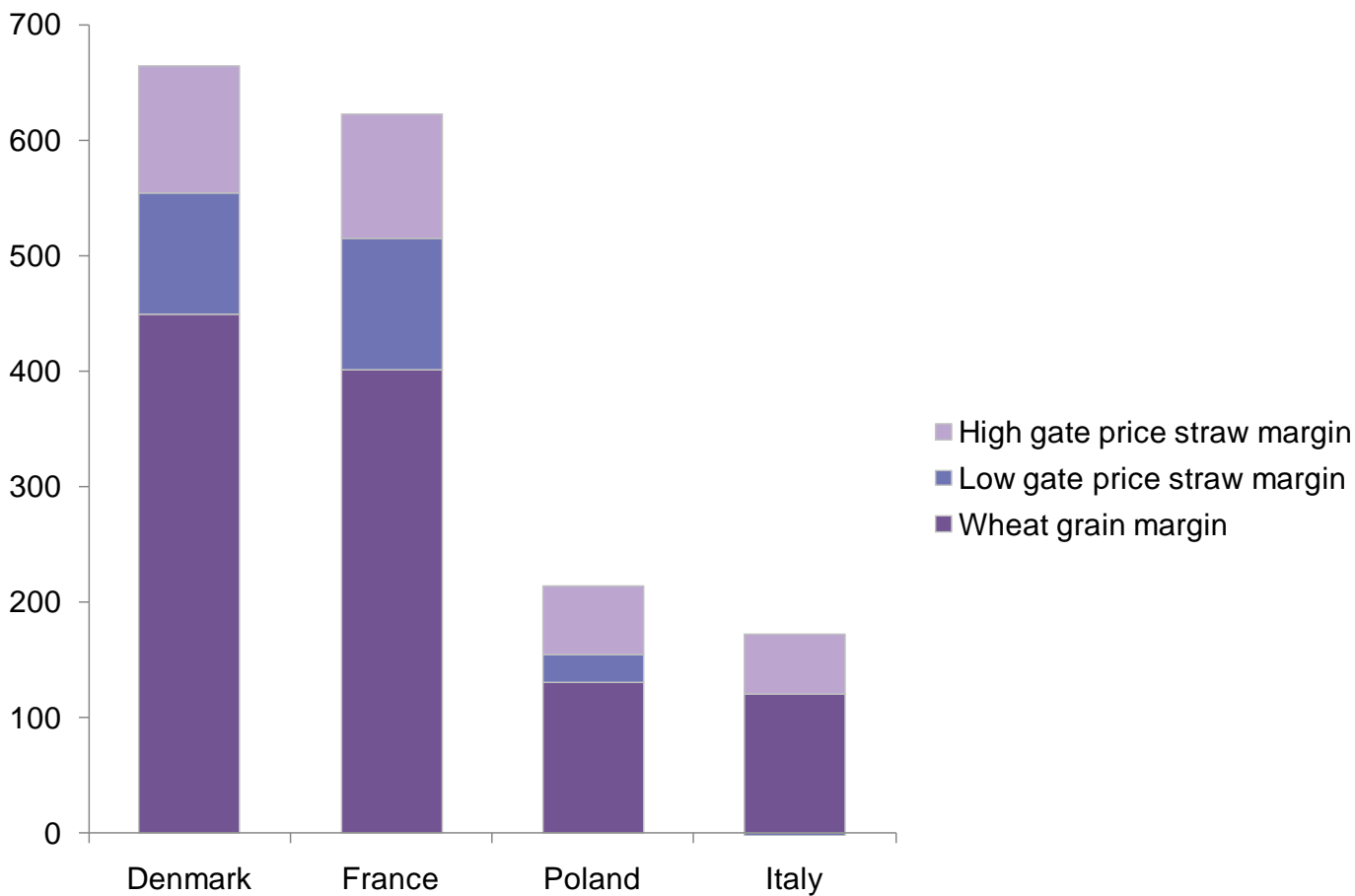


It is **impossible to determine** how the value chain “margin pot” will be **split** between next-generation ethanol producers and farmers as global crude oil prices change.



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

FARMERS' WHEAT STRAW RESIDUE AND FOOD MARGINS PER HECTARE, 2015 (EUR/HECTARE)



Note: "Wheat grain margin" is based on yield projections and historic commodity prices; grain harvesting costs account for historic national operating costs without subsidies; straw margins in the high gate price scenario are incremental. Italian wheat straw has a negative margin of EUR 2 per hectare in the low gate price scenario.

Source: Bloomberg New Energy Finance, European Commission Cereal Farm Report 2010

FARMERS' MARGINS PER HECTARE FOR AGRICULTURAL RESIDUES, 2015 (EUR/HECTARE)

COUNTRY	AGRICULTURAL RESIDUE	COSTS (EUR/HECTARE)	GATE PRICE (EUR/TONNE)	FARMERS' MARGINS (EUR/HECTARE)
Denmark	Wheat straw	227	EUR 60	105
			EUR 80	215
France	Wheat straw	208	EUR 60	115
			EUR 80	222
Poland	Wheat straw	154	EUR 60	24
			EUR 80	84
Italy	Wheat straw	162	EUR 60	-2
			EUR 80	51

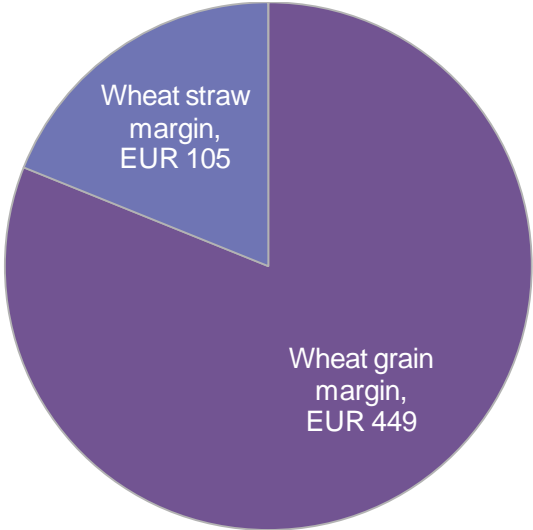
Note: "Farmers' margins" represent the agricultural residue gate price, under low and high gate price scenarios (EUR 60 and 80 per tonne respectively), less "Costs".

Agricultural residue yields per hectare are based on projections.

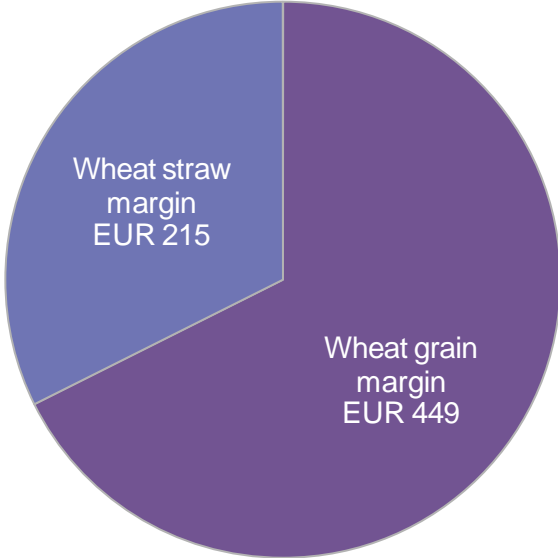
Source: Bloomberg New Energy Finance, FAO

DANISH WHEAT FIELD MARGINS, 2015 (EUR/HECTARE)

LOW GATE PRICE SCENARIO



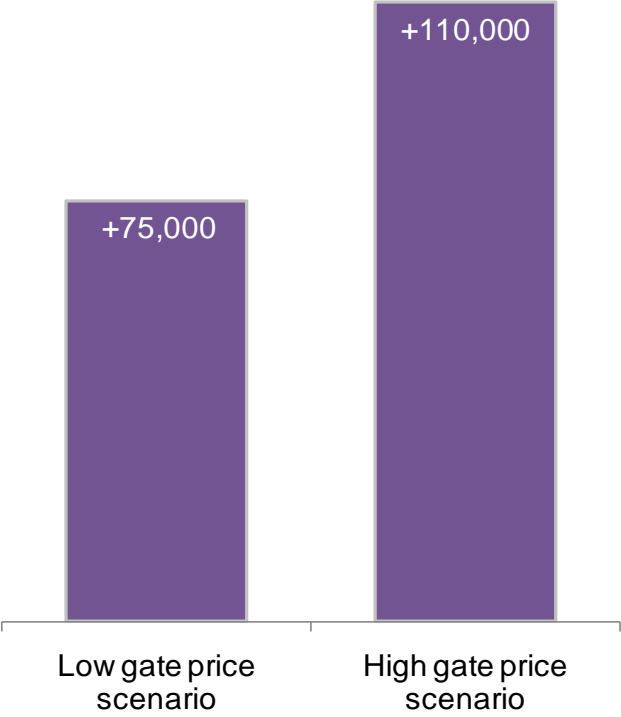
HIGH GATE PRICE SCENARIO



Note: The “Wheat straw margin” and “Wheat grain margin” calculations represent Danish conditions. “Wheat straw margin” represents the optimal agricultural residue margin. Both margins employ historic commodity prices and yield projections.

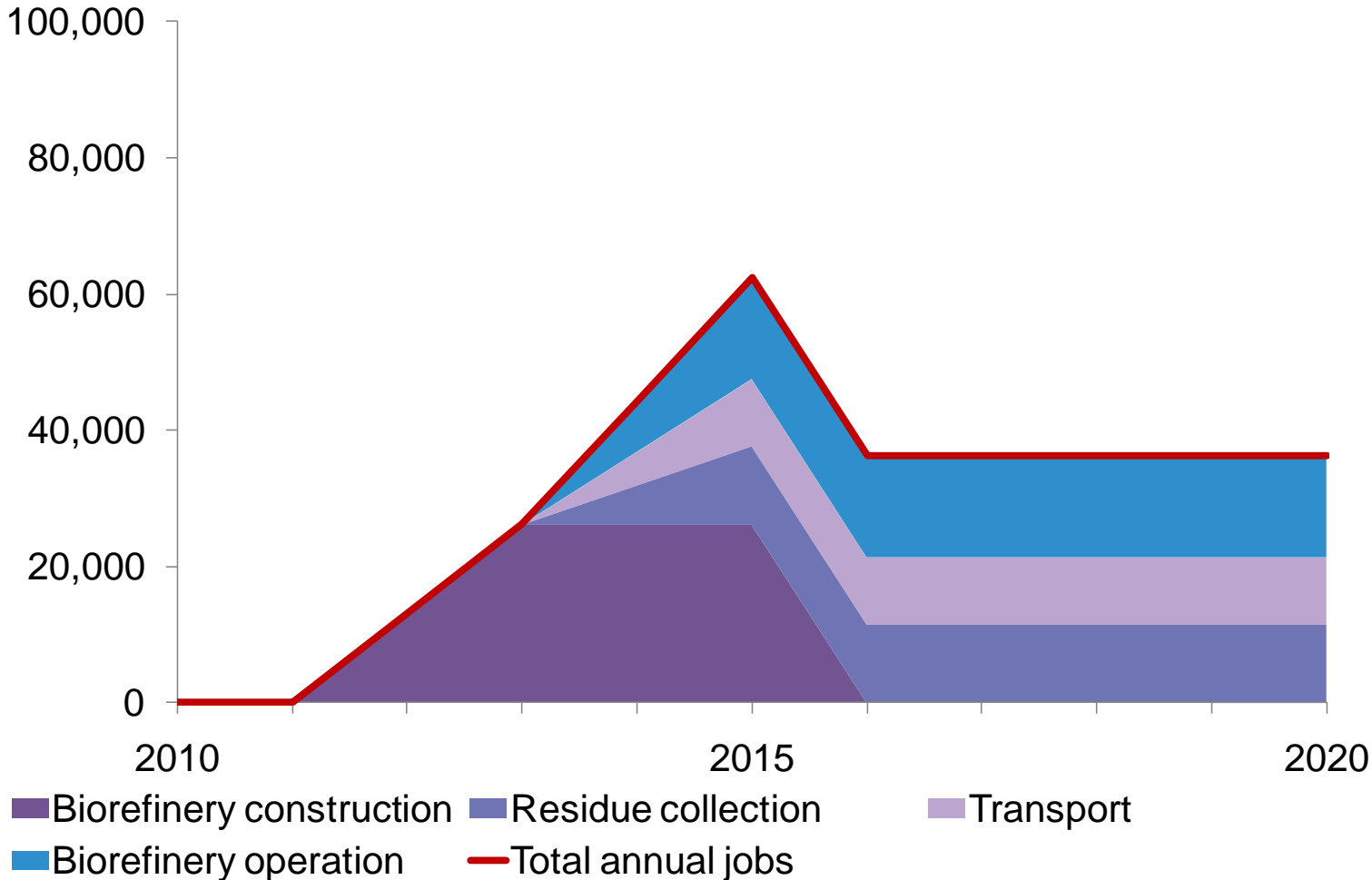
Source: Bloomberg New Energy Finance, European Commission Cereal Farm Report 2010

AGRICULTURAL RESIDUE JOB CREATION IN EU27, 2010-2020



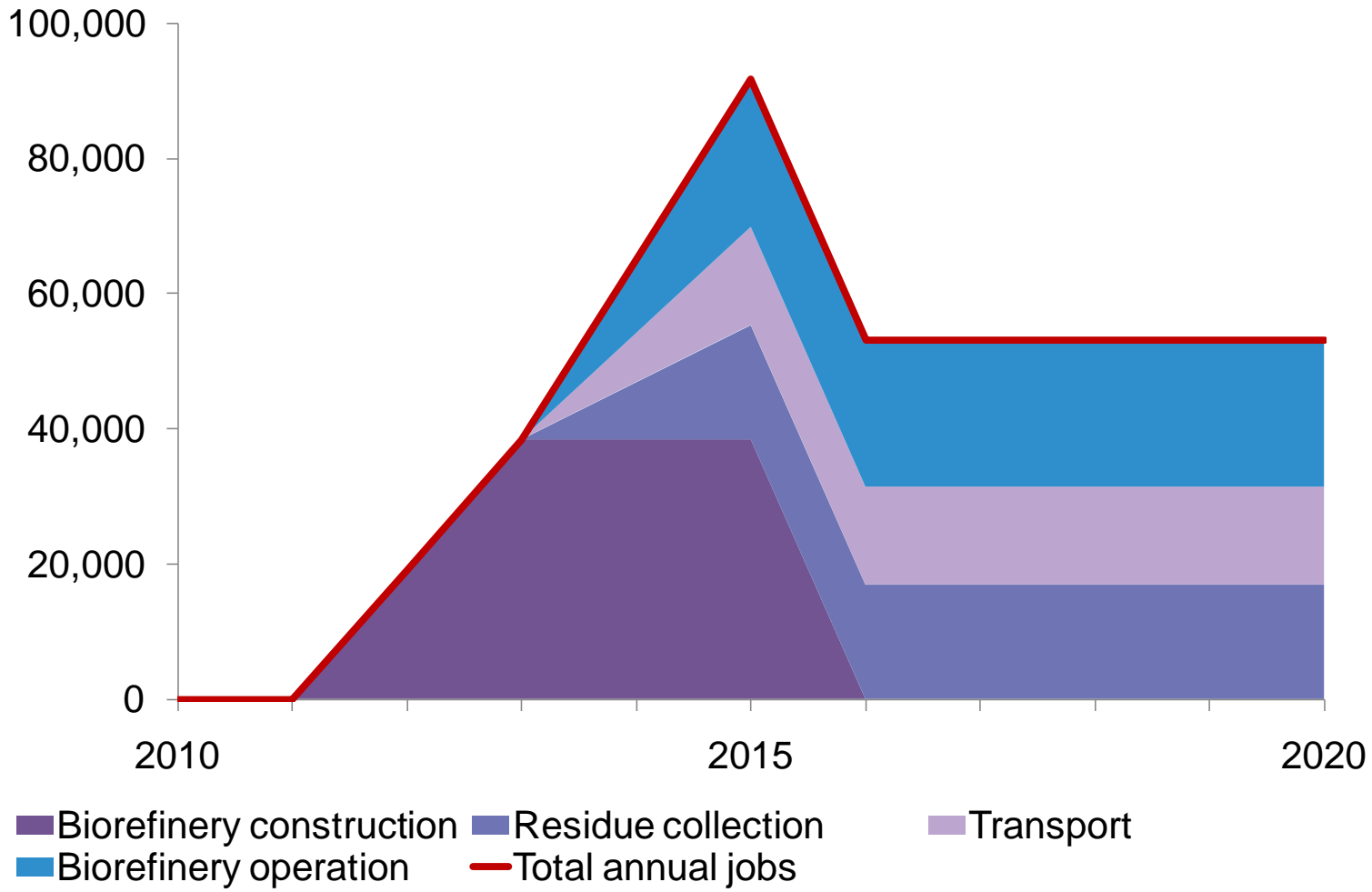
Source: Bloomberg New Energy Finance

POTENTIAL JOBS IN THE BIOPRODUCT INDUSTRY SECTOR UNDER LOW GATE PRICE SCENARIO, 2010-2020



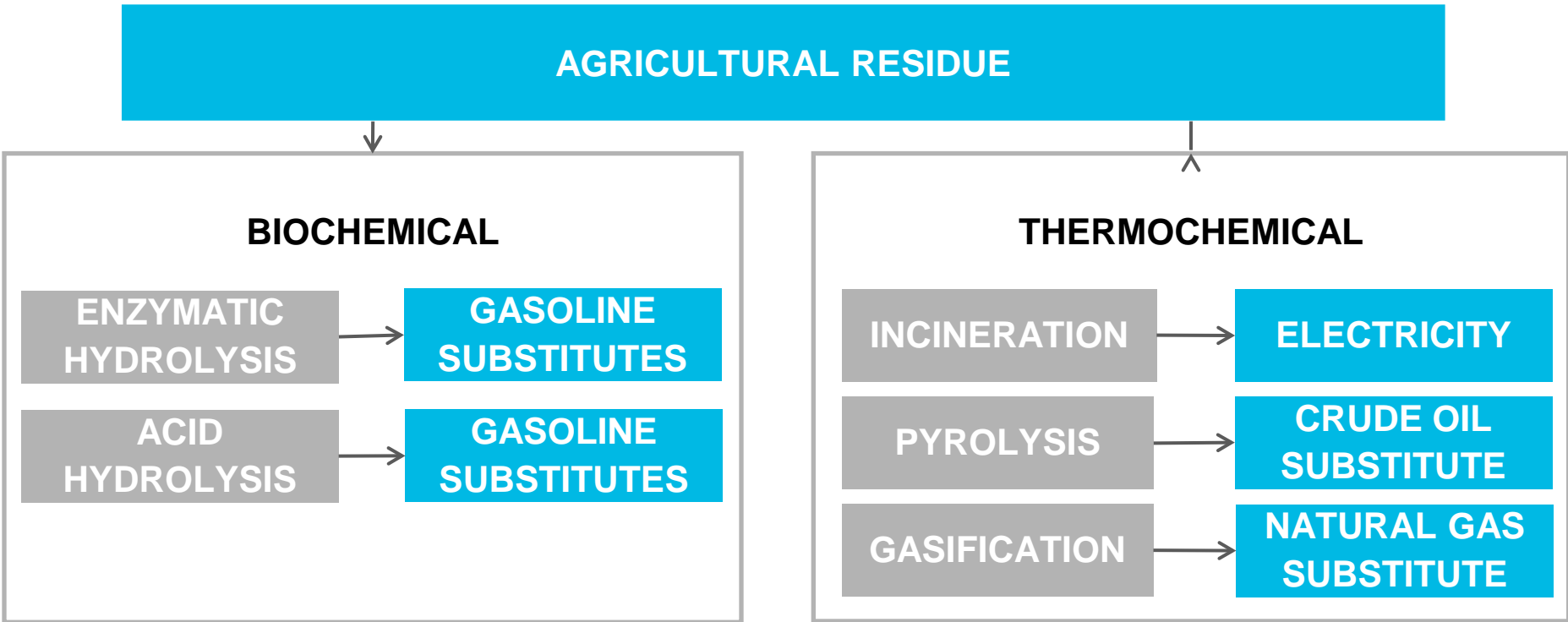
Note: Total annual job creation, or one man year, in the bioproduct industry comes in two parts: firstly, biorefinery construction and operation jobs; and secondly, agricultural residue supply chain jobs. Source: Bloomberg New Energy Finance, Danish Construction Association

POTENTIAL JOBS IN THE BIOPRODUCT INDUSTRY SECTOR UNDER HIGH GATE PRICE SCENARIO, 2010-2020



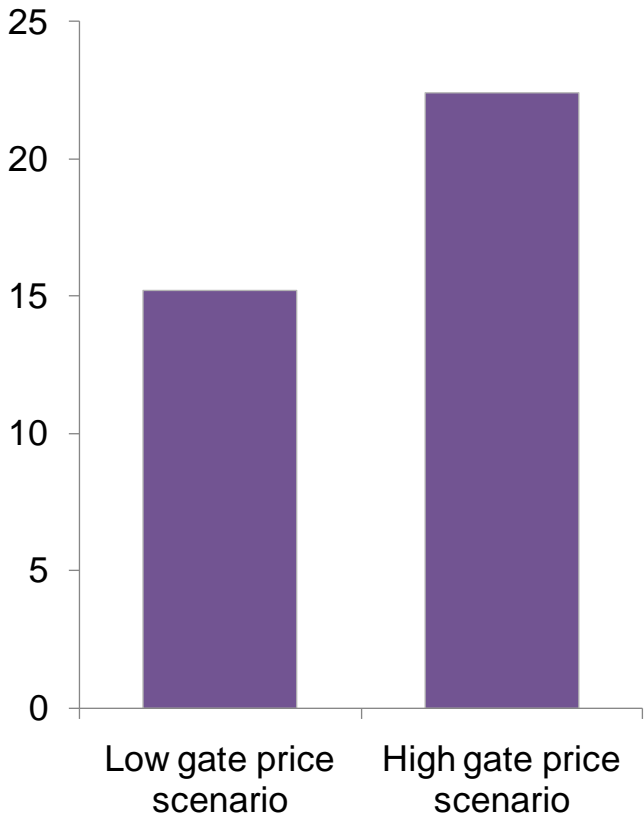
Note: Total annual job creation, or one man year, in the bioproduct industry comes in two parts: firstly, biorefinery construction and operation jobs; and secondly, agricultural residue supply chain jobs. Source: Bloomberg New Energy Finance, Danish Construction Association

NEXT-GENERATION BIOPRODUCTS FROM AGRICULTURAL RESIDUES, 2011-2020



Source: Bloomberg New Energy Finance

EU27 NEXT-GENERATION ETHANOL REVENUES, 2015 (BILLION EUR)



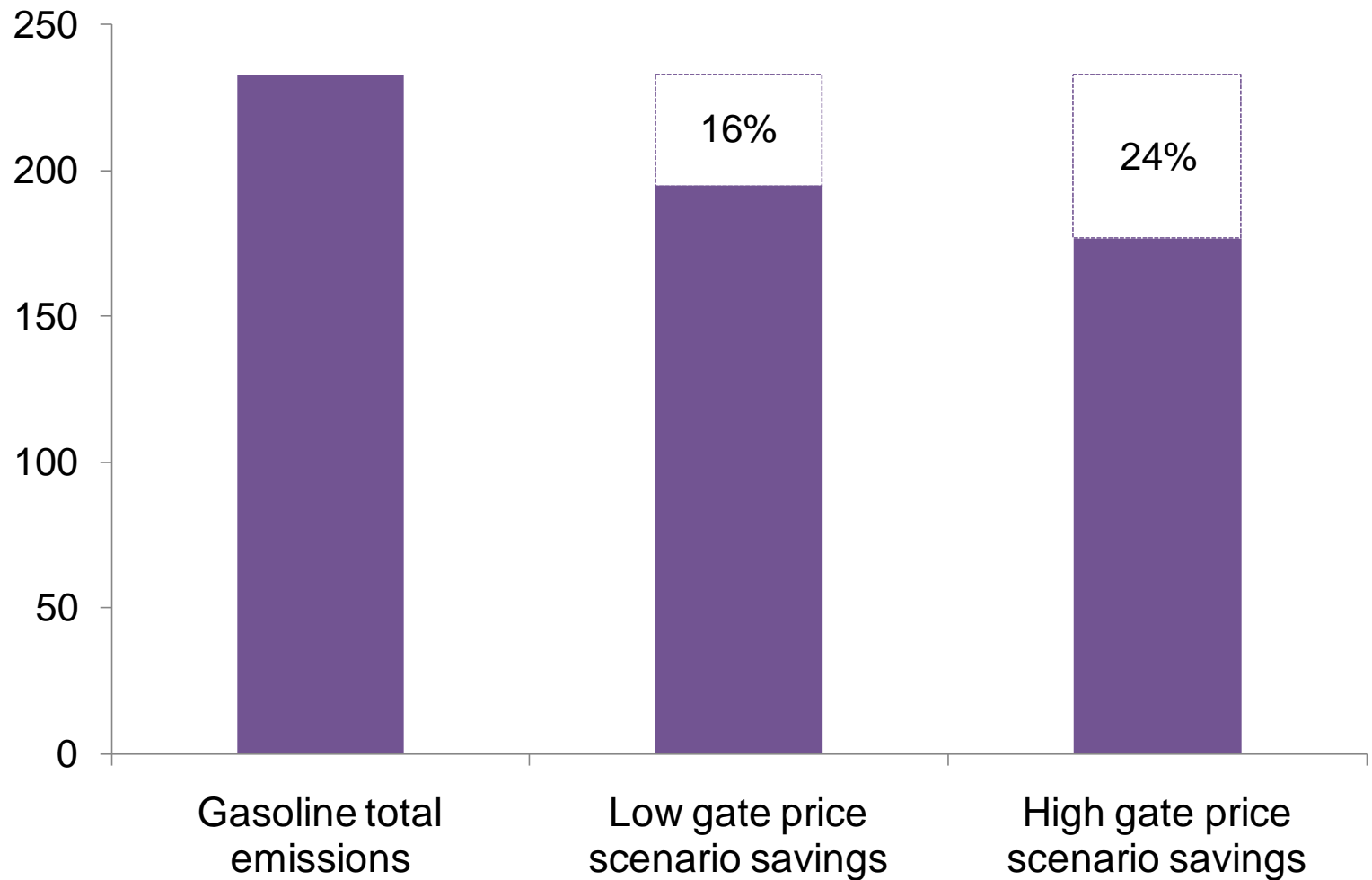
REVENUE GENERATION

- In a low gate price scenario the bioproduct industry could generate revenues of up to EUR 15bn in 2015 from next-generation ethanol production alone in the EU27.
- These revenues could increase to EUR 22bn in the high gate price scenario.

Note: Revenues for delivered next-generation ethanol; revenues are based on average 2010 ethanol prices (EUR 0.54 per litre).

Source: Bloomberg New Energy Finance

NEXT-GENERATION ETHANOL GREENHOUSE GAS EMISSION REDUCTIONS, 2015 (MILLION TONNES CO2E)



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%.

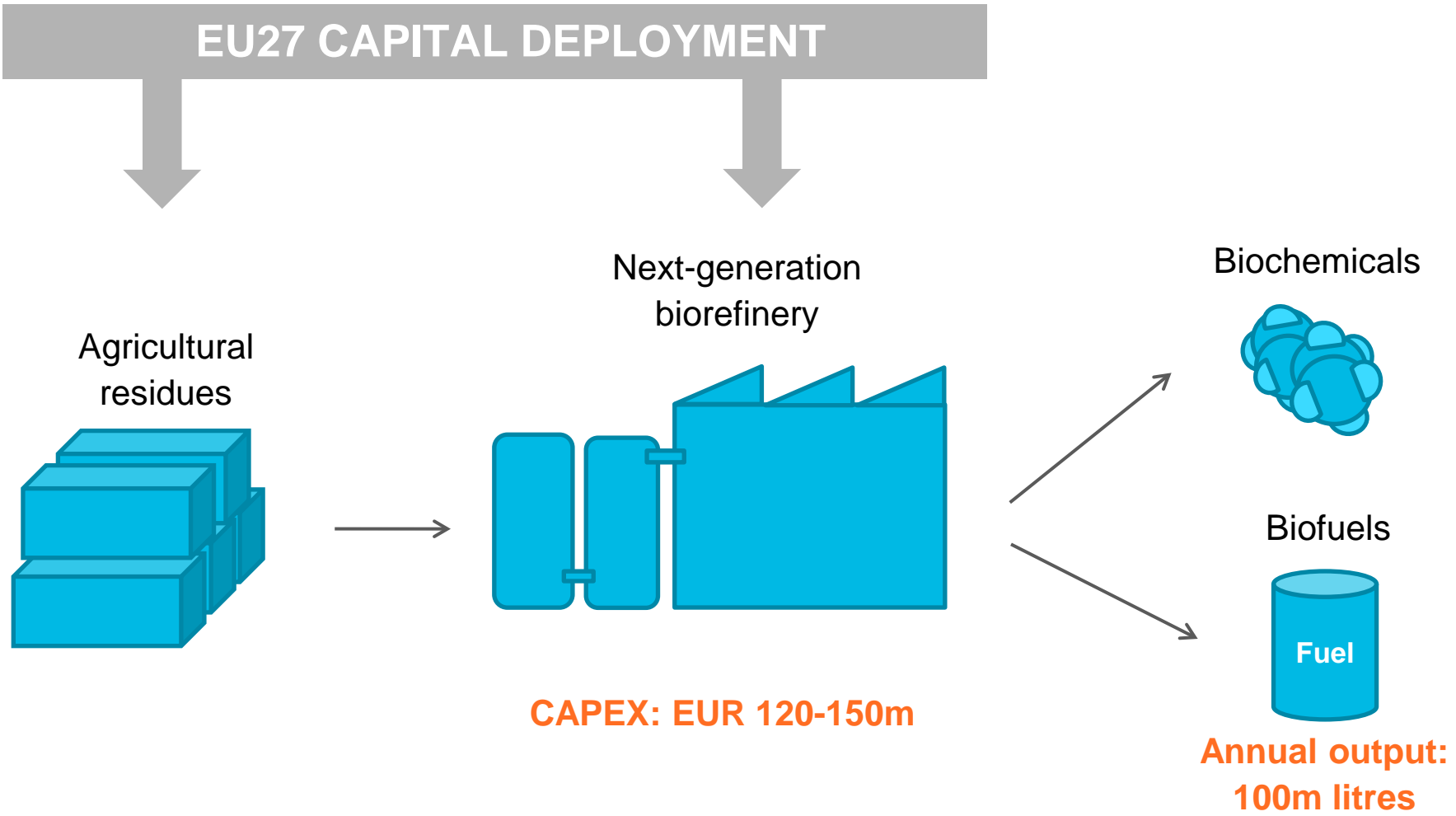
Source: Bloomberg New Energy Finance

BIOPRODUCTS: DIVERSIFYING FARMERS' INCOME

1. What is the resource?
2. Agricultural residue collection costs
3. Potential farmers' margins (2015)
4. Investment demands
5. Industry barriers (2011)
6. Rural community benefits (2011-20)

7. Roadmap

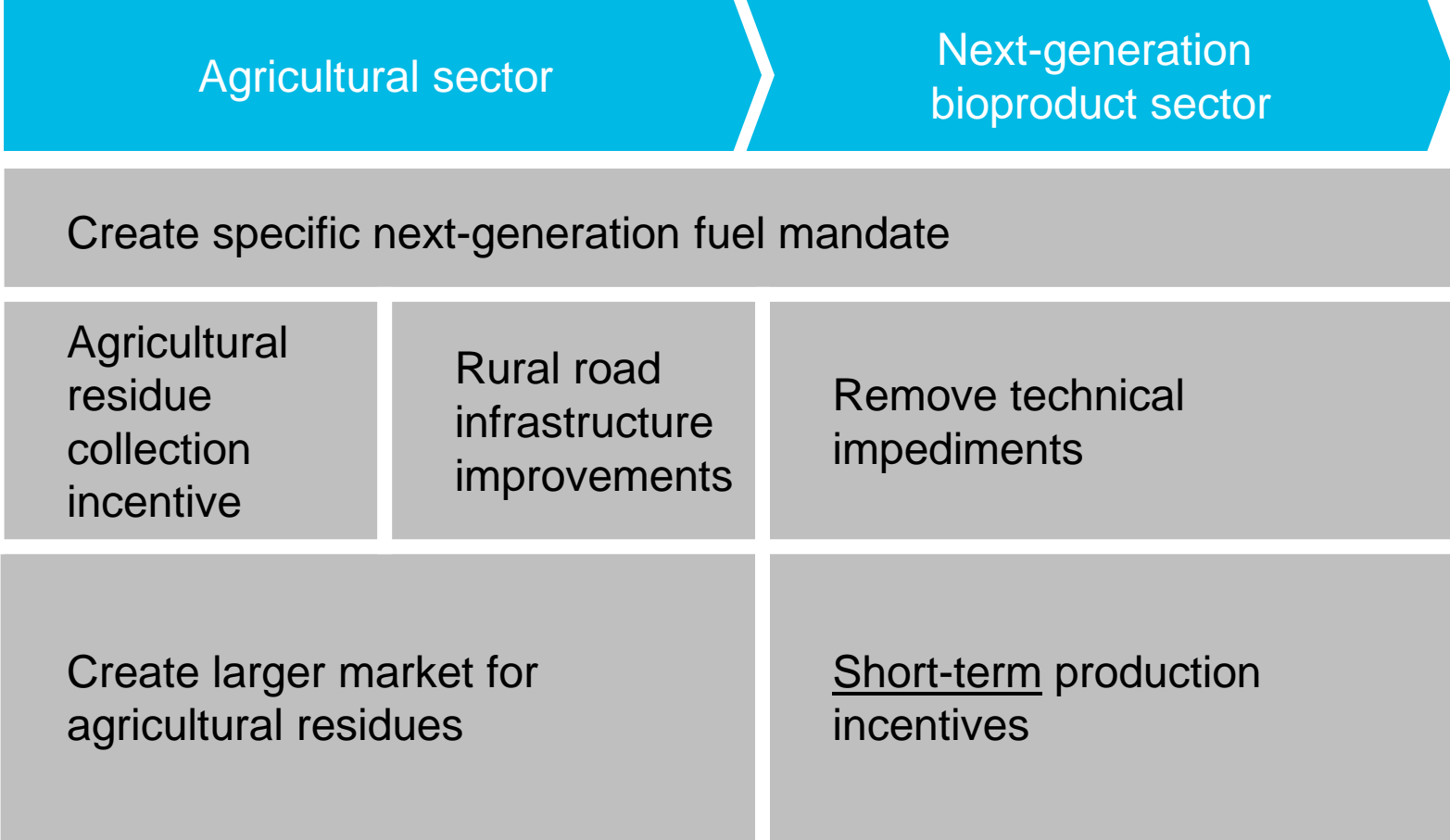
BUILDING THE NEXT-GENERATION BIOPRODUCT VALUE CHAIN



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

Source: Bloomberg New Energy Finance

BIOPRODUCT INDUSTRY POLICY ROADMAP, 2011-2020



BIOPRODUCT INDUSTRY DEVELOPMENT, 2011–20



2011

2020



SPECIFIC NEXT-GENERATION BIOFUEL MANDATES

REMOVE TECHNICAL IMPEDIMENTS

**SHORT-TERM AGRICULTURAL
RESIDUE COLLECTION INCENTIVE?**

**CREATE LARGER AGRICULTURAL
RESIDUE MARKETS**

**SHORT-TERM PRODUCTION
INCENTIVE?**

Source: Bloomberg New Energy Finance

POLICY SUGGESTIONS AND OUTCOMES

REMOVE TECHNICAL IMPEDIMENTS

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.

CREATE SPECIFIC NEXT-GENERATION BIOFUEL MANDATE

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.

AGRICULTURAL RESIDUE COLLECTION INCENTIVE

Incentivises farmers to collect agricultural residue and helps overcome the critical “chicken and the egg” problem, is there enough to meet bioenergy refinery demand?

POLICY SUGGESTIONS AND OUTCOMES (CONT'D)

SHORT-TERM PRODUCTION INCENTIVES

This short-term measure will pull capital towards a nascent next-generation bioproduct industry, which will help bring the first biorefineries online. Investors will then become more comfortable with project risk.

CREATE LARGER MARKET FOR AGRICULTURAL RESIDUES

Creating a large agricultural residue market will again attract much needed capital to the agricultural sector, especially in the new member states.

RURAL ROAD INFRASTRUCTURE IMPROVEMENTS

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

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DIVERSIFYING FARMERS' INCOME

HOW A BIOPRODUCT INDUSTRY WILL AFFECT THE EU27 AGRICULTURAL SECTOR

MARKETS

Renewable Energy

Carbon Markets

Energy Smart Technologies

Renewable Energy Certificates

Carbon Capture & Storage

Power

Water

Nuclear

SERVICES

Insight: research, analysis & forecasting

Industry Intelligence: data & analytics

News & Briefing: daily, weekly & monthly

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