

# International Biomass Business Opportunities

Global biomass, bioenergy and bioplastics trends



March 2014

more info at: [rvo.nl/biomass](http://rvo.nl/biomass)

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- > This presentation provides an overall and global picture of important biomass, bioenergy and bioplastic developments, based on a review of more than 180 publicly available reports.
- > It's aim is to provide Dutch companies with a quick global overview as a starting point for further references.
- > The presentation is part of a more elaborate project aimed at assisting Dutch companies, active in the Biobased Economy, in doing business internationally.
- > Partners for Innovation is carrying out this assignment for RVO.nl (formerly NL Agency). More information about the project can be found at [rvo.nl/biomass](https://rvo.nl/biomass)

The presentation is divided into the 7 following chapters:

1. Global energy demand and supply
2. Bioenergy in general
3. Biogas
4. Wood pellets
5. Biofuels
6. Bioplastics and biobased economy
7. Opportunities and Market trends

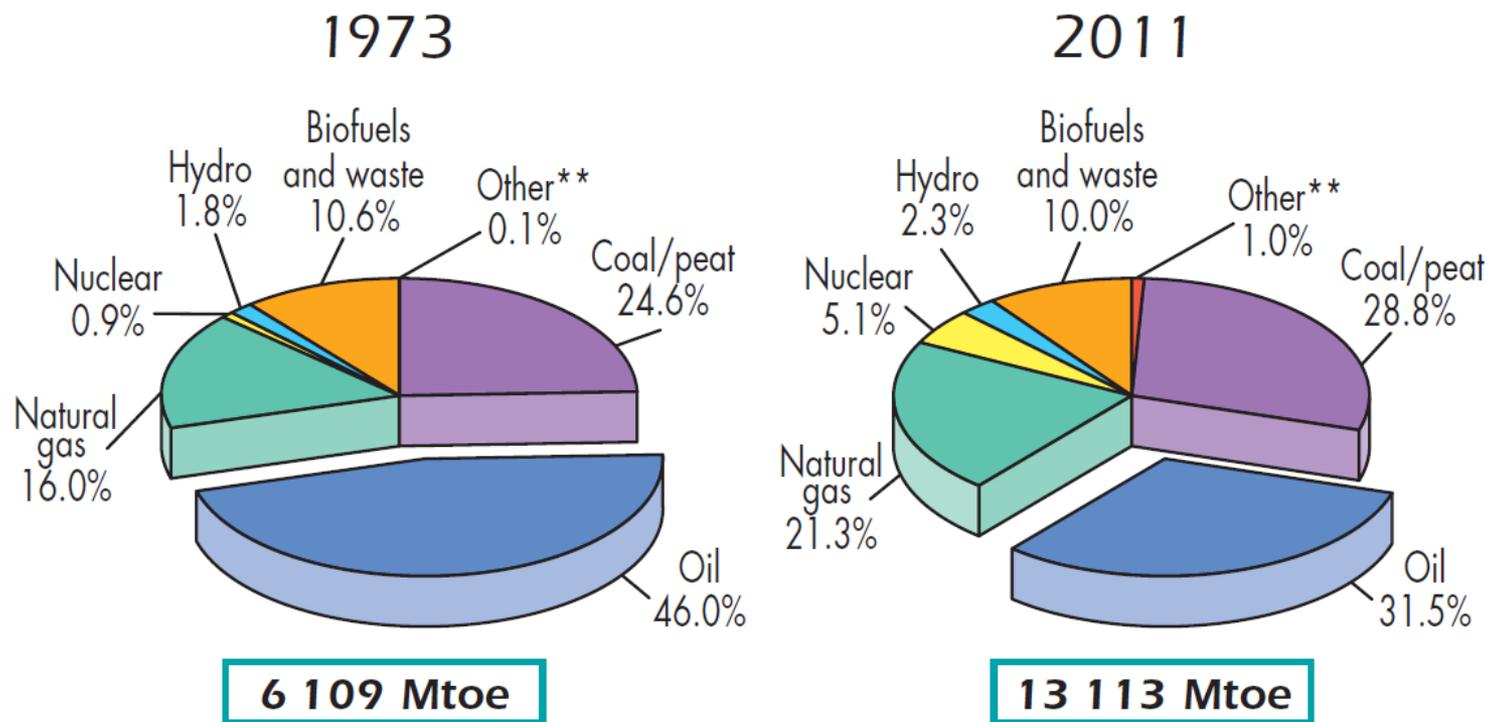
The final two pages present a reference list, with the numbers referring to the projects reference overview ([rvo.nl/biomass](https://rvo.nl/biomass)).

# Global energy demand and supply

## *Chapter 1*

# Global energy demand and supply

IEA, 2013 Key World Energy Statistics



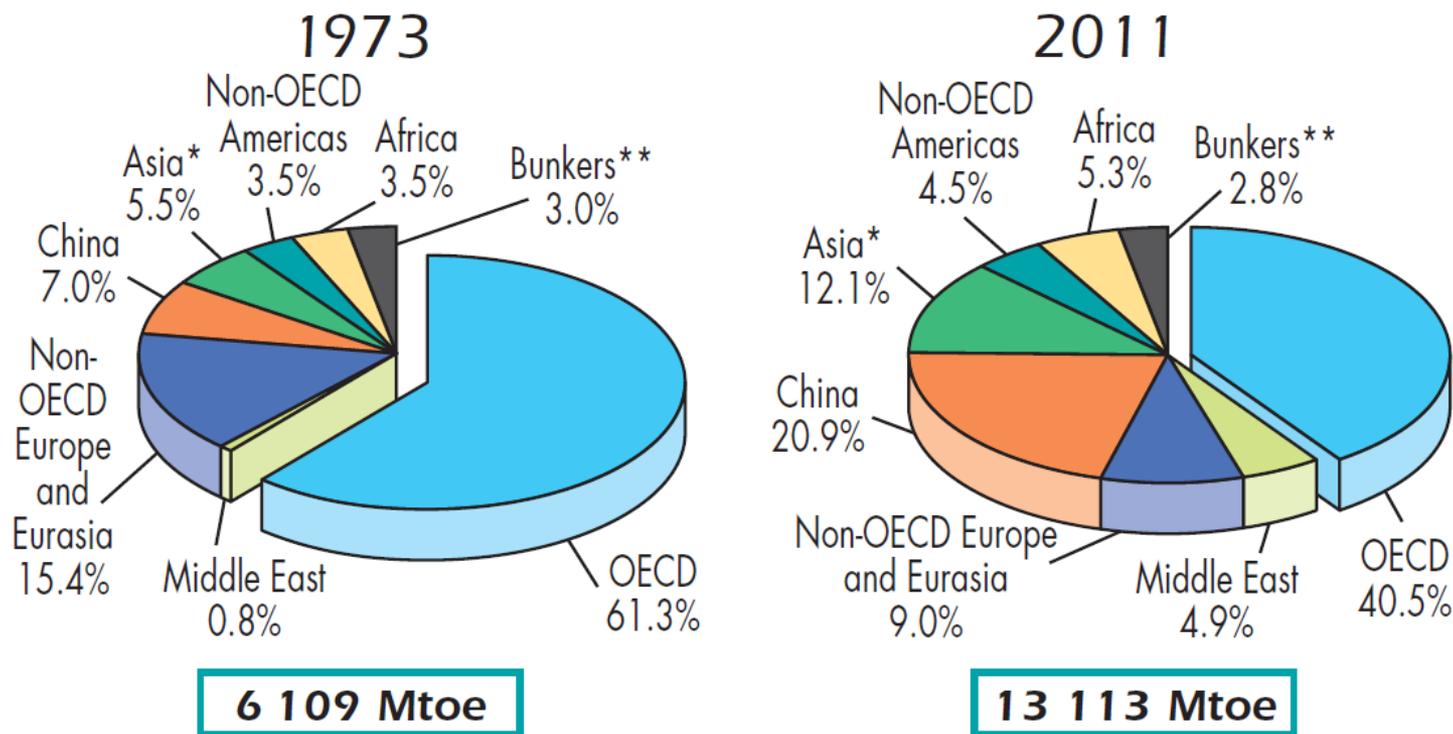
\*World includes international aviation and international marine bunkers.

\*\*Other includes geothermal, solar, wind, heat, etc.

> TPES: Increasing global energy supply; + 2% per year

# Global energy demand and supply

IEA, 2013 Key World Energy Statistics



\*Asia excludes China.  
 \*\*Includes international aviation and international marine bunkers.

> Non-OECD now 60% of TPES - switched places with OECD

## Global energy demand and supply

BP Energy Outlook 2035, January 2015



BP: “We project that by 2035 global energy consumption will increase by 41% from today’s levels with virtually all (95%) the growth in non-OECD countries and more than half coming from India and China”.

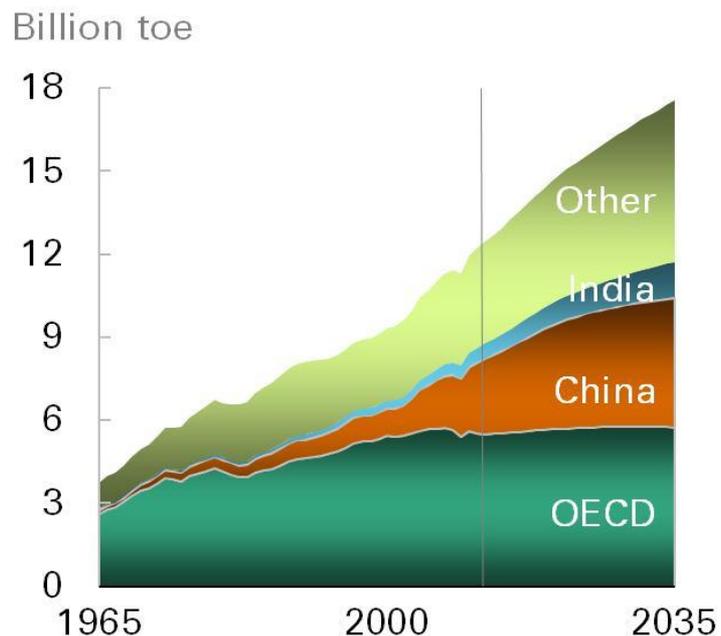
# Global energy demand and supply

BP Energy Outlook 2035, January 2015

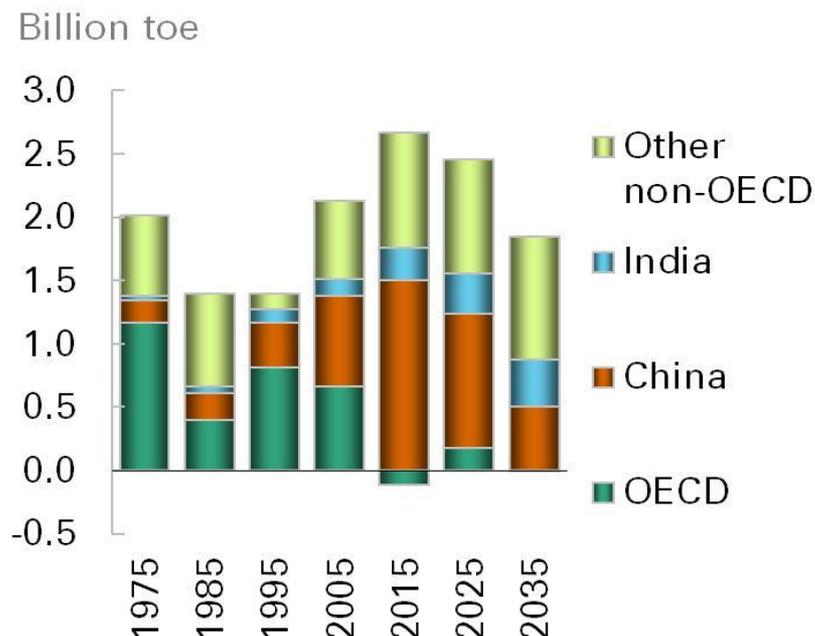


## Primary energy consumption growth slows

### Consumption by region



### Ten year increments by region



Energy Outlook 2035

© BP 2014

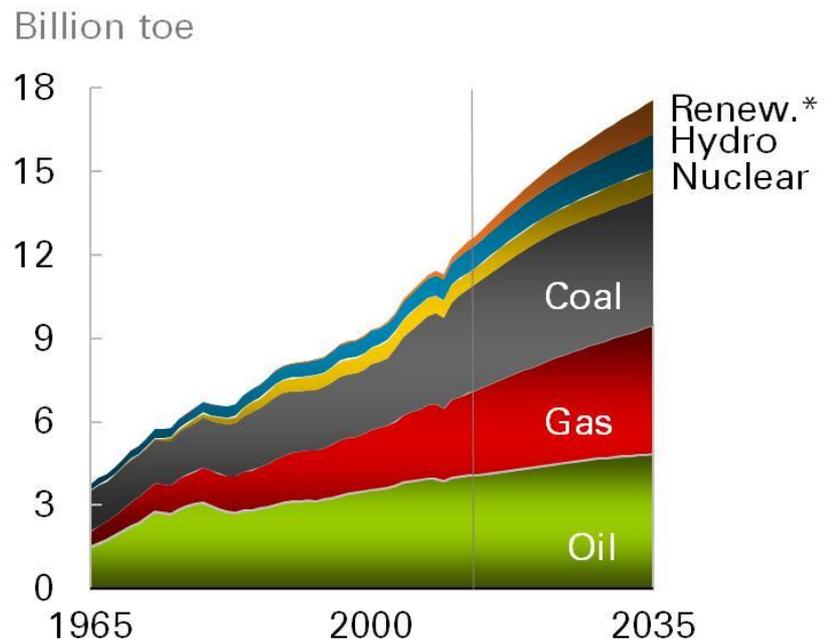
# Global energy demand and supply

BP Energy Outlook 2035, January 2015

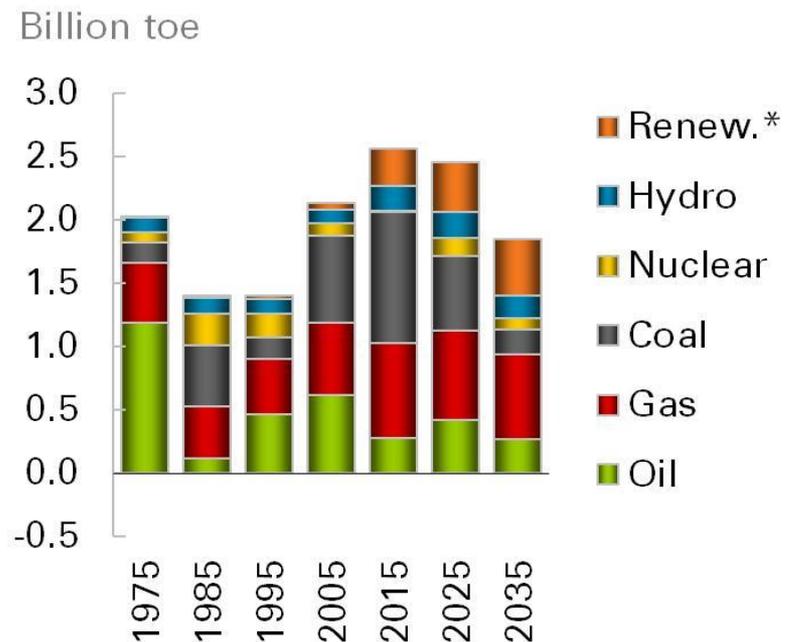


## The slowdown in China and industry is reflected in coal

### Consumption by fuel



### Ten year increments by fuel



\*Includes biofuels

Energy Outlook 2035

© BP 2014

# Global energy demand and supply

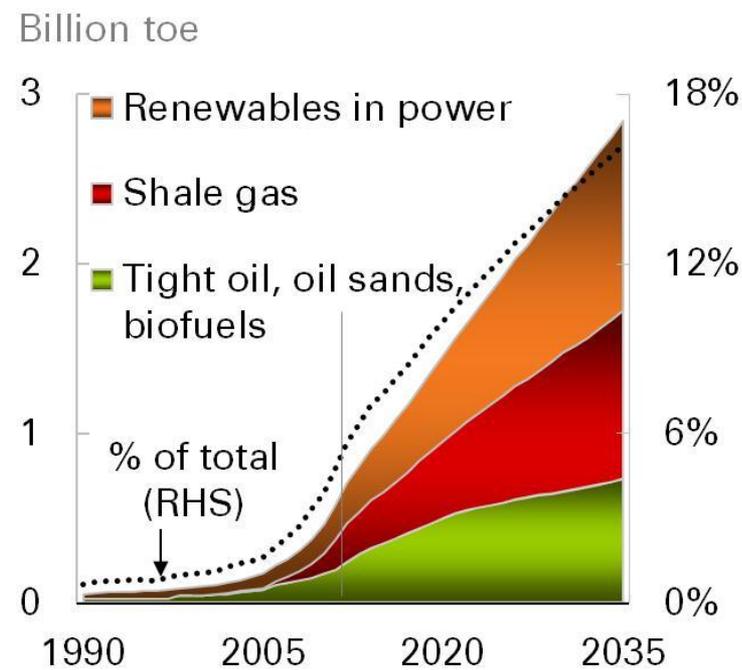
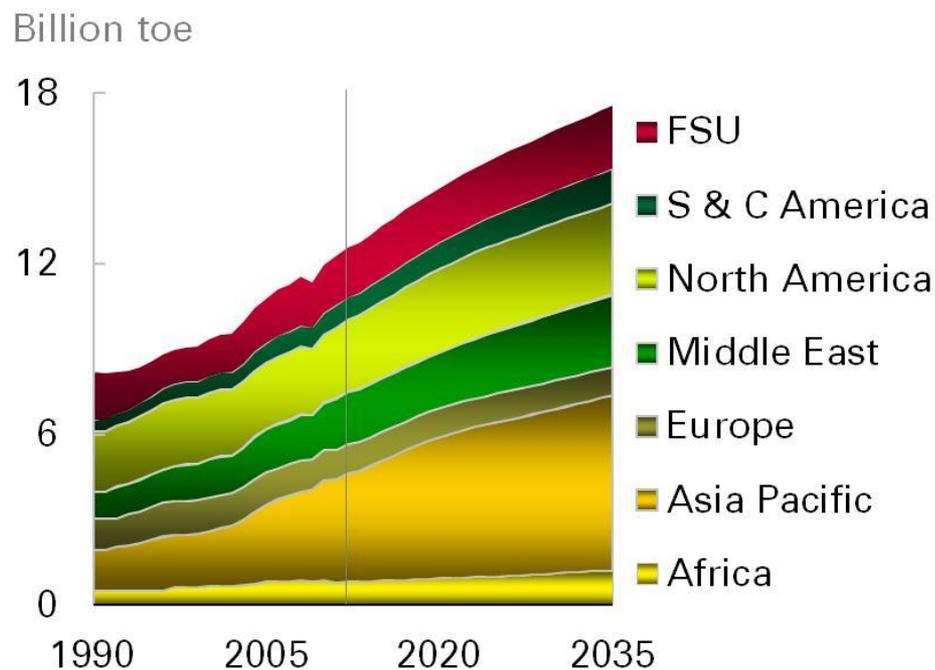
BP Energy Outlook 2035, January 2015



## New sources help to supply sufficient energy

### Primary energy production

### New energy forms



Energy Outlook 2035

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# Global energy demand and supply

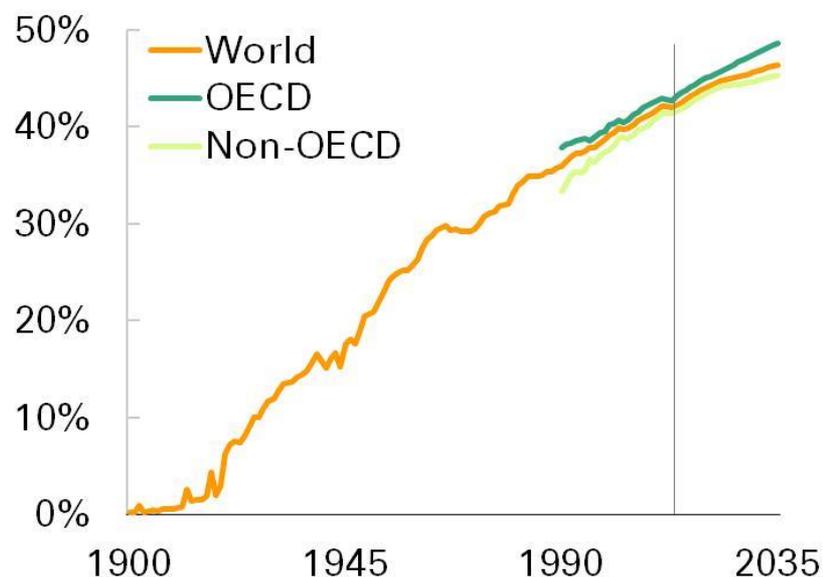
BP Energy Outlook 2035, January 2015



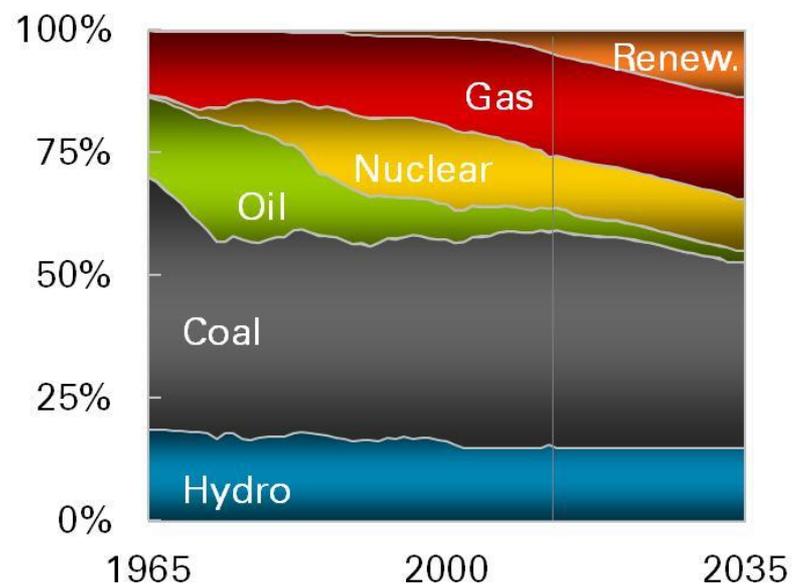
## The power sector takes an increasing share of energy



Inputs to power as a share of total primary energy



Primary inputs to power



Energy Outlook 2035

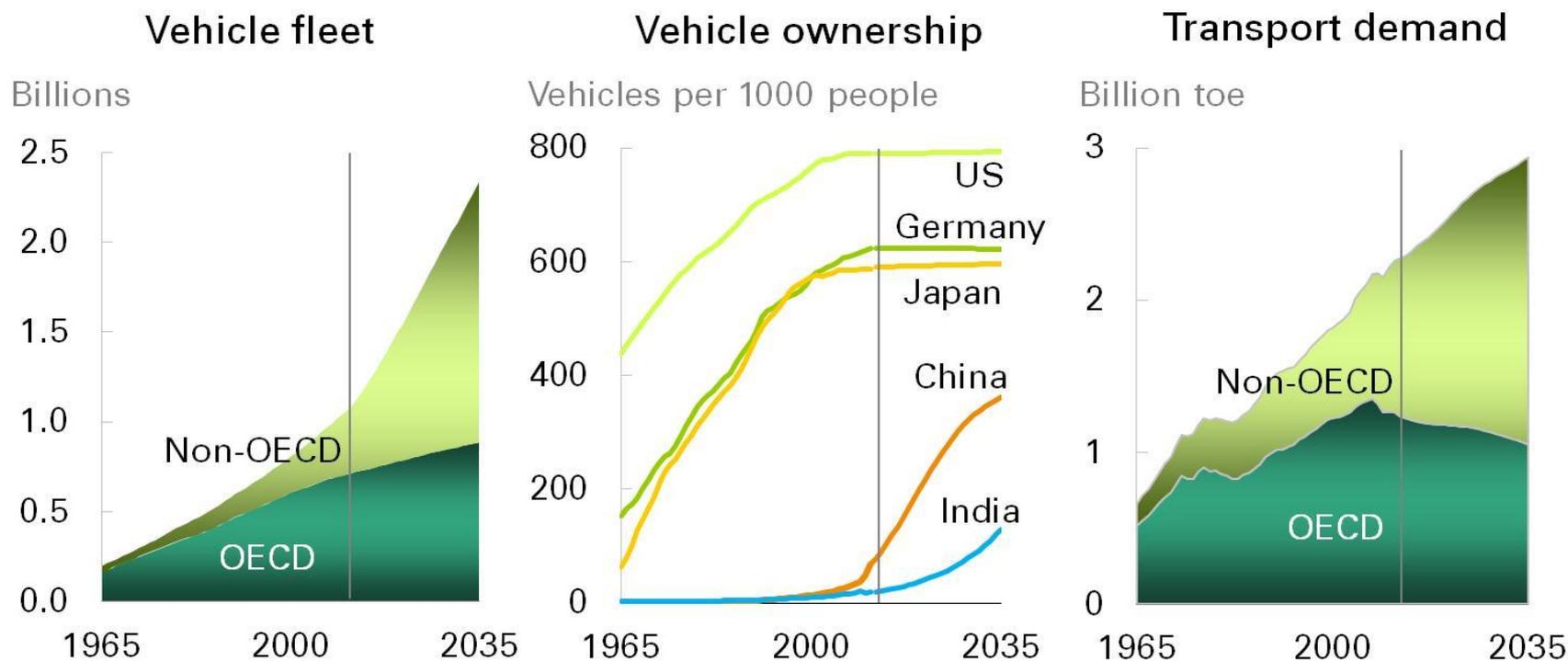
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# Global energy demand and supply

BP Energy Outlook 2035, January 2015



## Vehicle numbers are set to grow rapidly in the non-OECD



Energy Outlook 2035

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# Global energy demand and supply

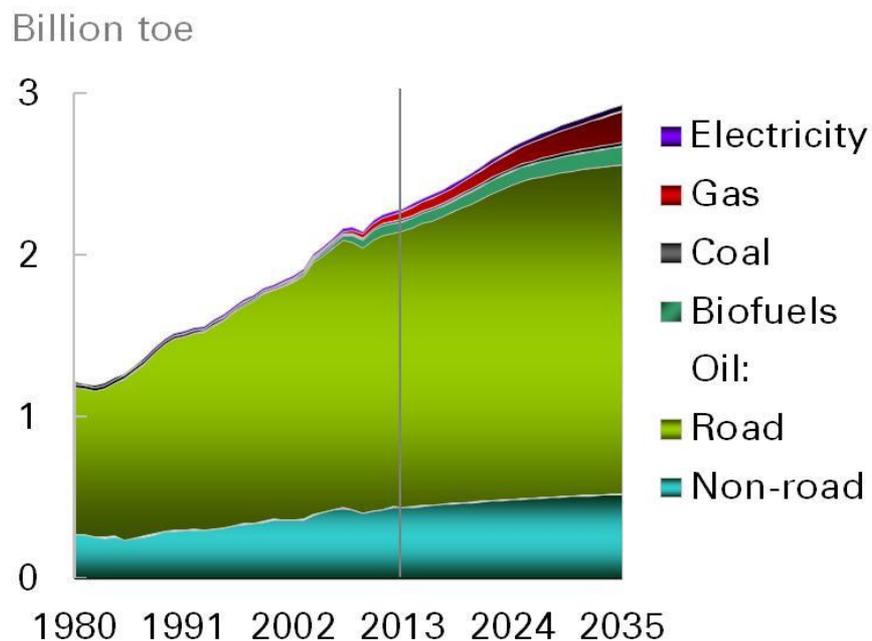
BP Energy Outlook 2035, January 2015



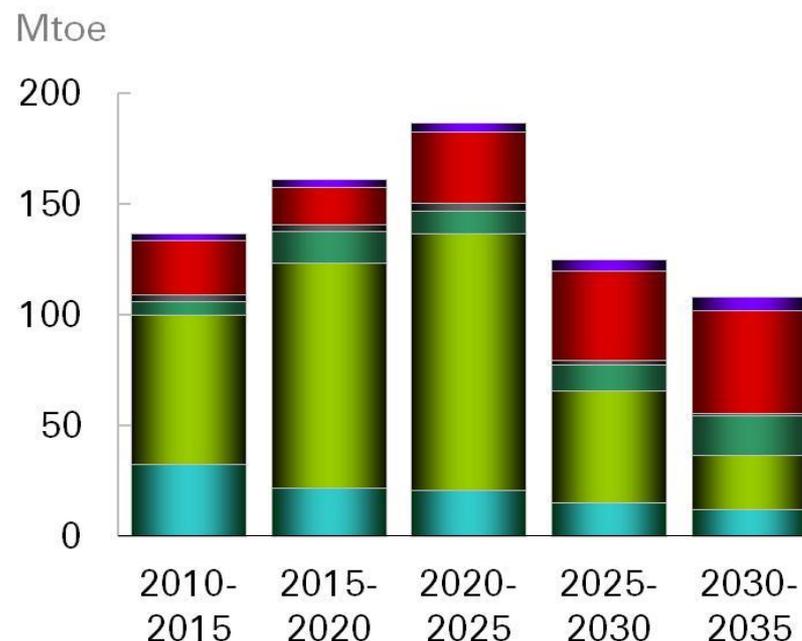
## Global transport demand growth slows



### Transport demand by fuel



### Five year increments by fuel



Energy Outlook 2035

© BP 2014

# Global energy demand and supply

BP Energy Outlook 2035, January 2015



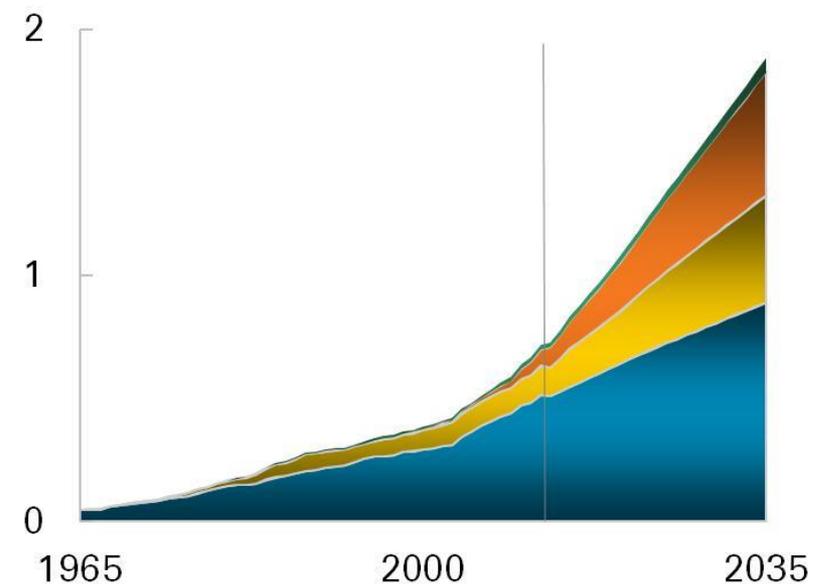
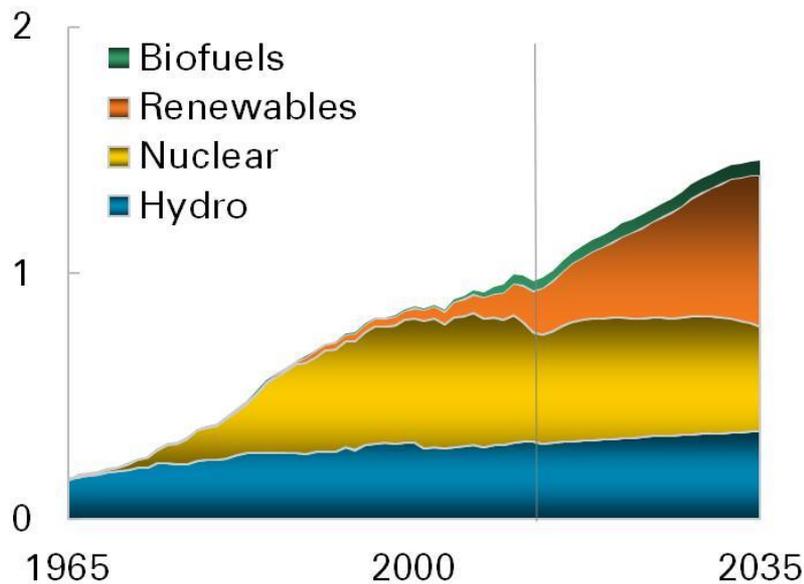
## Non-fossil fuels grow rapidly

OECD

Non-OECD

Billion toe

Billion toe



Energy Outlook 2035

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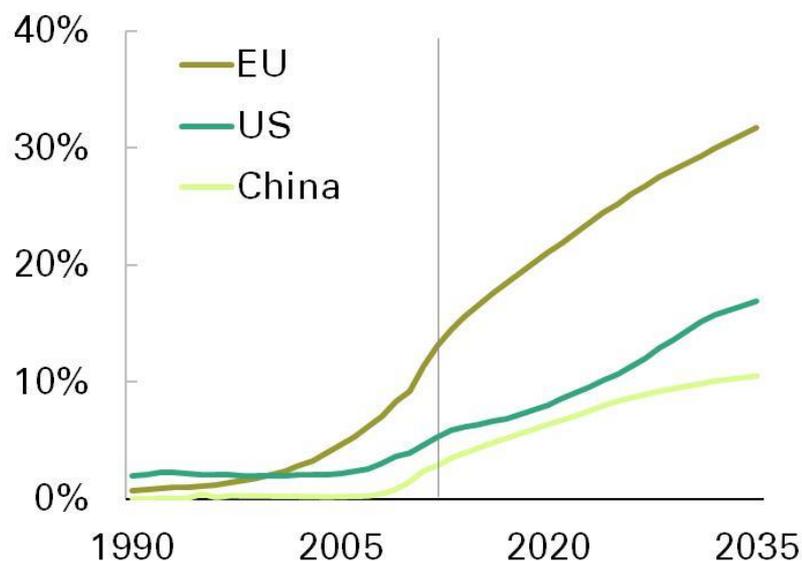
# Global energy demand and supply

BP Energy Outlook 2035, January 2015

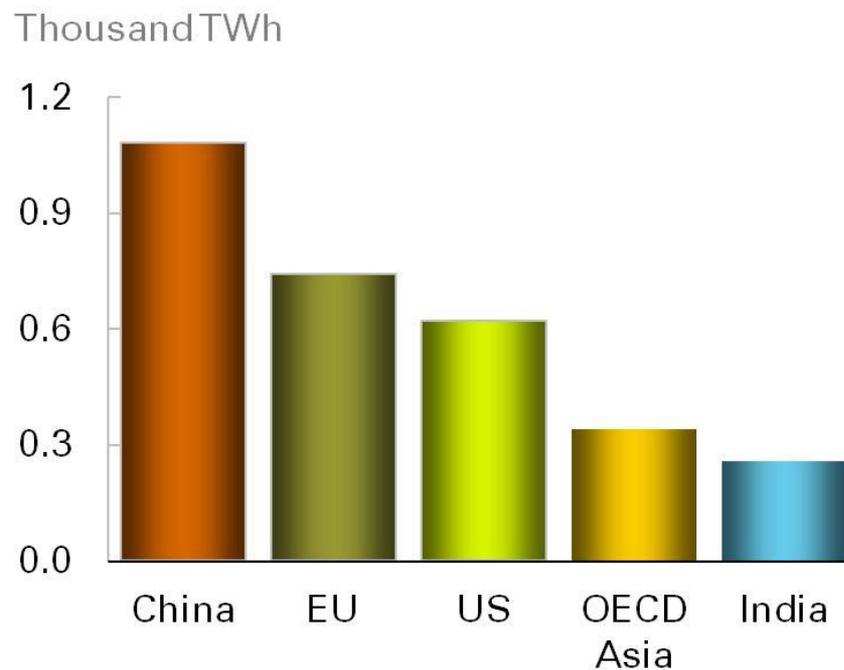


## Renewables in power gain share most rapidly in Europe

### Renewables share of power



### Renewables growth 2012-35



Energy Outlook 2035

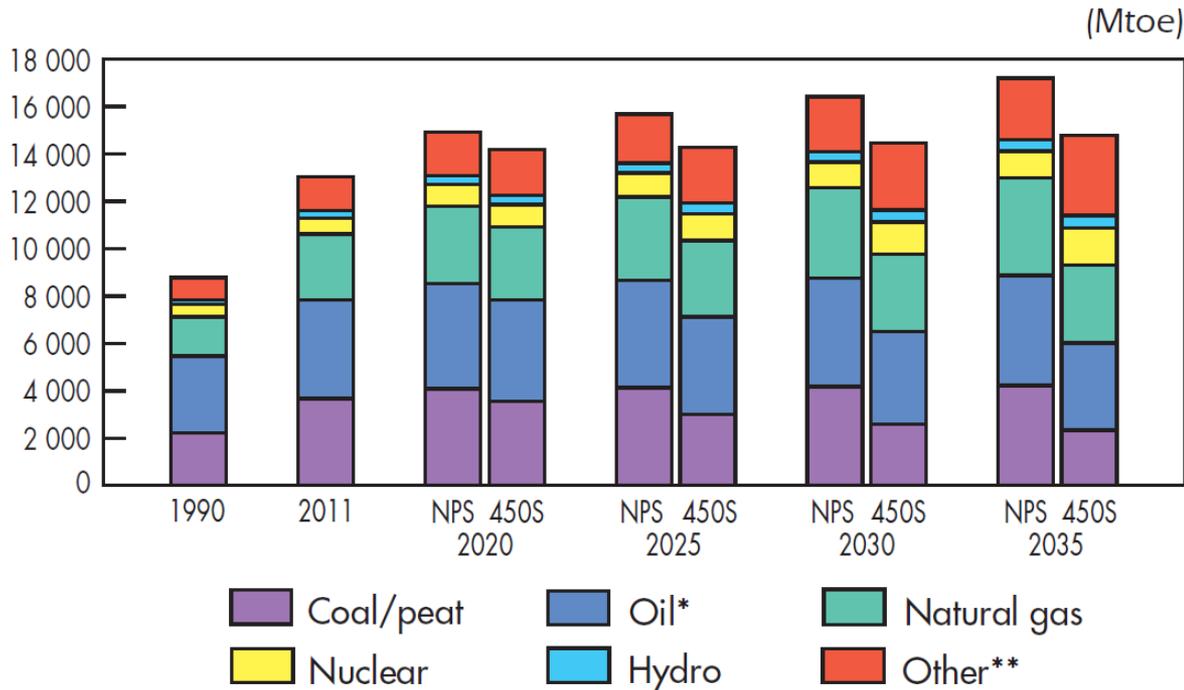
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# Bioenergy in general

## *Chapter 2*

# Bioenergy in general

IEA, 2013 Key World Energy Statistics



> Renewables will increase under all scenario's

NPS: New Policies Scenario  
(based on policies under consideration)

450S: 450 Scenario\*\*\*  
(based on policies needed to limit global average temperature increase to 2 °C)

\*Includes international aviation and international marine bunkers.

\*\*Other includes biofuels and waste (referred to as "bioenergy" in WEO 2012), geothermal, solar, wind, tide, etc.

\*\*\*Based on a plausible post-2012 climate-policy framework to stabilise the long-term concentration of global greenhouse gases at 450 ppm CO<sub>2</sub>-equivalent.

# Bioenergy in general

REN21, Renewables 2013 Global Futures Report



Table 1: Sectoral Shares of Renewable Energy in Recent Global Scenarios

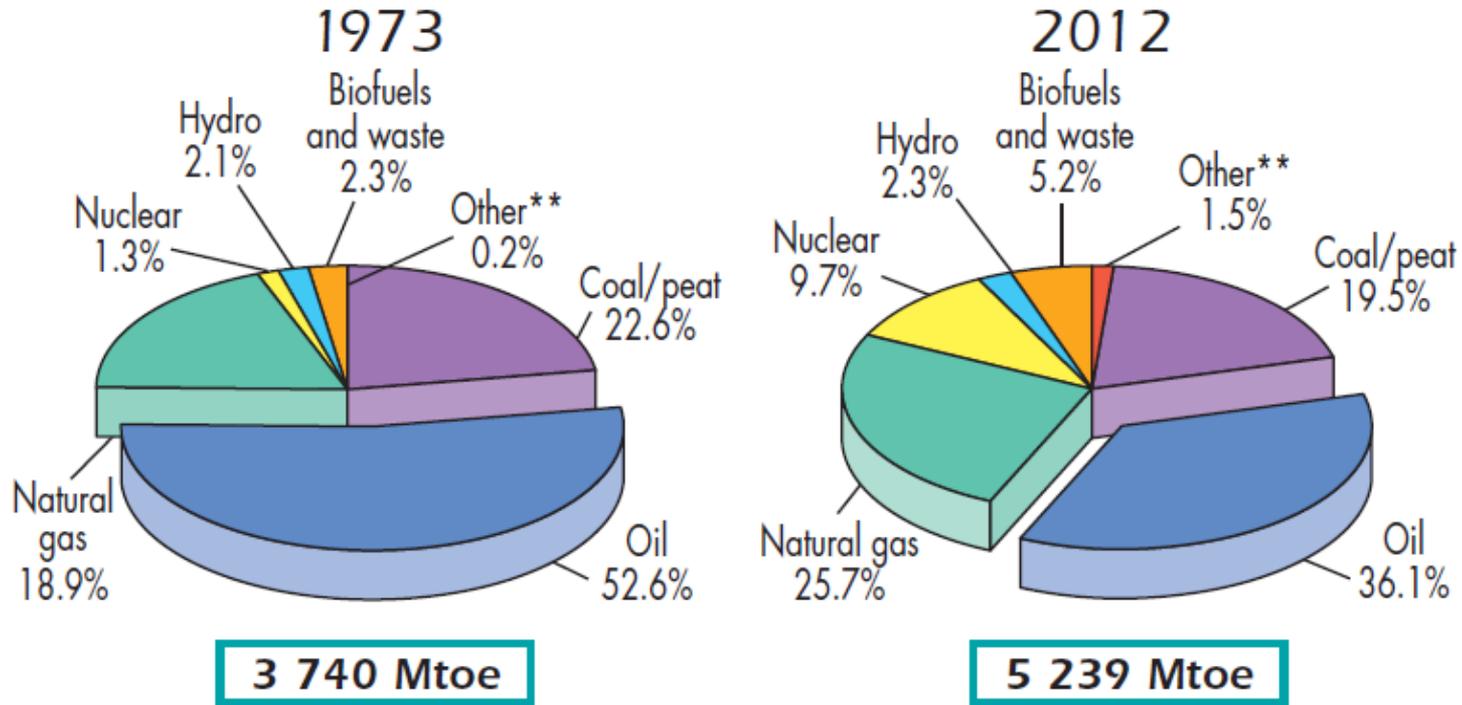
Scenario	By Year	Electricity	Heat	Transport
<b>By 2030–2040</b>				
ExxonMobil <i>Outlook for Energy: A View to 2040</i> (2012)	2040	16%	—	—
BP <i>Energy Outlook 2030</i> (2012)	2030	25%	—	7%
IEA <i>World Energy Outlook</i> (2012) “New Policies”	2035	31%	14%	6%
IEA <i>World Energy Outlook</i> (2012) “450”	2035	48%	19%	14%
Greenpeace (2012) <i>Energy [R]evolution</i>	2030	61%	51%	17%
<b>By 2050</b>				
IEA <i>Energy Technology Perspectives</i> (2012) “2DS”	2050	57%	—	39%
GEA <i>Global Energy Assessment</i> (2012)	2050	62%	—	30%
IEA <i>Energy Technology Perspectives</i> (2012) “2DS High Renewables”	2050	71%	—	—
Greenpeace (2012) <i>Energy [R]evolution</i>	2050	94%	91%	72%
WWF (2011) <i>Ecofys Energy Scenario</i>	2050	100%	85%	100%

Notes: Transport shares for IEA WEO, IEA ETP, and BP are only for biofuels; transport share for Greenpeace includes electric vehicles; transport share for WWF is entirely biofuels. Heat share for WWF is only industry and buildings. Electricity share for BP is estimated from graphics. Electricity share for GEA is based on the central “Efficiency” case.

> Renewables will increase under all scenario’s

# Bioenergy in general

IEA, 2013 Key World Energy Statistics



\*Excludes electricity trade.  
\*\*Other includes geothermal, solar, wind, heat, etc.

> TPES: Biofuels and waste energy supply has tripled

# Bioenergy in general

Business Insight, Global Biomass Market Outlook, 2011



Details	Actual scenario	Current policies scenario***			New policies scenario***		
	2008 (Mtoe)	2020 (Mtoe)	2035 (Mtoe)	CAGR 2020– 35 (%)	2020 (Mtoe)	2035 (Mtoe)	CAGR 2020– 35 (%)
Coal	3,315	4,307	5,281	1.4	3,966	3,934	-0.1
Oil	4,059	4,443	5,026	0.8	4,346	4,662	0.5
Gas	2,596	3,166	4,039	1.6	3,132	3,748	1.2
<b>Biomass*</b>	<b>1,225</b>	<b>1,461</b>	<b>1,715</b>	<b>1.1</b>	<b>1,501</b>	<b>1,957</b>	<b>1.8</b>
Nuclear	712	915	1,081	1.1	968	1,273	1.8
Other renewables**	89	239	468	4.6	268	699	6.6
Hydroelectric	276	364	439	1.3	376	476	1.6
<b>Total</b>	<b>12,271</b>	<b>14,896</b>	<b>18,048</b>	<b>1.3</b>	<b>14,556</b>	<b>16,748</b>	<b>0.9</b>

Source: IEA

Note: \*Includes traditional and modern uses

\*\* Other renewables includes biomass, solar, wind, geothermal and marine power

\*\*\*IEA's forecast refers to a New Policies Scenario, taking into account broad policy commitments and plans, which have been announced by countries globally. This includes pledges to reduce greenhouse gas emissions and plans to phase out fossil-energy subsidies even where the measures to implement these commitments have yet to be identified or announced by countries. Current Policies Scenario assumes no change in policies as of mid-2010.

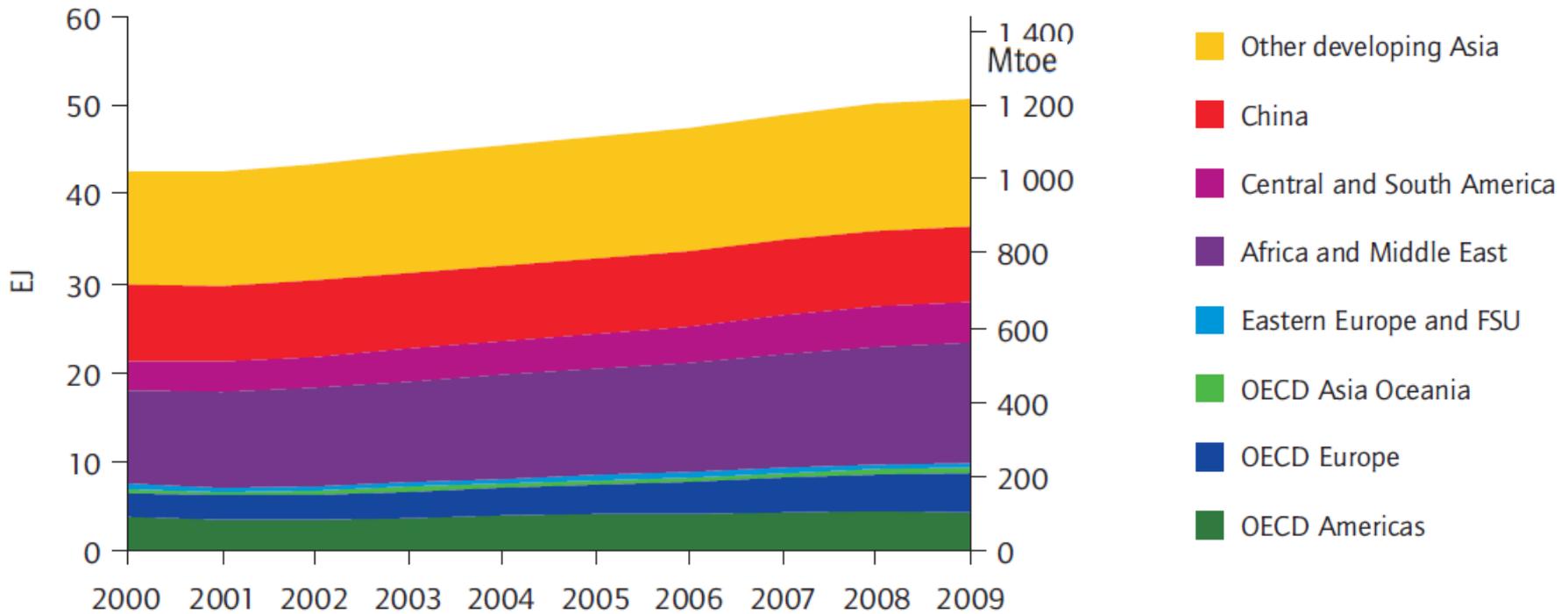
> Bioenergy growing in all scenarios; 20% (2020); 40-60% (2035)

# Bioenergy in general

IEA, Technology Roadmap Bioenergy for Heat & Power



## Figure 1: Global primary bioenergy supply

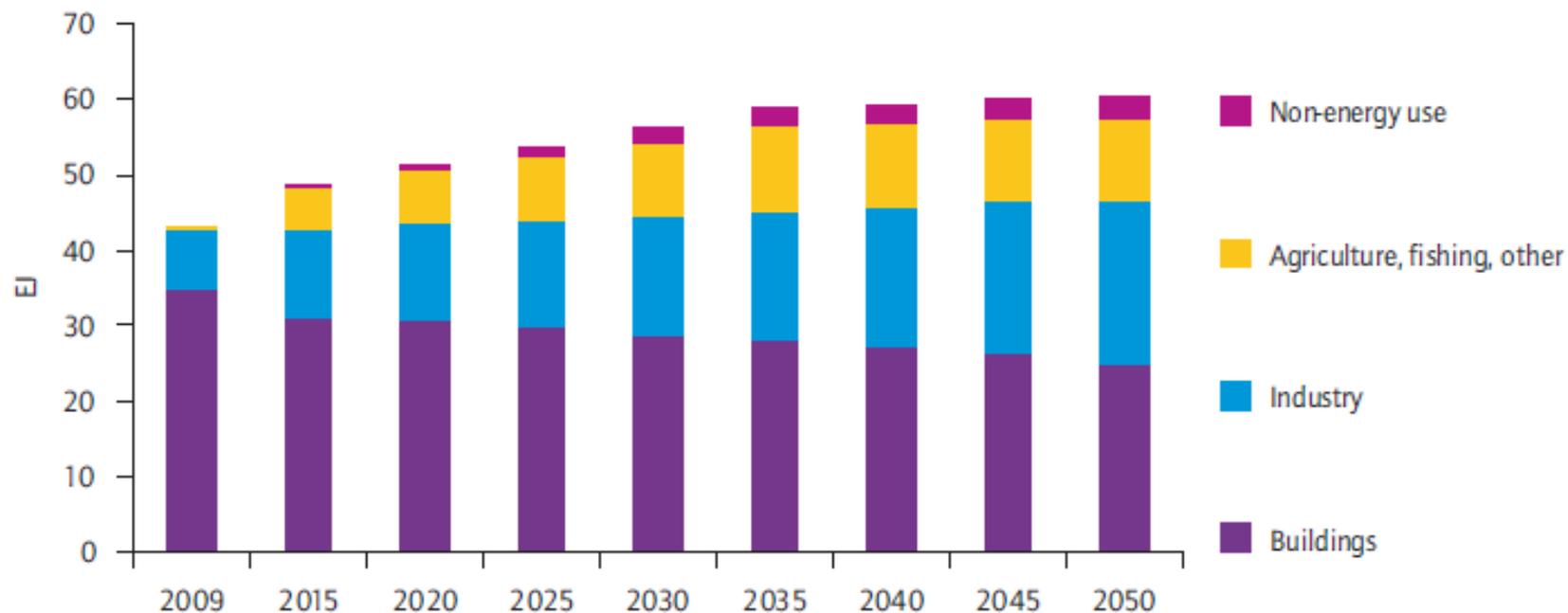


> Traditional biomass use in emerging & developing countries

# Bioenergy in general

IEA, Technology Roadmap Bioenergy for Heat & Power

### Figure 8: Roadmap vision of world final bioenergy consumption in different sectors



Note: Bioenergy use in the buildings sector is for both heating and cooking. Demand for transport fuels is not shown here since this has been discussed in a previous roadmap (IEA, 2011b).

The above figure includes traditional use of biomass and the transition towards efficient cook stoves.

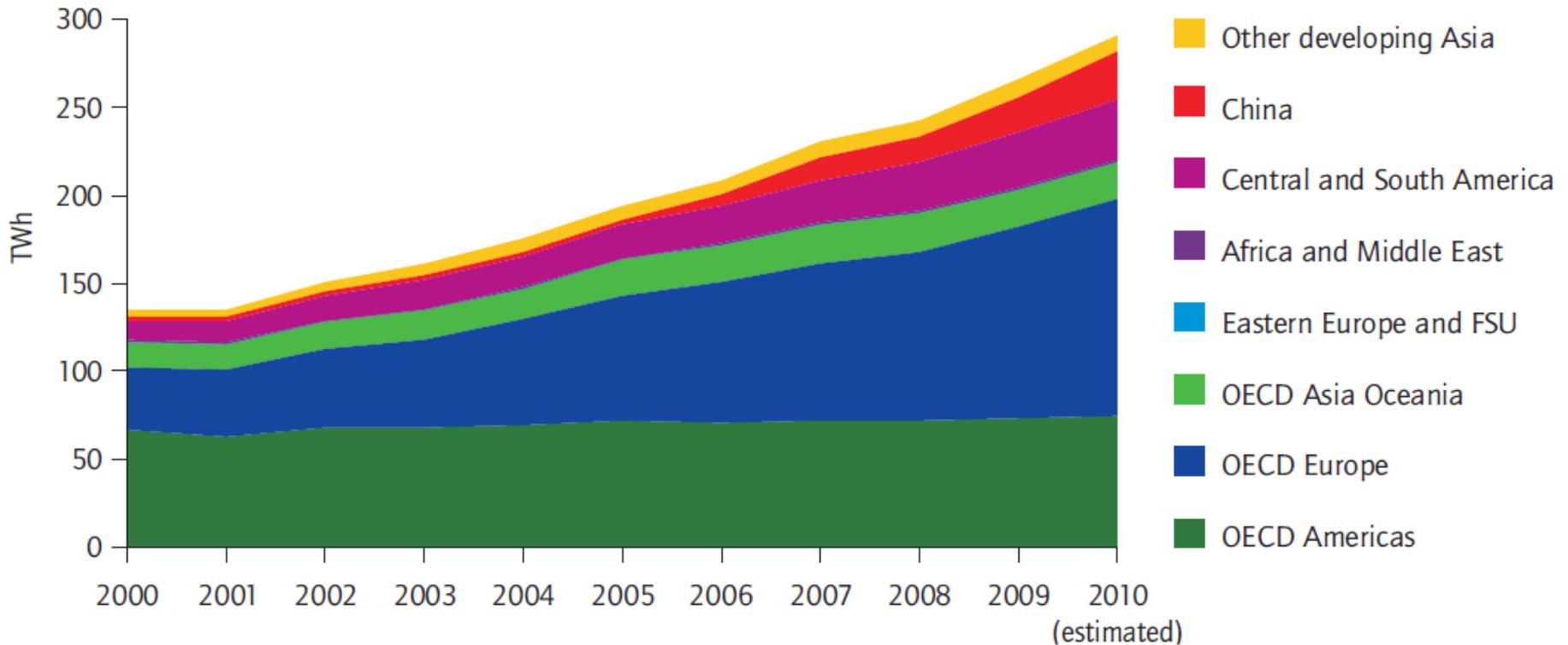
> Increasing bioenergy for productive use (not transport)

# Bioenergy in general

IEA, Technology Roadmap Bioenergy for Heat & Power



### Figure 3: Global bioenergy electricity generation 2000-10



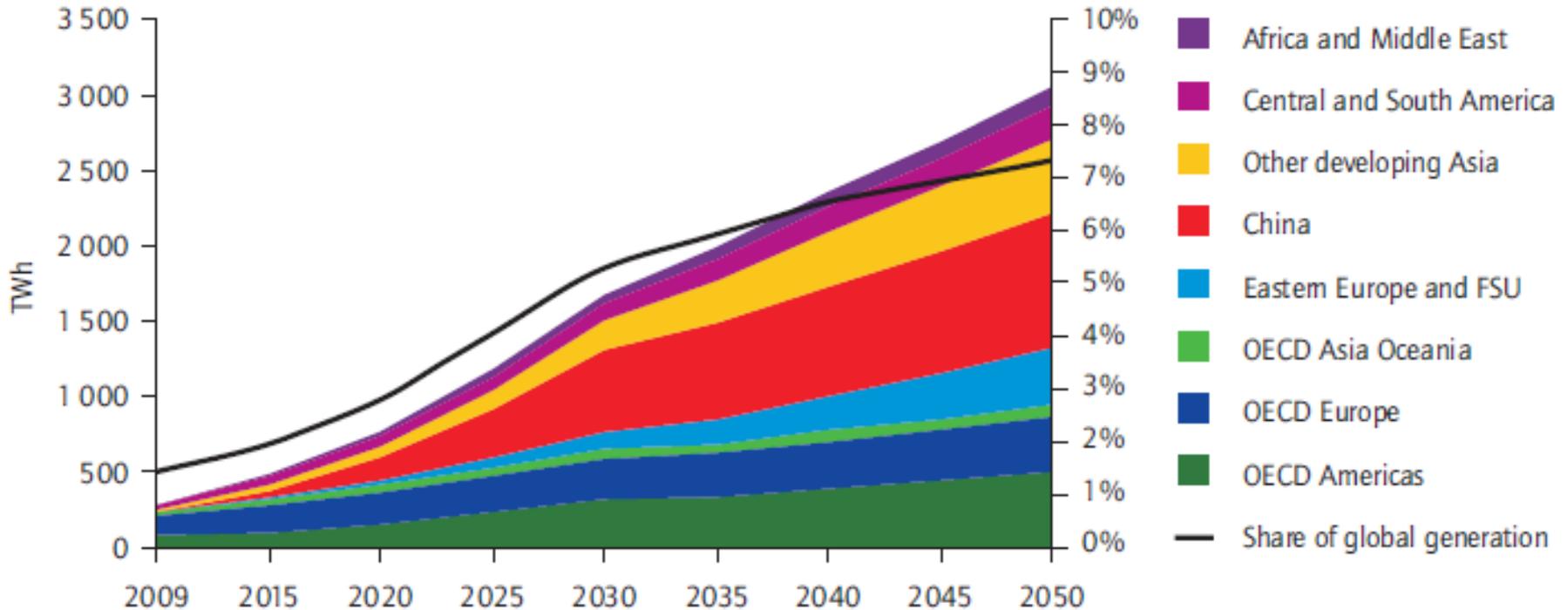
> Bioelectricity generation high in OECD countries and rising in China

# Bioenergy in general

IEA, Technology Roadmap Bioenergy for Heat & Power



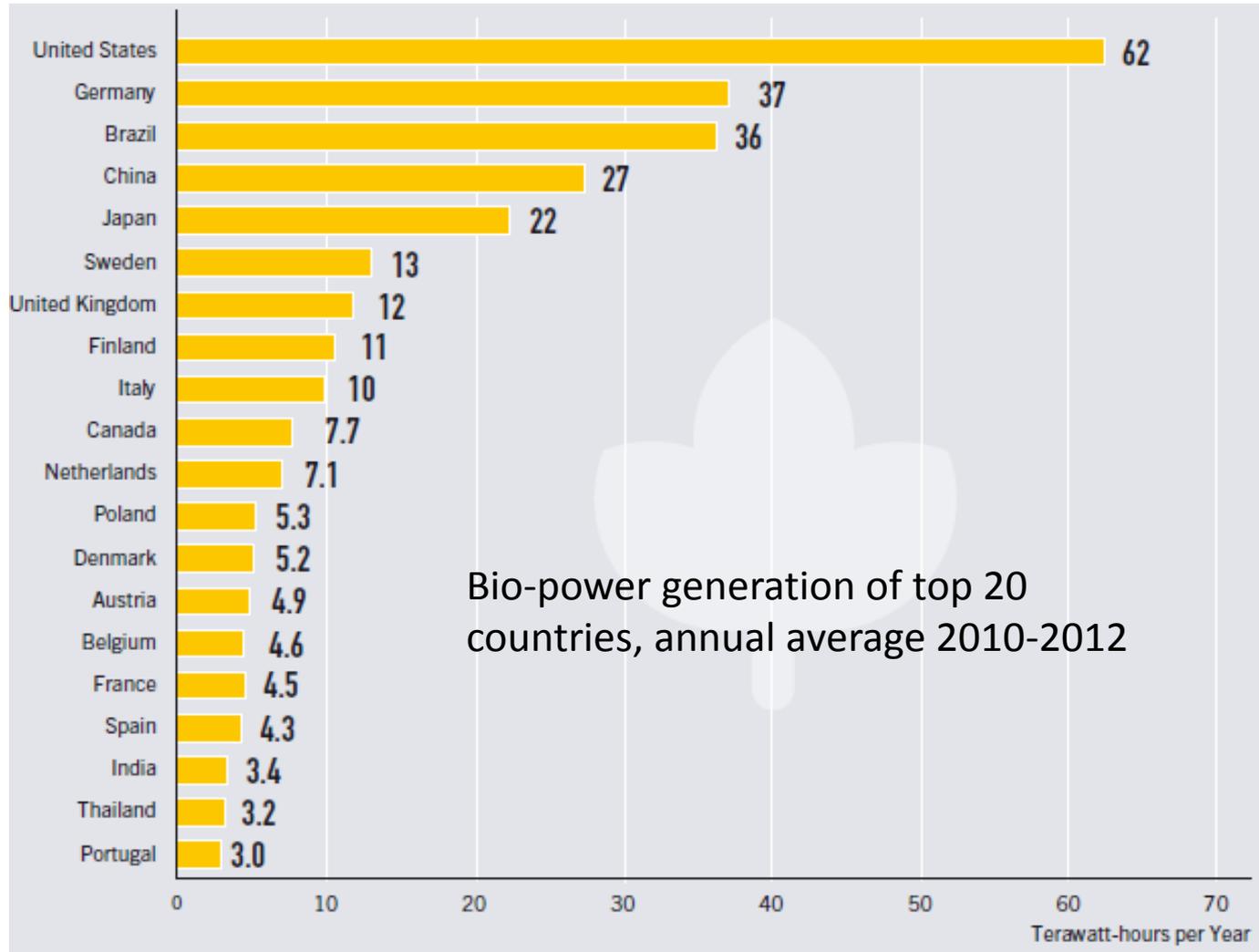
Figure 9: Roadmap vision of bioenergy electricity generation by region



> Very strong growth of global bioelectricity generation, especially Eastern Europe/FSU, China and other developing Asia

# Bioenergy in general

REN21, Renewables 2013 Global Status Report

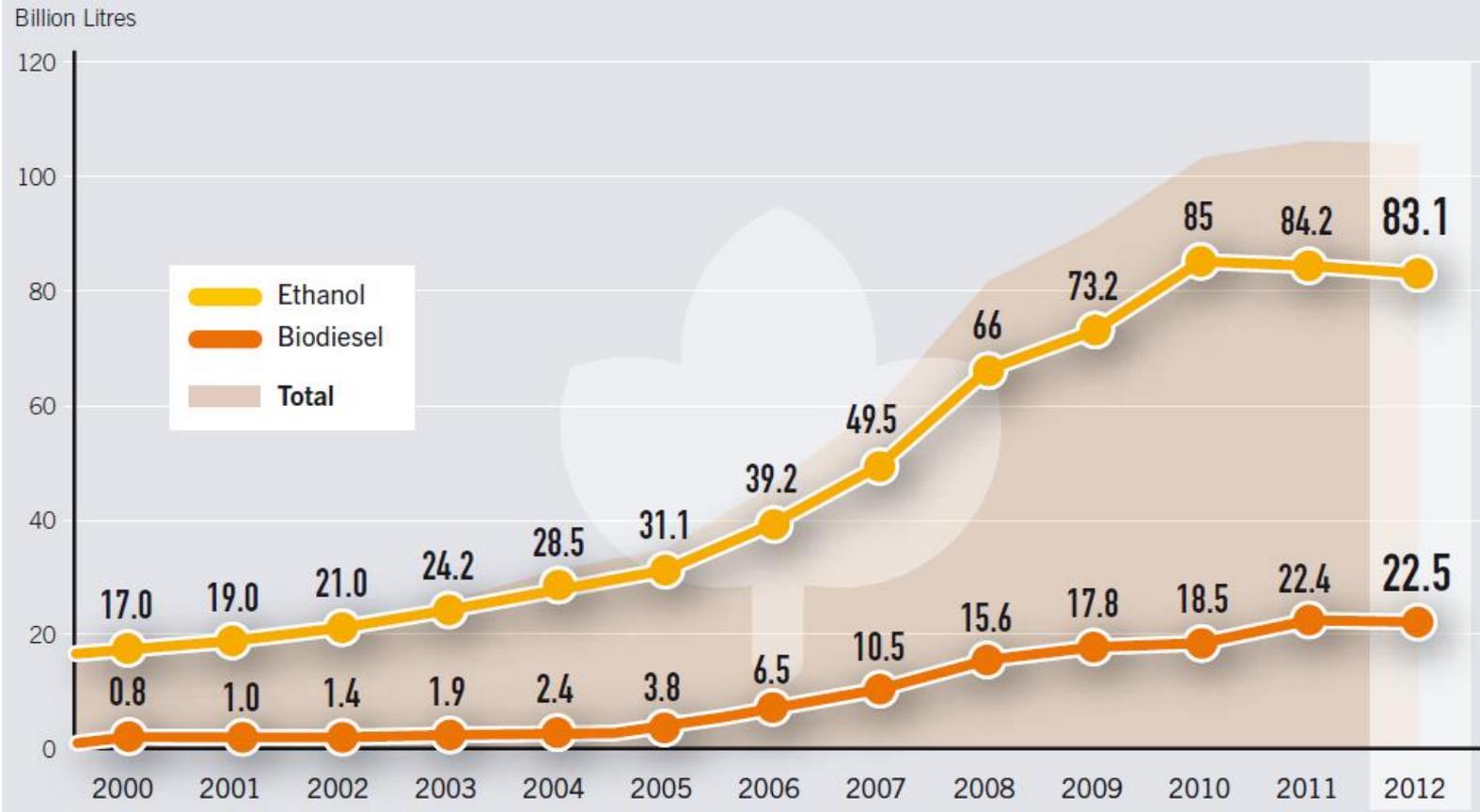


# Bioenergy in general

REN21, Renewables 2013 Global Status Report



FIGURE 8. ETHANOL AND BIODIESEL GLOBAL PRODUCTION, 2000–2012



# Bioenergy in general

REN21, Renewables 2013 Global Status Report



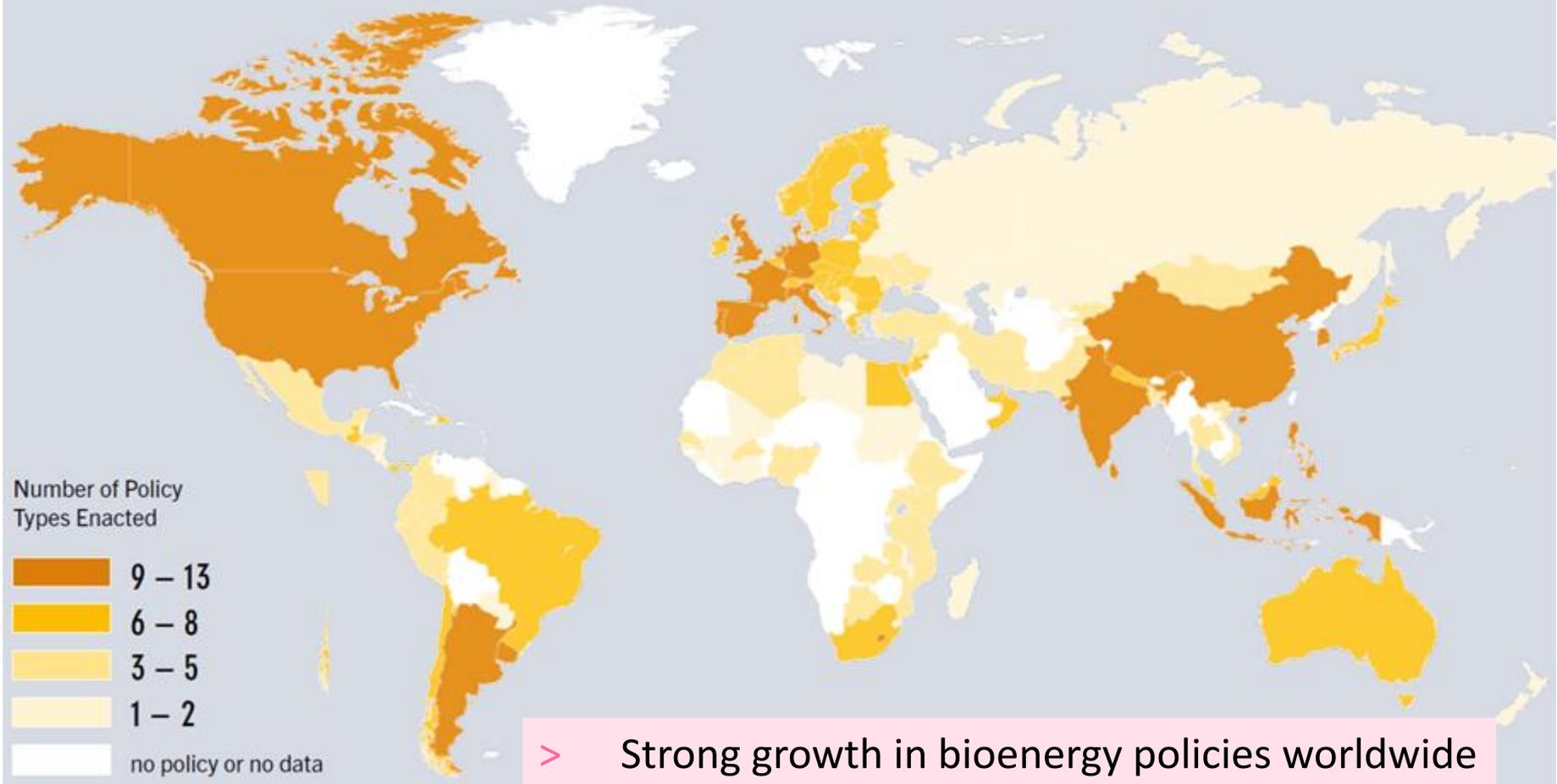
## FIGURE 26. COUNTRIES WITH RENEWABLE ENERGY POLICIES, 2005



# Bioenergy in general

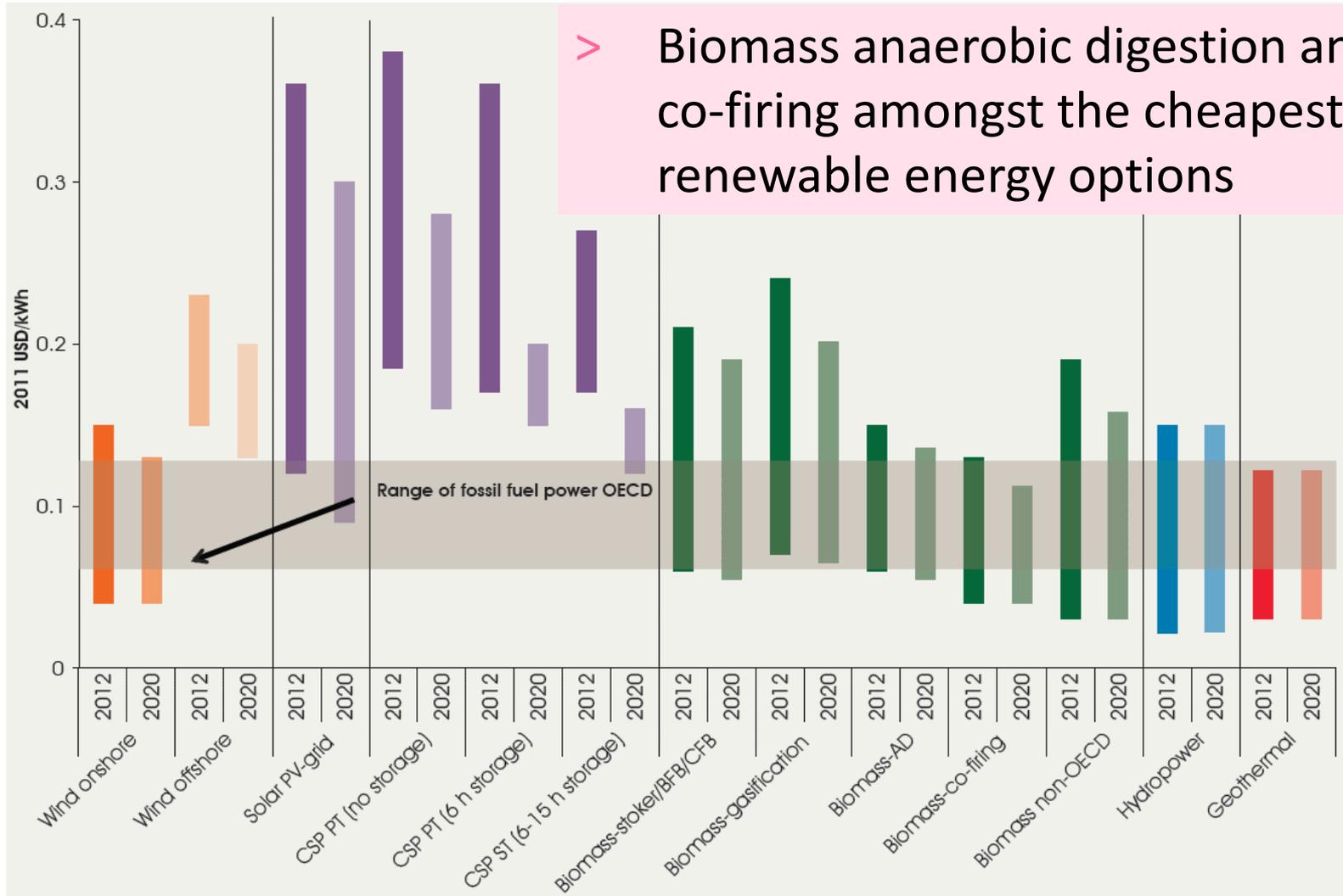
REN21, Renewables 2013 Global Status Report

FIGURE 25. COUNTRIES WITH RENEWABLE ENERGY POLICIES, EARLY 2013



# Bioenergy in general

Business Insight, Global Biomass Market Outlook, 2011

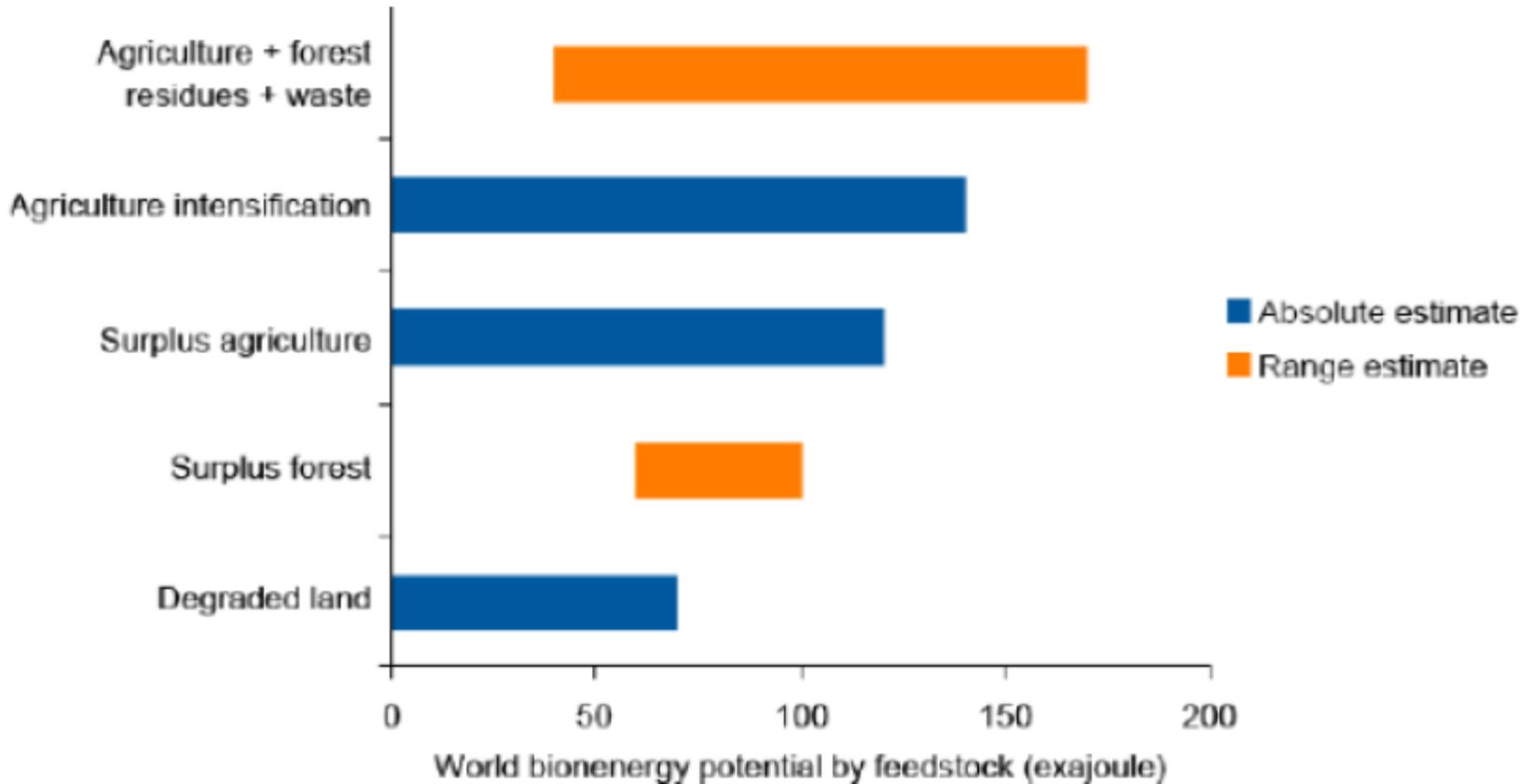


# Bioenergy in general

Business Insight, Global Biomass Market Outlook, 2011



## World bioenergy potential estimate by feedstock (exajoules), 2050



Source: University of Copenhagen (Doornbosch and Steenblik, 2008)

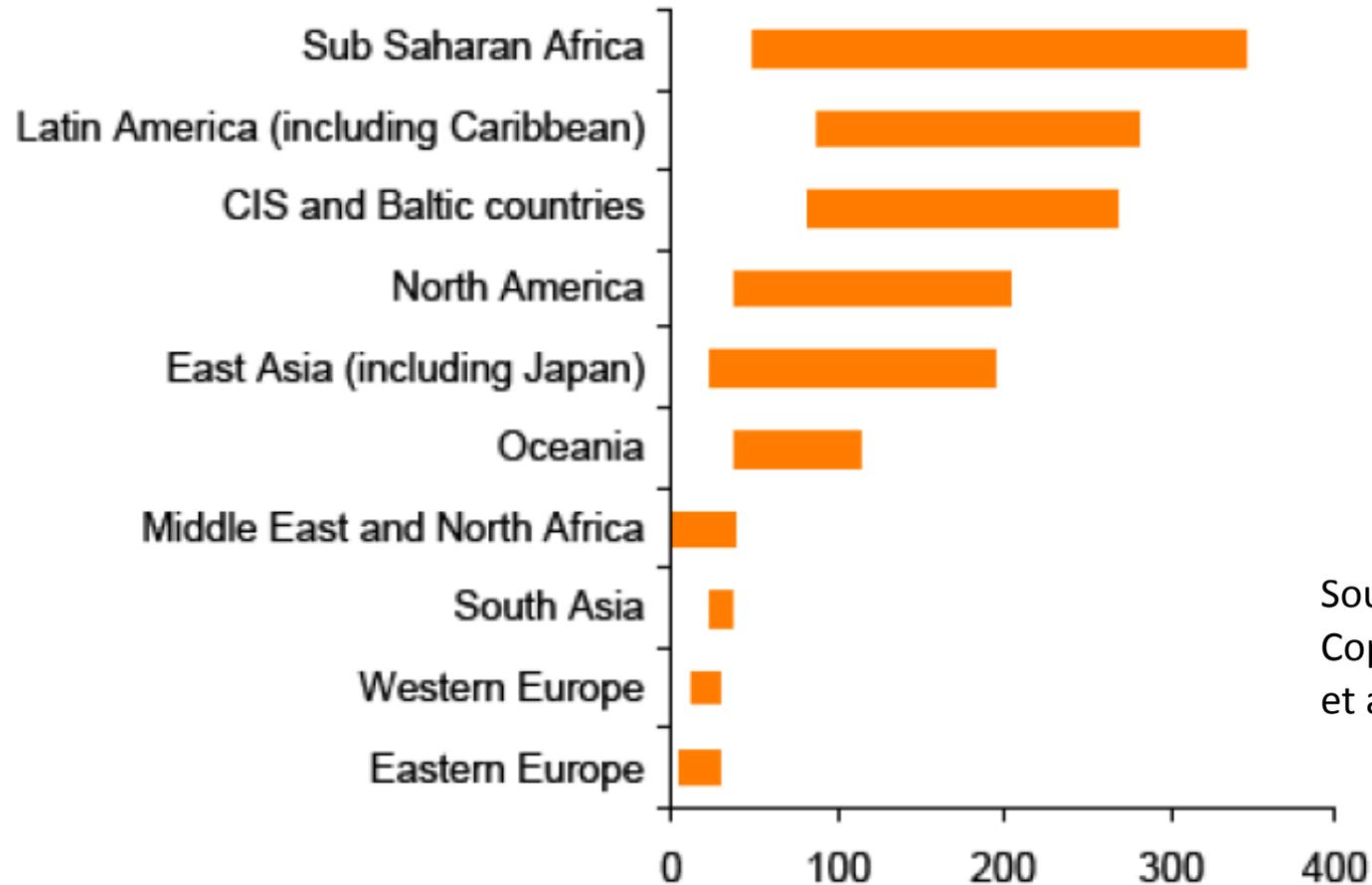
BUSINESS INSIGHTS

> Huge global bioenergy potential

# Bioenergy in general

Business Insight, Global Biomass Market Outlook, 2011

## World bioenergy potential by region (exajoules), 2050



Source: University of Copenhagen (Smeets et al, 2007)

> Huge potential in emerging and developing countries

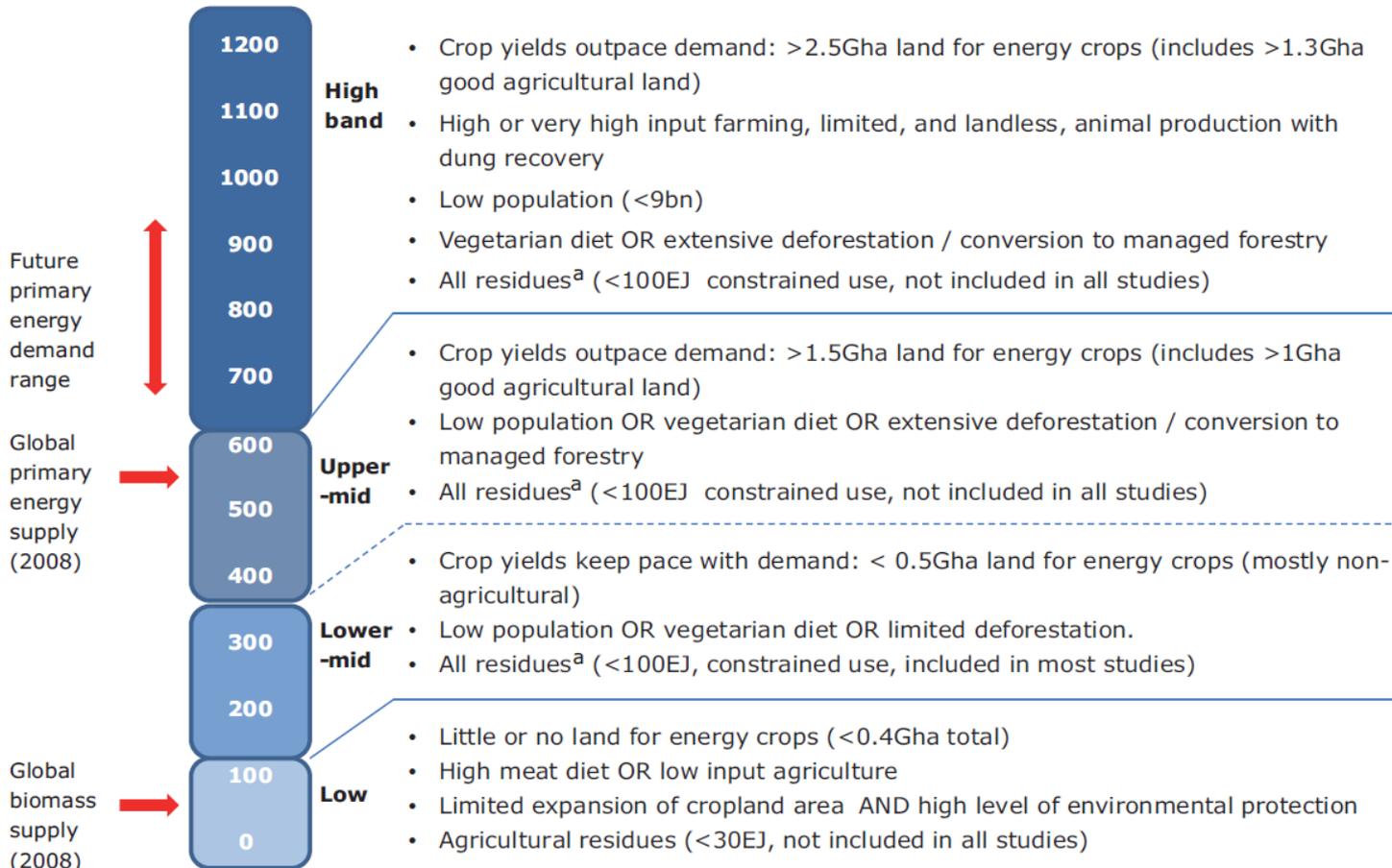
# Bioenergy in general

UKERC, Energy from biomass – global resources, 2011



Global biomass potential (EJ)

Essential pre-conditions



<sup>a</sup> Agricultural residues, forestry residues, wastes (dung, MSW, industrial)

# Biogas

## *Chapter 3*

# Biogas

## AEBIOM, European Bioenergy Outlook 2013

	2010				2011*			
	Landfill Gas	Sewage sludge gas <sup>1</sup>	Other biogas <sup>2</sup>	Total	Landfill Gas	Sewage sludge gas <sup>1</sup>	Other biogas <sup>2</sup>	Total
EU27	2801.7	1065	10875.4	10875.4	3157.9	1208	5719.3	10085.8
BE	41.9	14.6	70.9	127.4	41.9	14.6	70.9	127.4
BG	-	-	-	-	-	-	-	-
CZ	29.5	35.9	111.3	176.7	31.8	38.8	179.9	249.6
DK	8.1	20.1	74	102.2	5.2	19.6	73.2	98.1
DE	232.5	402.6	6034.5	6669.6	149	504.2	4414.2	5067.6
EE	2.7	1.1	0	3.7	2.2	1.1	0	3.3
IE	44.2	9.6	4.6	58.4	43.8	8.2	5.6	57.6
EL	51.7	15	1	67.7	55.4	16.1	1.4	72.8
ES	119.6	12.4	66.7	198.7	148.1	15.3	82.6	246
FR	236.7	44.1	53.2	334	249.7	41.9	58	349.6
IT	349.6	8.1	149.8	507.5	755.6	16.2	323.9	1095.7
CY	0	0	1	1	0	0	1	1
LV	7.9	3.3	2.2	13.3	7.8	2.4	11.8	22
LT	2	3	5	10	5.9	3.1	2.1	11.1
LU	0.1	1.2	11.7	13	0.1	1.4	11.3	12.8
HU	2.6	12.3	19.3	34.2	7.3	6.4	15.5	29.1
MT	-	-	-	-	-	-	-	-
NL	36.7	50.2	206.5	293.4	31.5	51.5	208.3	291.3
AT	5.1	22.3	144.2	171.6	4.3	16.4	138.8	159.5
PL	43.3	63.3	8	114.6	47.5	67.8	20.1	135.4
PT	28.2	1.7	0.8	30.7	42.3	1.8	0.9	45
RO	0	0	3	3	0	0	3	3
SE	35.7	60.7	14.8	111.2	12.4	68.9	37.9	119.3
SI	7.7	2.8	19.9	30.4	7.1	2.7	26.2	36
SK	0.8	9.5	1.8	12.2	3	13.6	29.3	45.8
FI	22.7	13.2	4.5	40.4	23.9	13.4	4.8	42
UK	1492.6	258	0	1750.6	1482.4	282.4	0	1764.8

### Primary energy production of biogas in the EU 27 in 2010 and 2011\* (ktoe)

\* Estimation

\*\* Overseas department not included

<sup>1</sup> Urban and industrial

<sup>2</sup> Decentralised agricultural plants, municipal solid waste, mechanisation plants, centralized co-digestion plants.

Source: Euroobserver 2012

- > Germany EU leader in biogas
- > UK second, mainly landfill gas
- > Italy third
- > Rest of EU is lagging behind

# Biogas

## AEBIOM, European Bioenergy Outlook 2013

Electricity

	Biogas		
	2010 Production (GWh)		2020 TARGETS Production (GWh)
	NREAPs	PR	
<b>TOTAL EU27</b>	28719	23817	63028
AT	553	649	581
BE	393,3	568,2	1439,1
BG	2	16	357
CY	30	35,13	143
CZ	624	0	2871
DK	194	333	2493
EE	0	10	0
FI	40	89	270
FR	935	1013	3701
DE	13829	16200	23438
GR	181	216	895
HU	85	112	636
IE	320	18	319
IT	2129	2054	6020
LV	64	57	584
LT	50	31	413
LU	44	56	144
MT	8,68	0	49,98
NL	872	1044	4664
PO	328	398,38	4018
PT	138	100	525
RO	0	0,245	0
SK	70	32	860
SI	148	97	367
ES	799	653	2617
SE	53	36	53
UK	6830	0	5570

Heat

	Biogas		
	2010		2020 TARGETS
	NREAPs	PR	
<b>Total EU27</b>	1476,41	1928,999	4416,12
AT	15	28	16
BE	8,9	26,2	55
BG	0	3	20
CY	2	2,39	6
CZ	53	0	167
DK	59	49	165
EE	0	2	0
FI	30	8	60
FR	83	129	555
DE	912	1293	1692
GR	0	2	0
HU	0	9	56
IE	10	7,6	33
IT	26	26	266
LV	7	4	49
LT	6	5	50
LU	4,6	6,5	13,4
MT	1,01	0,15	1,72
NL	111	116	228
PO	65	45,3	453
PT	10	32	37
RO	1	0,859	20
SK	4	7	60
SI	0	5	0
ES	33	39	100
SE	16,9	83	11
UK	18	0	302

- > European biogas electricity sector needs to grow almost factor 3 up to 2020
- > European biogas heat sector needs to grow more than factor 2 up to 2020

NREAPs = National renewable energy action plans  
 PR = EC renewable energy progress report, 27 March 2013

# Biogas

SNV Biogas Program, <http://www.snvworld.org/>



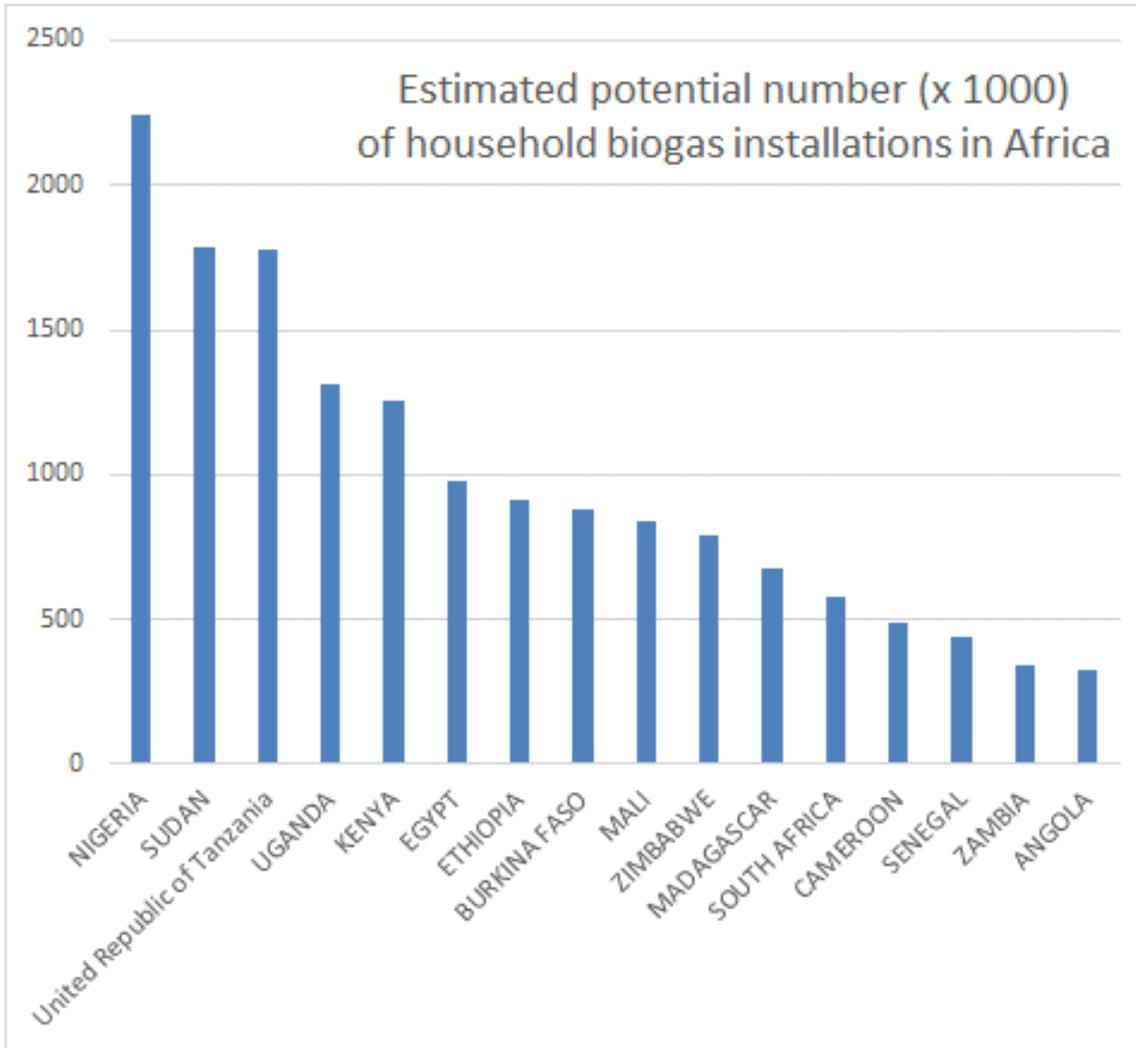
	Country	Programme took off in	2011 (official)	1 <sup>st</sup> half of 2012 (official)	Cumulative up to 1 <sup>st</sup> half of 2012
Asia	Nepal <sup>1</sup>	1992	19,246	17,942	268,418
	Vietnam <sup>2</sup>	2003	23,309	16,984	140,698
	Bangladesh	2006	5,049	2,855	23,611
	Cambodia	2006	4,826	2,478	17,450
	Lao PDR	2006	439	310	2,715
	Pakistan	2009	860	650	2,097
	Indonesia	2009	2,970	959	5,572
	Bhutan	2011	40	115	155
	Rwanda	2007	785	325	2,171
Africa	Ethiopia	2008	1,641	732	3,232
	Tanzania	2008	1,444	763	3,334
	Kenya	2009	2,399	1,678	4,917
	Uganda	2009	1,276	423	2,325
	Burkina Faso	2009	609	456	1,177
	Cameroon	2009	33	6	111
	Benin	2010	20	0	42
	Senegal	2010	225	95	334

Installed household biogas systems in Asia and Africa in SNV biogas programmes.

> SNV small scale (household) biogas programmes are very successful throughout Asia and Africa, with more than 450,000 already installed

# Biogas

SNV



> Opportunities for household biogas in many African countries

# Biogas

WBA Factsheet Biogas, May 2013



**TABLE 5: POTENTIAL FOR BIOGAS IN PJ (BILLION M<sup>3</sup> BIOMETHANE), CH<sub>4</sub>: EU 27, CHINA, WORLD**

Type of resource	EU 27 [4] PJ	EU 27 [4] Billion m <sup>3</sup> CH <sub>4</sub>	China [8,9] PJ	China [8,9] Billion m <sup>3</sup> CH <sub>4</sub>	World [7] PJ	World [7] Billion m <sup>3</sup> CH <sub>4</sub>
Manure	738	20.5	2591	72		
Residues (straw from grain, corn, rice, landscape cleaning)	407	11.3	1152	32		
Energy crops	978	27,2	1799	50		
<b>Total from agriculture</b>	<b>2123</b>	<b>59</b>	<b>5542</b>	<b>154</b>	<b>22674</b>	<b>630</b>
Urban waste (organic fraction of MSW)	360	10	2591	72		
Agro-industry waste (organic fraction)	108	3	1152	32		
Sewage sludge	216	6	576	16		
<b>Total waste, billion m<sup>3</sup> CH<sub>4</sub></b>	<b>684</b>	<b>19</b>	<b>4319</b>	<b>120</b>	<b>13316</b>	<b>370</b>
<b>Total (agriculture and waste)</b>	<b>2807</b>	<b>78</b>	<b>9861</b>	<b>274</b>	<b>35990</b>	<b>1000</b>
<b>Total in EJ</b>	<b>2.8</b>		<b>9.9</b>		<b>35,9</b>	

> Only 5-7% of biogas potential is currently used

- > China leader in biogas plants:
  - in 2013, 42 million small household biogas digesters and
  - 60,000 biogas installations for industrial purposes
- > India is second with 4,5 million biogas units
- > SNV is third with > 450.000 household biogas digesters
- > Germany market leader in biogas technology
- > Sweden is world leader in the use of biogas for transport with nearly 44,000 vehicles
- > Global Biogas Market to Nearly Double in Size to \$33 Billion by 2022 (Pike Research, June 2012)



## Agriculture shows greatest potential in biogas

75 %\* of the biogas potential is in the anaerobic digestion of agricultural crops, by-products and manure



17%\* in municipal and industrial organic waste



8%\* in sewage WWTF's



*\* The higher utilization rate of farmland as an energy resource could increase the share of manure, agricultural crops and by-products to 85%, leaving organic waste a 10% and WWTF's a 5% share*

*Source: Biomass Magazine, Global Water Intelligence, American Biogas Council, Frost And Sullivan, European Biomass Association, Eurostat, Iowa State University*

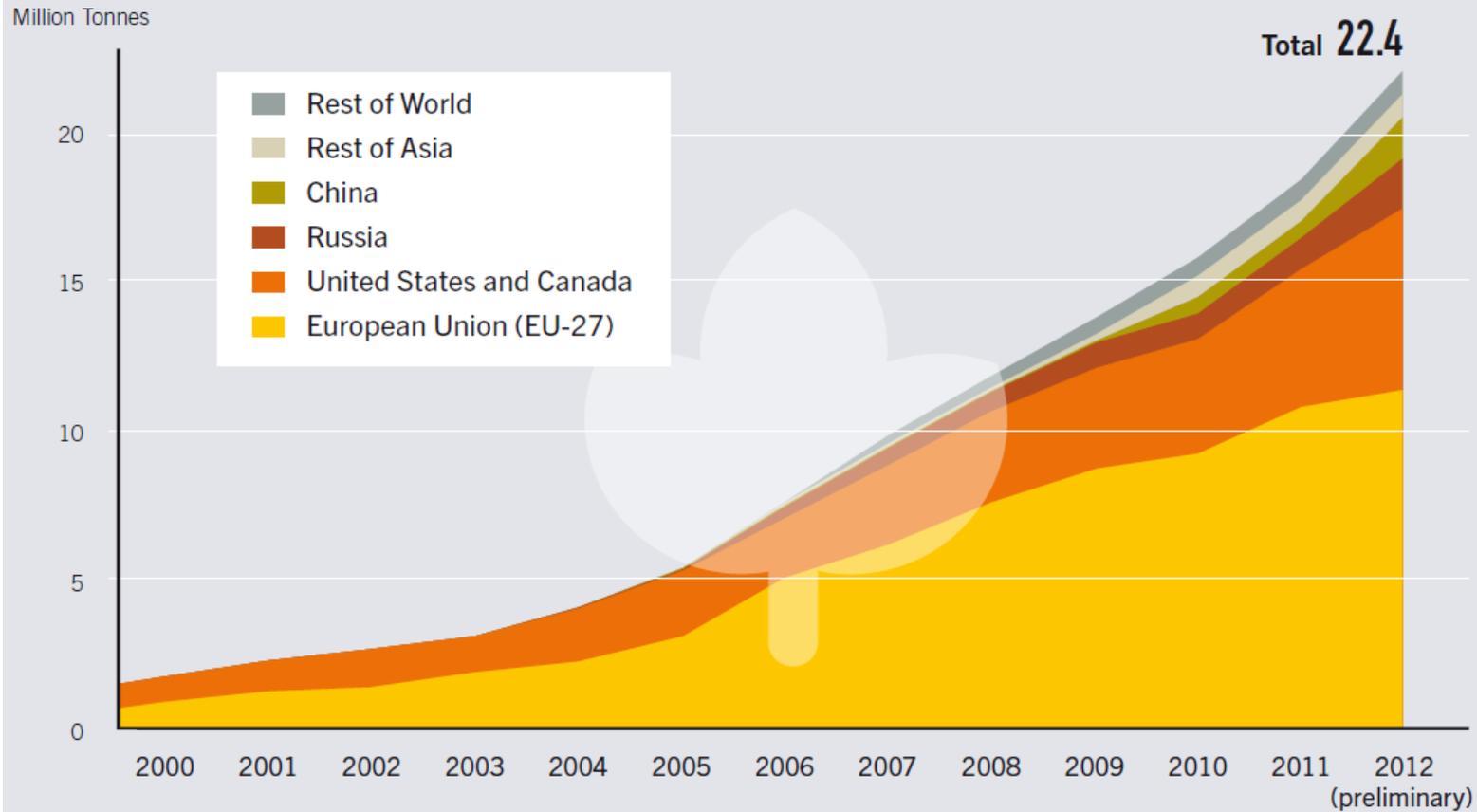
# Wood pellets

## *Chapter 4*

# Wood pellets

IEA, 2013 Key World Energy Statistics

## WOOD PELLET GLOBAL PRODUCTION, BY COUNTRY OR REGION, 2000–2012



> Strong growth global wood pellet production

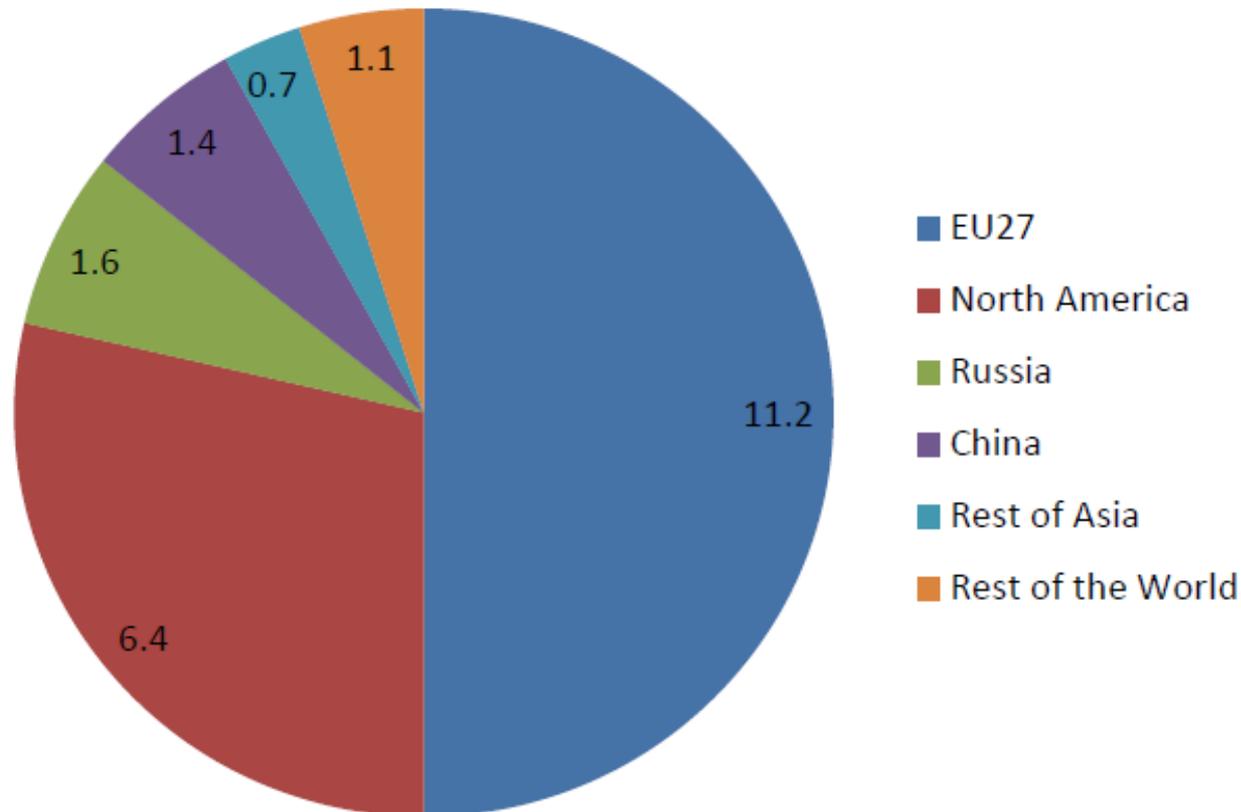
# Wood pellets

AEBIOM, European Bioenergy Outlook 2013



Figure 8.2 World wood pellet production share in 2012

Source: IEA Bioenergy Task 40, EPC



> EU produces 50% of global wood pellets

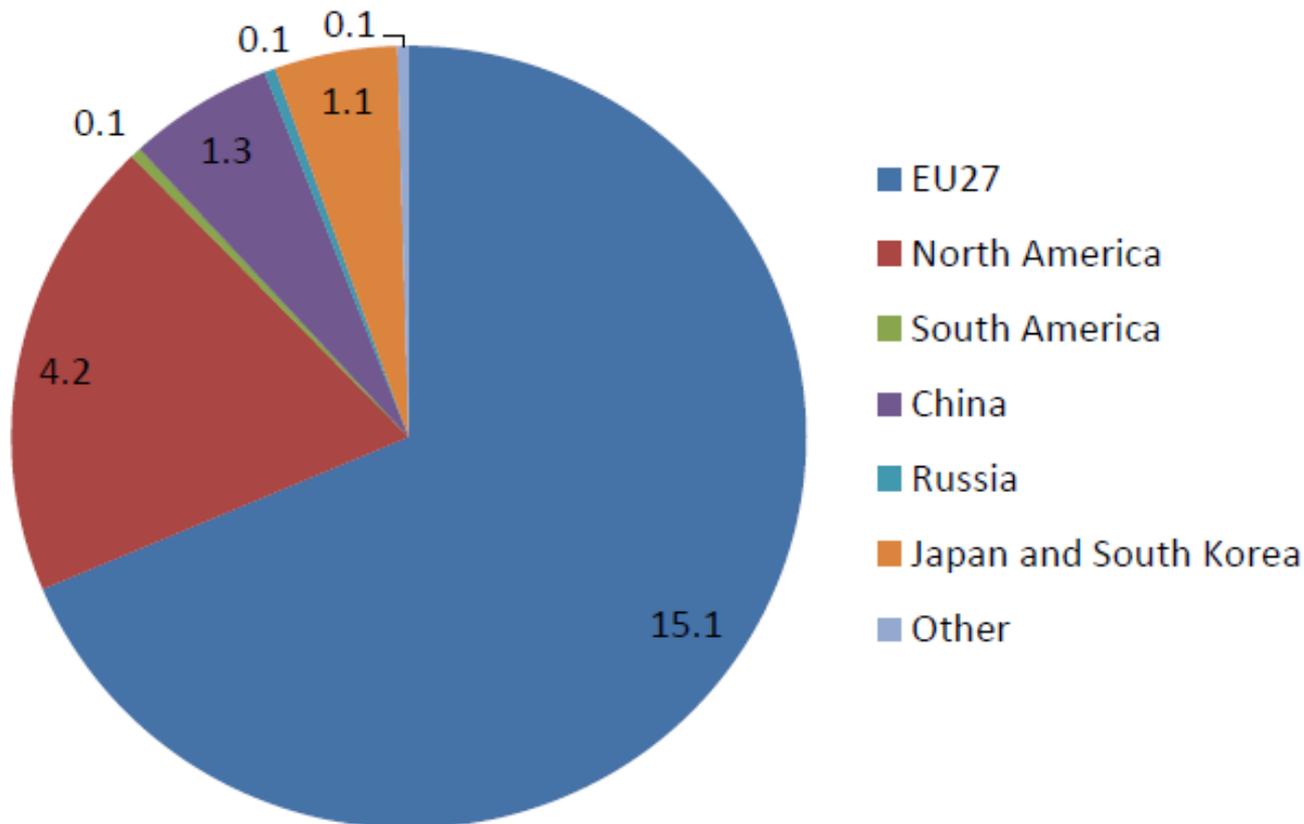
# Wood pellets

AEBIOM, European Bioenergy Outlook 2013



Figure 8.3 World wood pellets consumption share in 2012 (million tons)

Source: POYRY

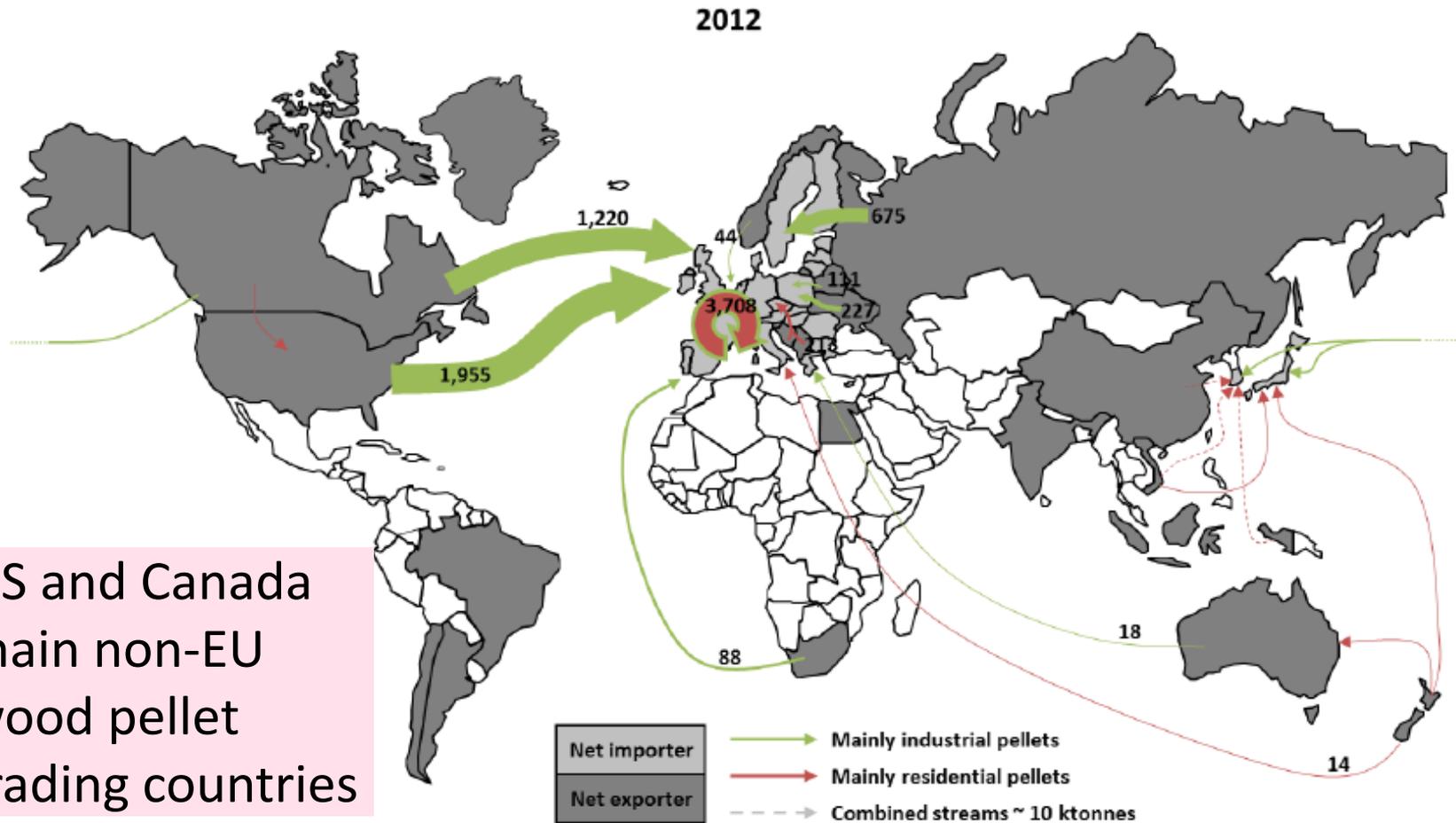


> EU consumes 70% of global wood pellets

# Wood pellets

AEBIOM, European Bioenergy Outlook 2013

Figure 8.4: World wood pellets trade map in 2012



> US and Canada main non-EU wood pellet trading countries

Source: IEA Bioenergy Task 40

# Wood pellets

REN21, Renewables 2013 Global Status Report



Exporter	Importer	Volume
		(kilotonnes)
United States →	EU-27	1,956
Canada →	EU-27	1,221
Russia →	EU-27	676
Ukraine →	EU-27	227
Croatia →	EU-27	132
Belarus →	EU-27	111
Bosnia and Herzegovina →	EU-27	61
South Africa →	EU-27	88
Serbia →	EU-27	22
Australia →	EU-27	19
Norway →	EU-27	45
New Zealand →	EU-27	14
Other →	EU-27	49
Canada →	Japan	50
Canada →	South Korea	50
Canada →	United States	30

> Main non-EU27 wood pellet trading countries; trade in 2012

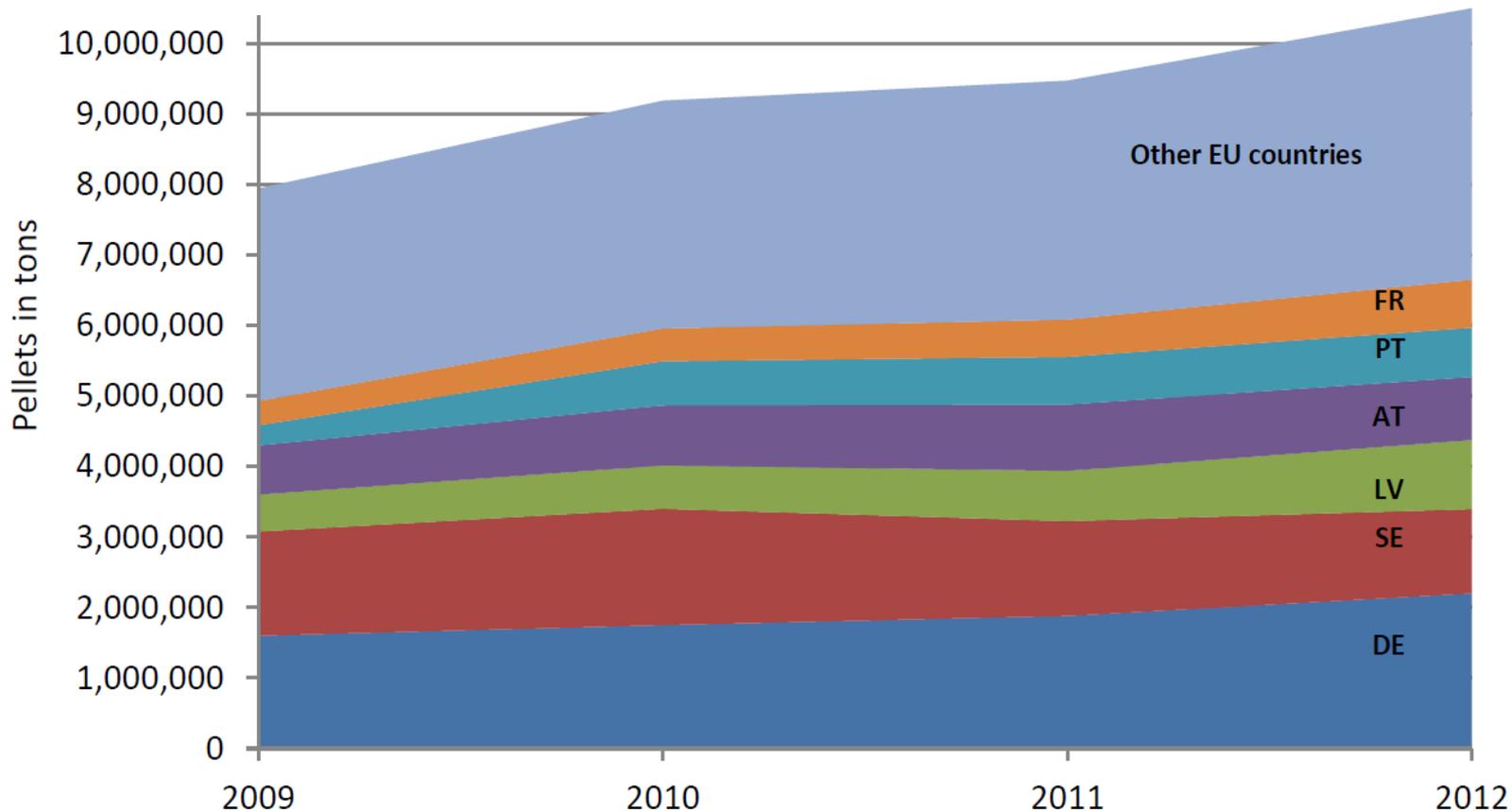
# Wood pellets

AEBIOM, European Bioenergy Outlook 2013



## actual pellet production of the biggest EU pellets producers

Source: EPC 2013



> EU pellet production gradually increasing

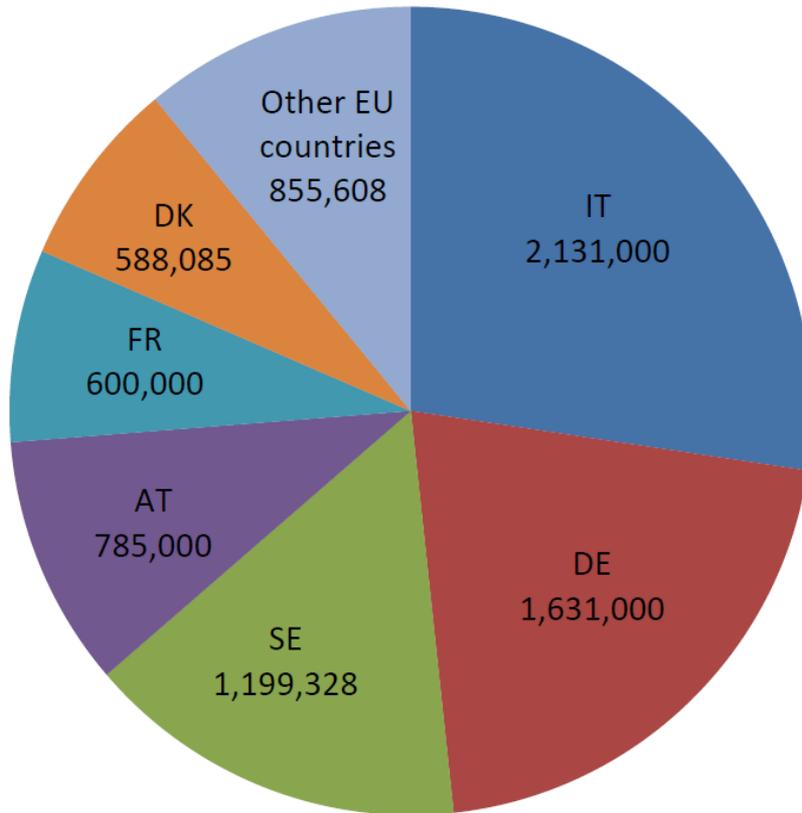
# Wood pellets

AEBIOM, European Bioenergy Outlook 2013



Figure 8.7 Main EU pellet consumers for heating in 2012 (in tons)

Source: EPC 2013

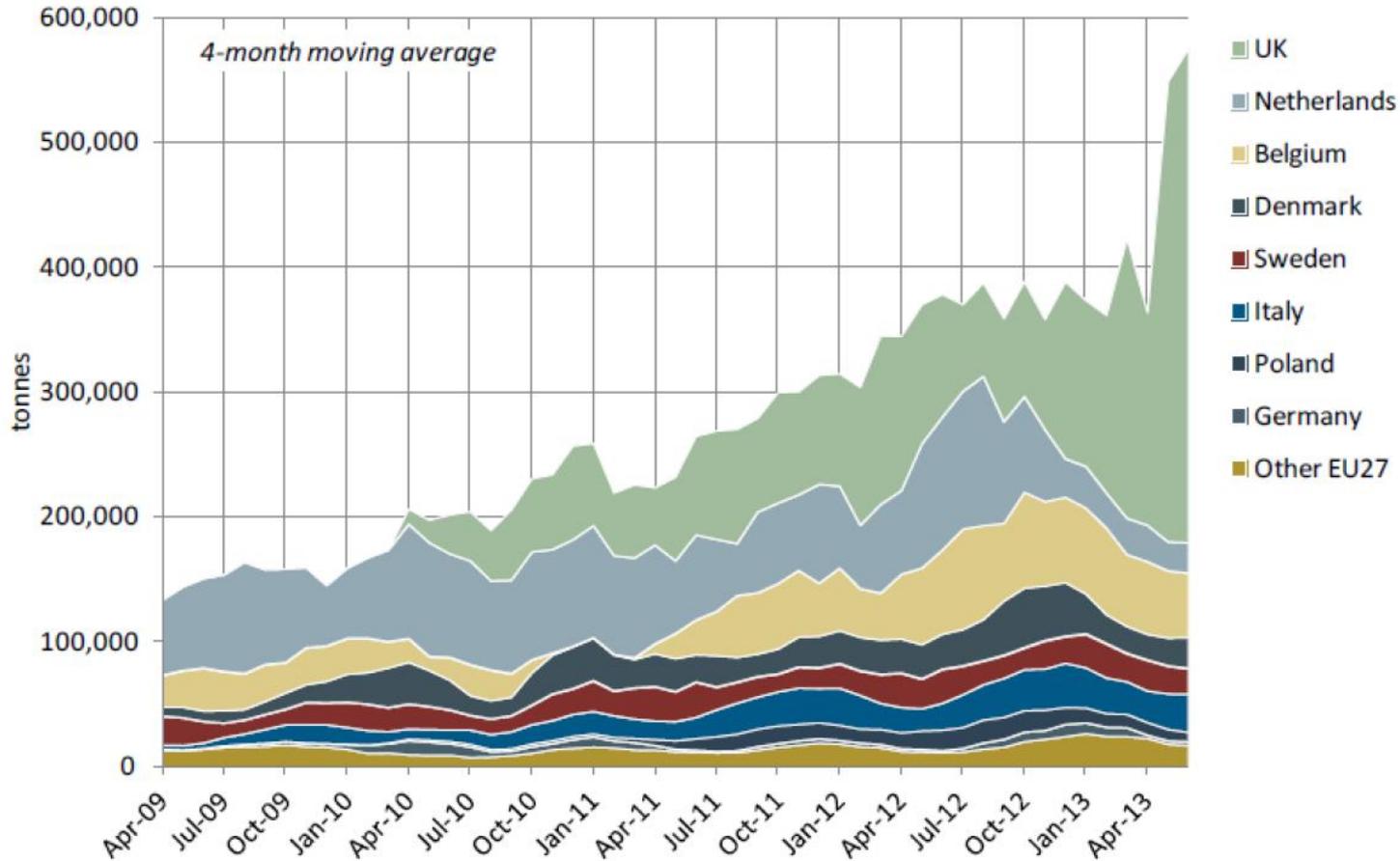


> Italy and Germany main consumers of pellets for heating

# Wood pellets

AEBIOM, European Bioenergy Outlook 2013

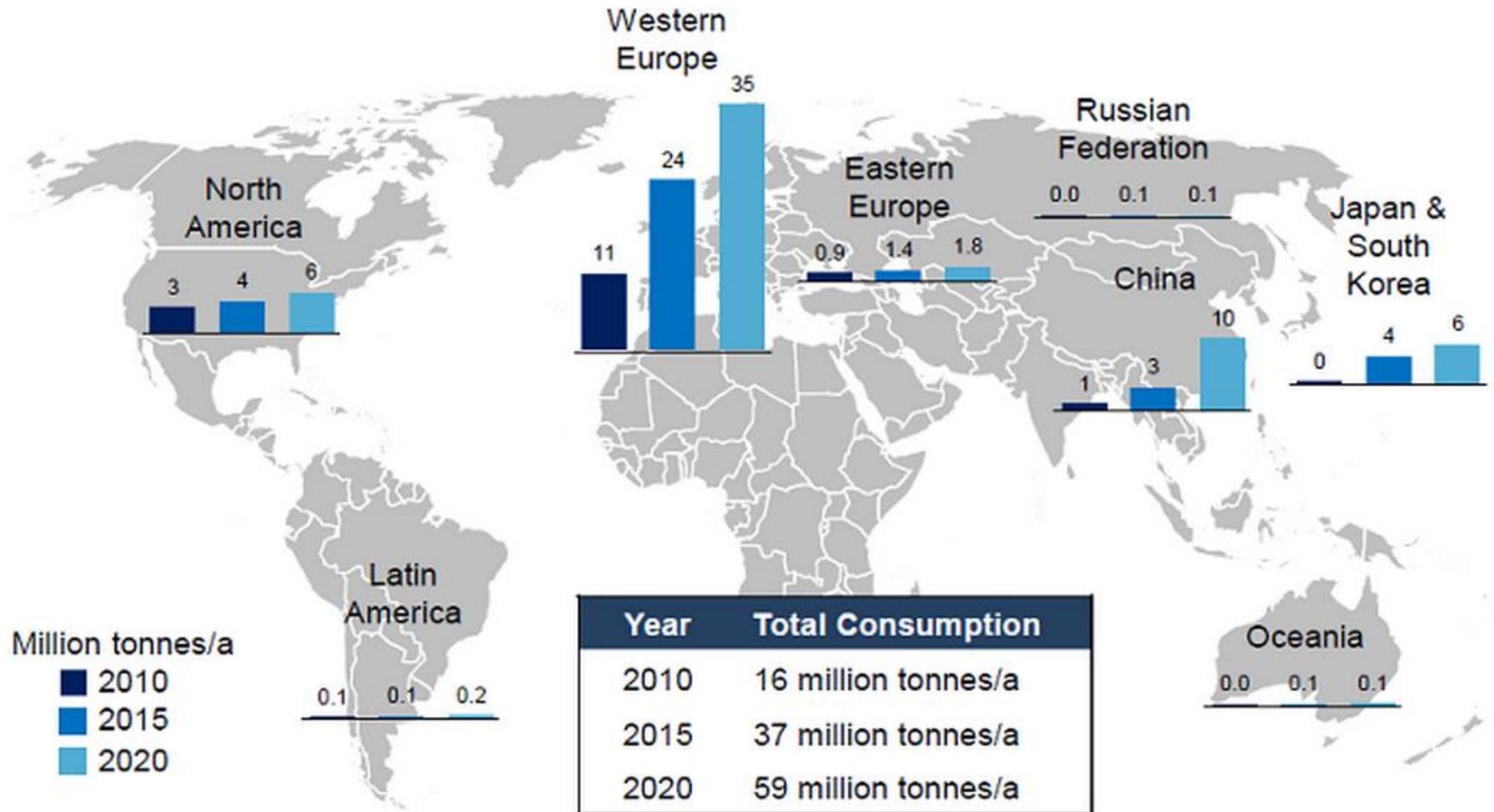
Figure 8.11 EU imports of wood pellets from non-EU countries (2009-2013)



> EU imports of wood pellets steadily increasing

# Wood pellets

Poyry Wood Pellet Multiclient



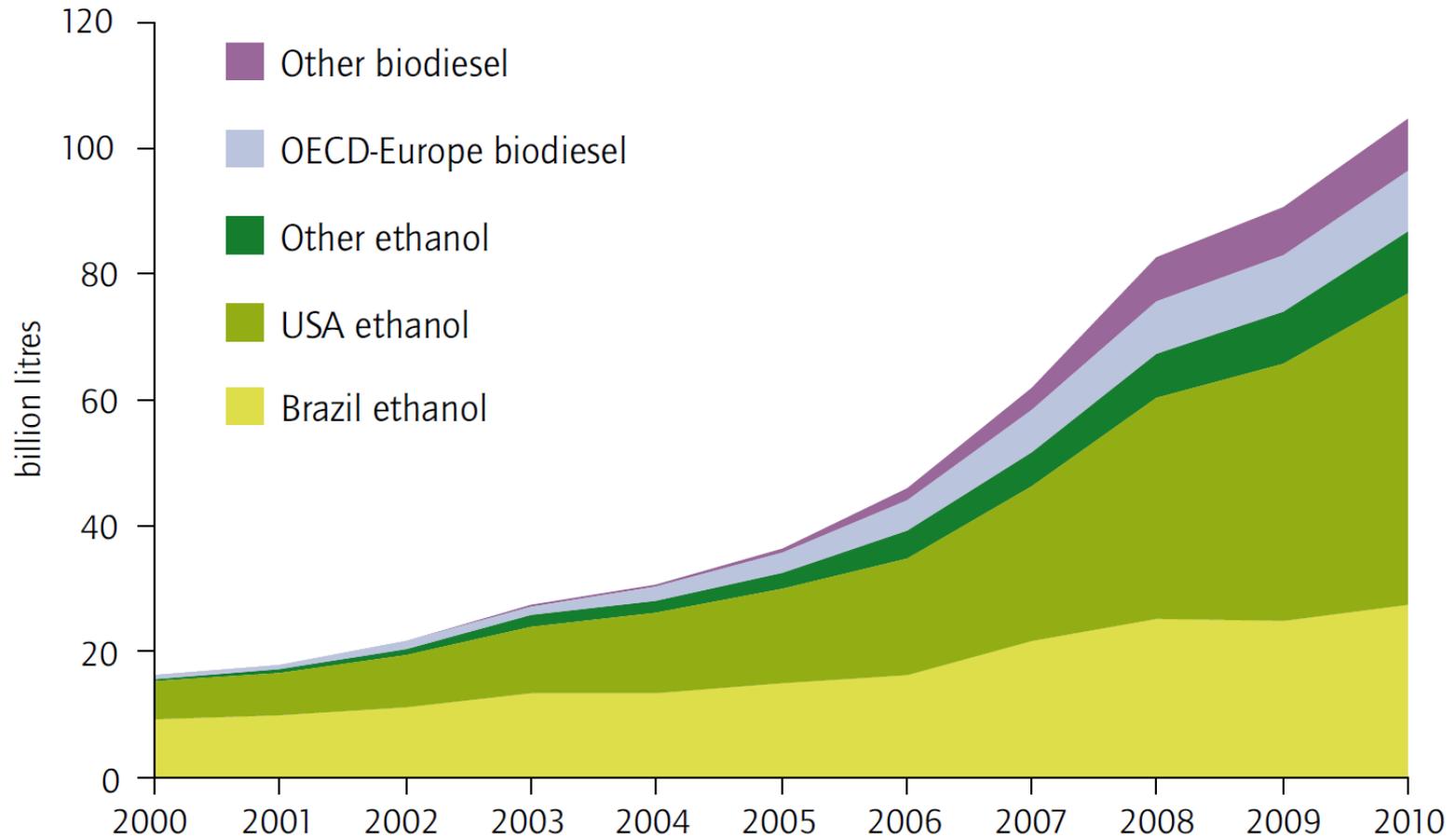
> Strong growth global wood pellet consumption

# Biofuels

## *Chapter 5*

# Biofuels

IEA 2011, Technology Roadmaps: Biofuels for Transport



> Global Biofuel Production steadily increasing

# Biofuels

## REN21, Renewables 2013 Global Status Report

Country	Fuel Ethanol	Biodiesel	Total	Comparison with Volumes Produced in 2011
	(billion litres)			
United States	50.4	3.6	54.0	- 2.4
Brazil	21.6	2.7	24.3	+ 0.6
Germany	0.8	2.7	3.5	- 0.5
Argentina	0.2	2.8	3.0	+ 0.1
France	1.0	1.9	2.9	+ 0.2
China	2.1	0.2	2.3	No change
Canada	1.8	0.1	1.9	+ 0.2
Thailand	0.7	0.9	1.6	+ 0.5
Indonesia	0.1	1.5	1.6	+ 0.2
Spain	0.4	0.5	0.9	- 0.3
Belgium	0.4	0.4	0.8	No change
Netherlands	0.2	0.5	0.7	- 0.1
Colombia	0.4	0.3	0.7	No change
Austria	0.2	0.4	0.6	No change
India	0.5	>0.0	0.5	+ 0.1
<b>World Total</b>	<b>83.1</b>	<b>22.5</b>	<b>105.6</b>	<b>- 1.0</b>
<b>EU-27</b>	<b>4.2</b>	<b>9.1</b>	<b>13.3</b>	<b>- 0.7</b>

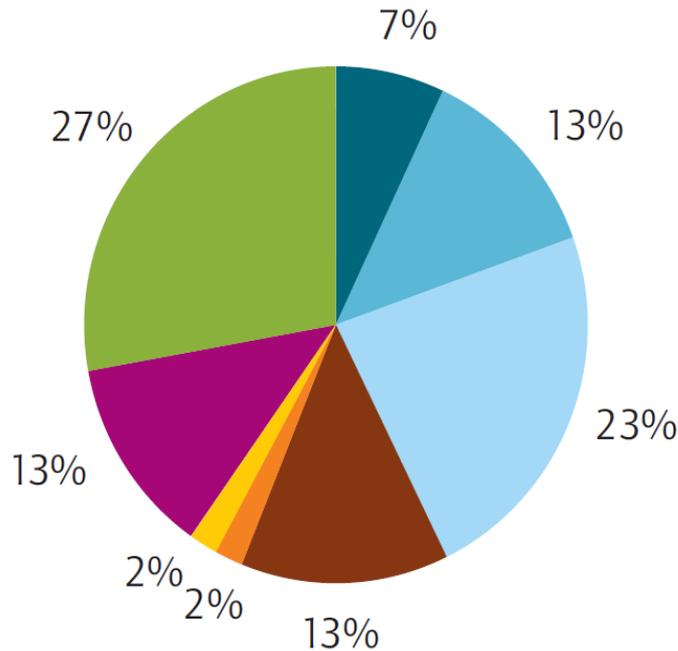
> Main biofuel producing countries in 2011

# Biofuels

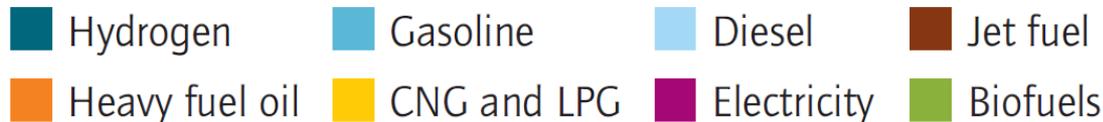
IEA 2011, Technology Roadmaps: Biofuels for Transport



Global energy use in the transport sector in 2050  
(BLUE Map Scenario)



Total: 116 EJ



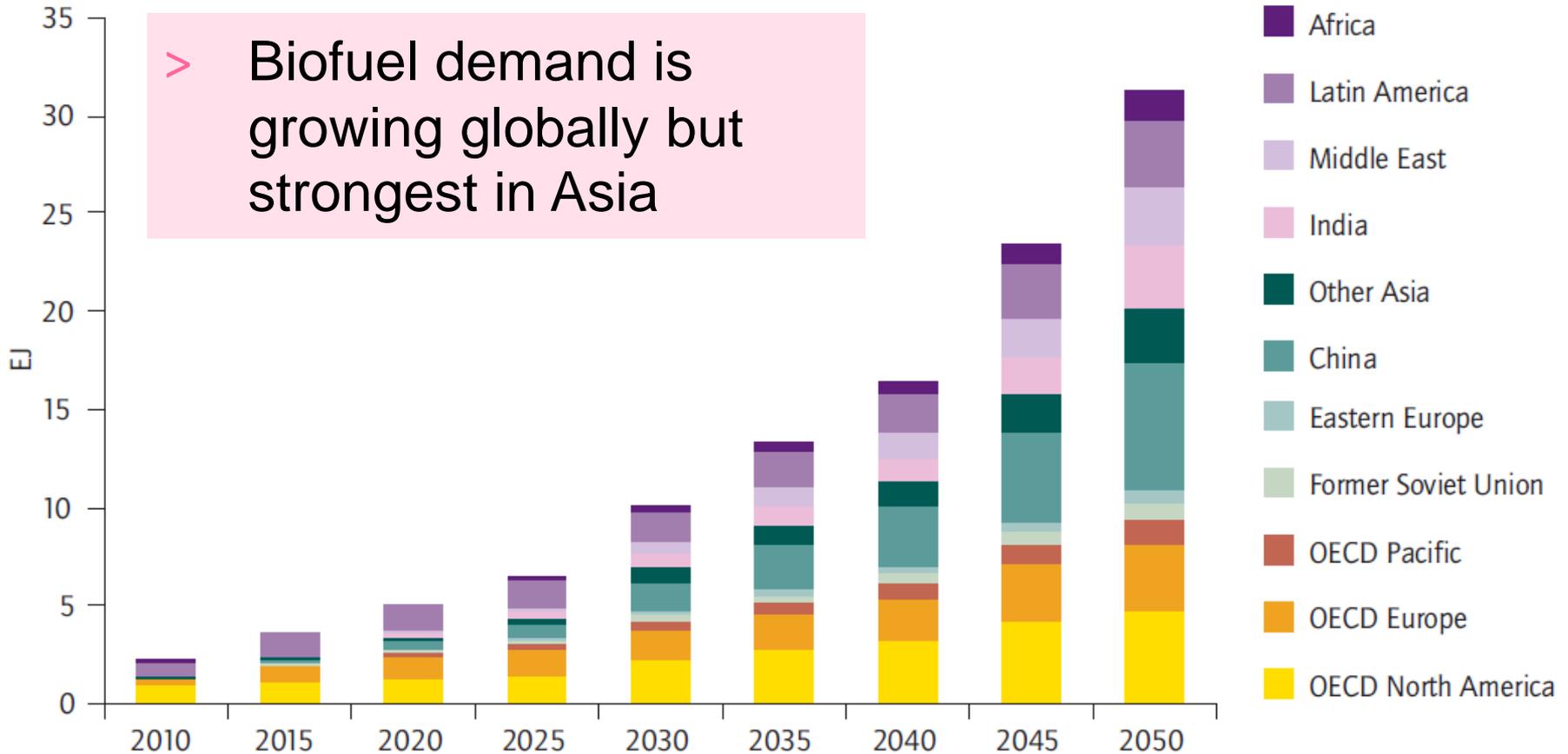
> Biofuels will have quarter (27%) of the energy market in transport sector

# Biofuels

IEA 2011, Technology Roadmaps: Biofuels for Transport



## Figure 8: Biofuel demand by region 2010-50



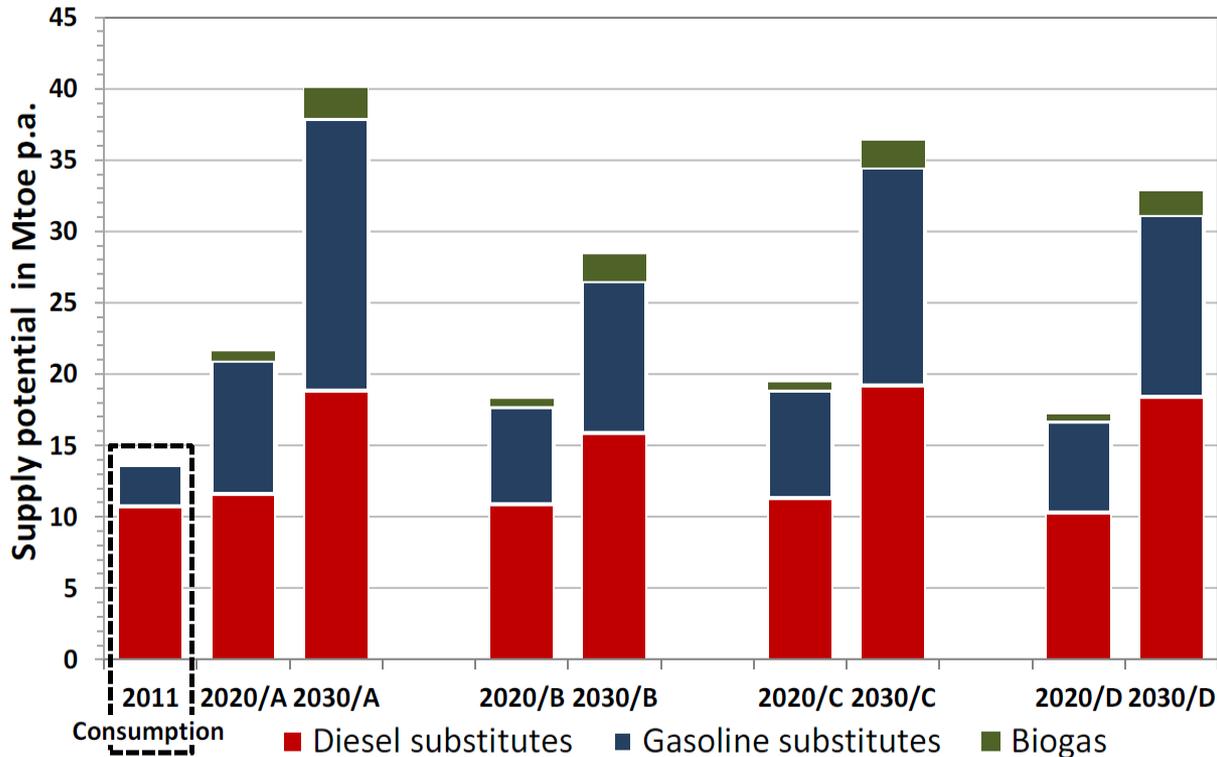
Note: FSU= Former Soviet Union.

# Biofuels

E4Tech, EU biofuel Roadmap to 2030, November 2013



Figure 8: Total biofuel availability to the EU in 2020 and 2030, across four scenarios A-D. For 2011 the values are based on the actual EU biofuel consumption from Eurostat.



Four scenarios are created in which the calculation of available biofuel supply is varied depending on a number of key parameters for feedstock, technology and supply chain.

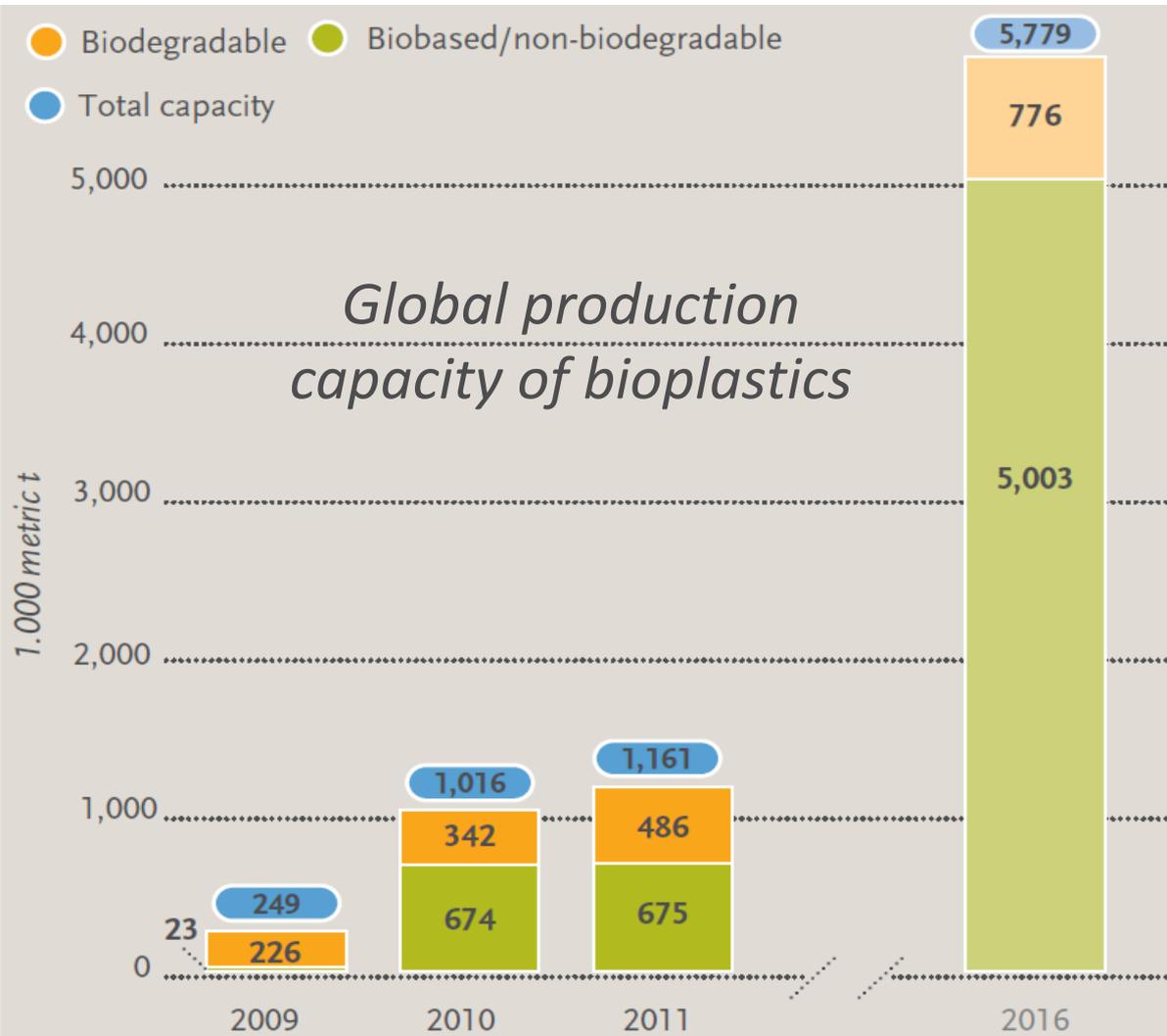
> Biofuel use will increase under all scenario's between 2-3 times in 2030, especially gasoline substitutes

# Bioplastics and biobased economy

## *Chapter 6*

# Bioplastics and biobased economy

## European Bioplastics e.V., Facts and figures, 2013



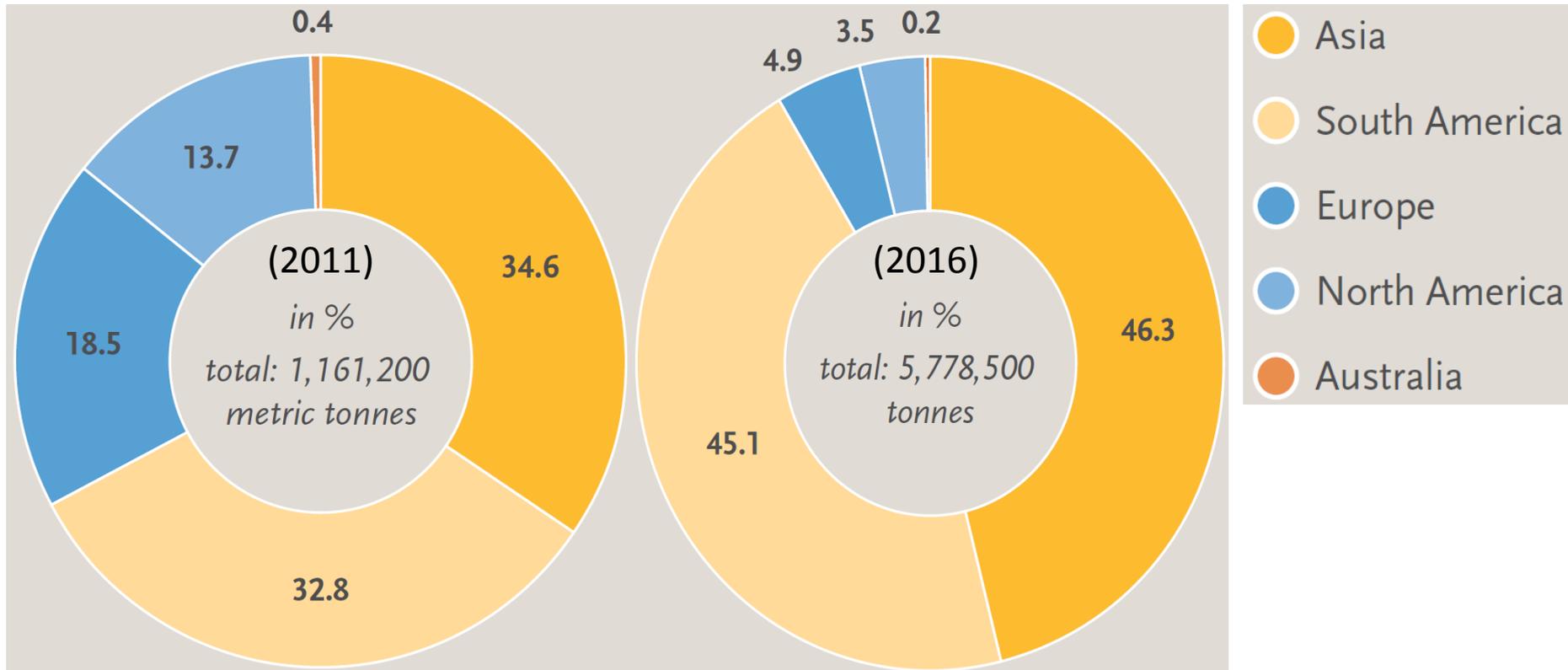
> Global production expected to grow 5-fold in 2016, mainly biobased plastics

Source: European Bioplastics | Institute for Bioplastics and Biocomposites (October 2012)

# Bioplastics and biobased economy

Bio-based polymers in the world, nova-Institut 2013

## Global production capacity of bioplastics in 2011 and 2016



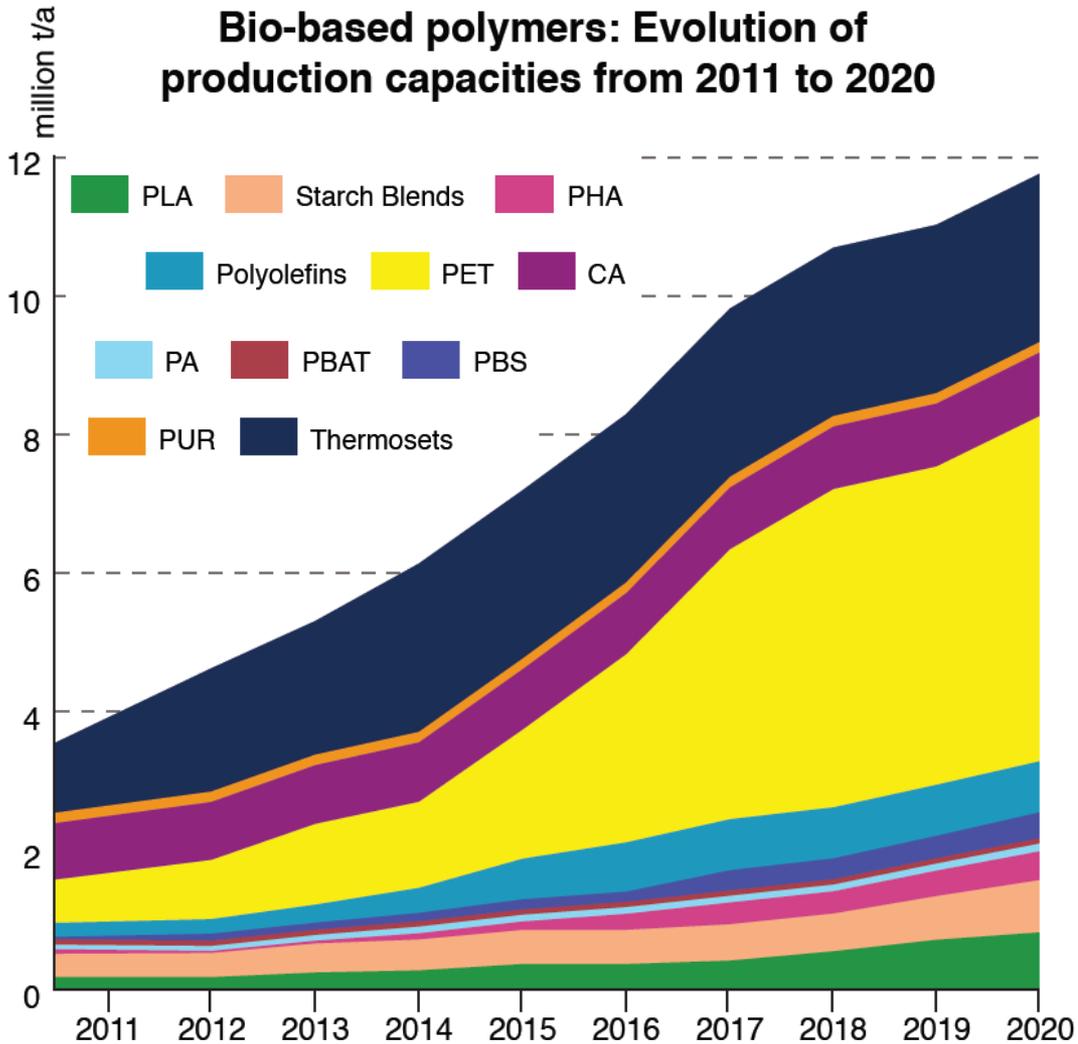
> Global bioplastics production capacities grow fastest outside Europe

# Bioplastics and biobased economy

Bio-based polymers in the world, nova-Institut 2013



**Bio-based polymers: Evolution of production capacities from 2011 to 2020**



> Market expected to grow 3-fold in 2020

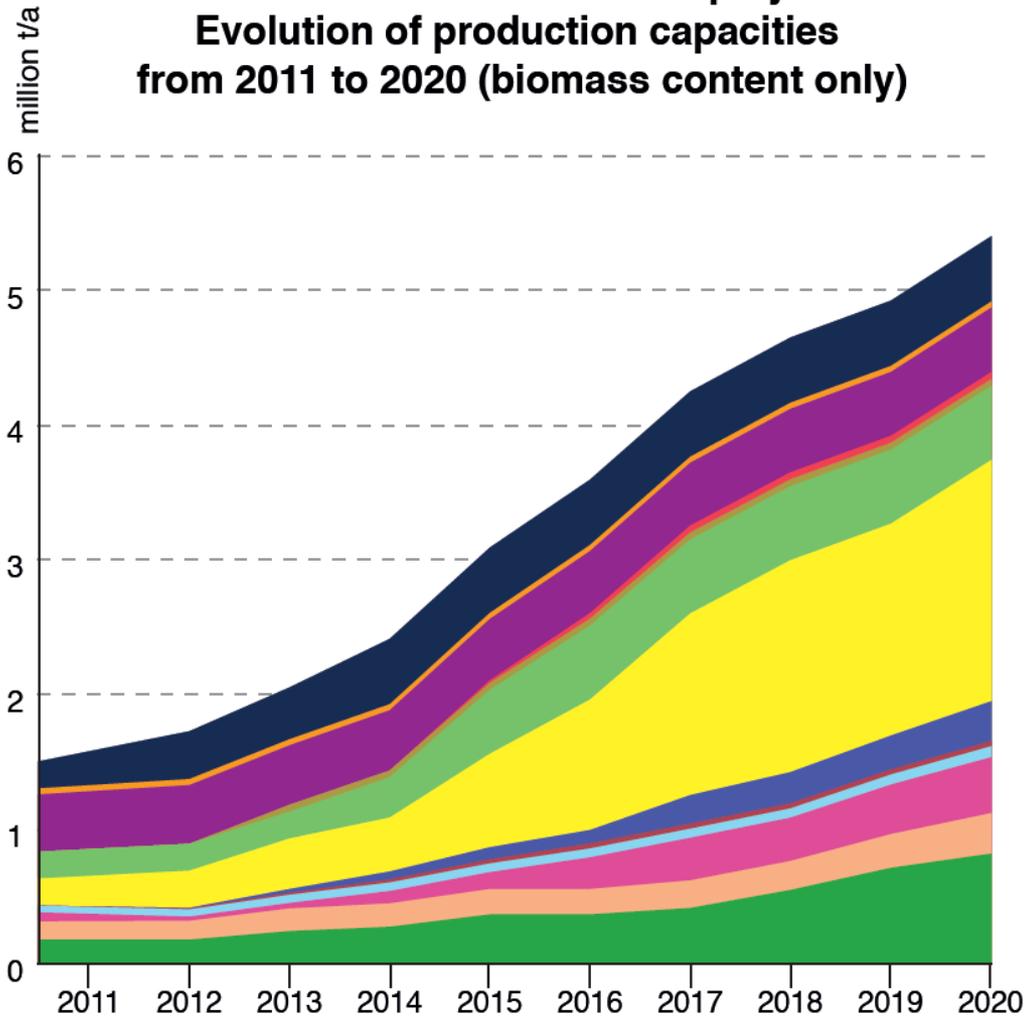
Cellulose Acetate	CA
Polyamide	PA
Polybutylene Adipate Terephthalat	PBAT
Polybutylene Succinate	PBS
Polyethylene	PE
Polyethylene Terephthalat	PET
Polyhydroxy Alkanoates	PHAs
Polylactic Acid	PLA
Polypropylene	PP
Polyvinyl Chloride	PVC
Polyurethane	PUR

# Bioplastics and biobased economy

## Bio-based polymers in the world, nova-Institut 2013



**Biomass content in bio-based polymers:  
Evolution of production capacities  
from 2011 to 2020 (biomass content only)**



> Market expected to grow 3-fold in 2020

- PLA
- Starch Blends
- PHA
- PET
- PE
- PP
- PVC
- PA
- PBAT
- PBS
- CA
- PUR
- Thermosets

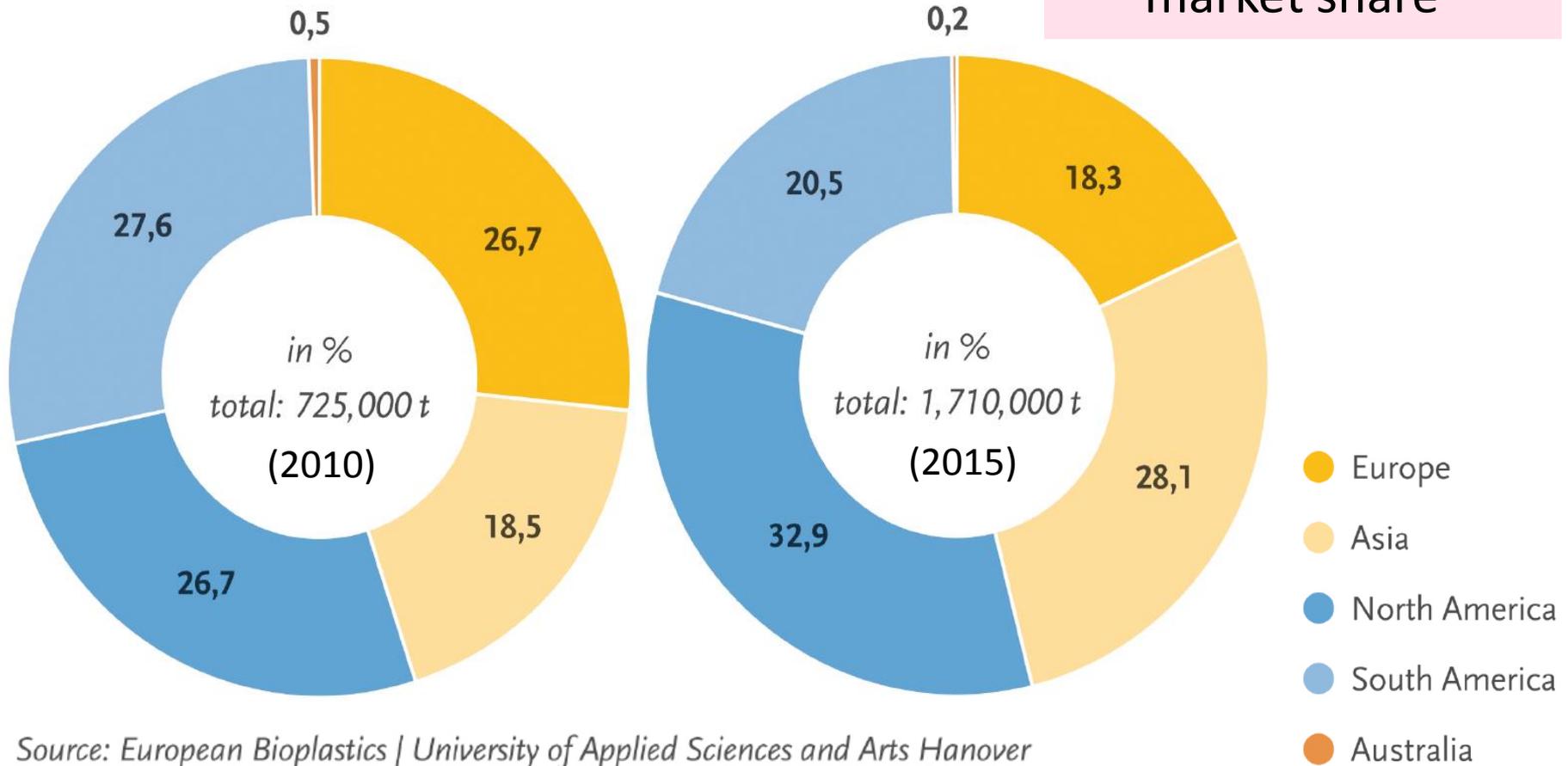
# Bioplastics and biobased economy

Bio-based Economy in EU-27, nova-Institut 2013



*Production capacity of biopolymers in 2010 and 2015*

> Europe is losing market share

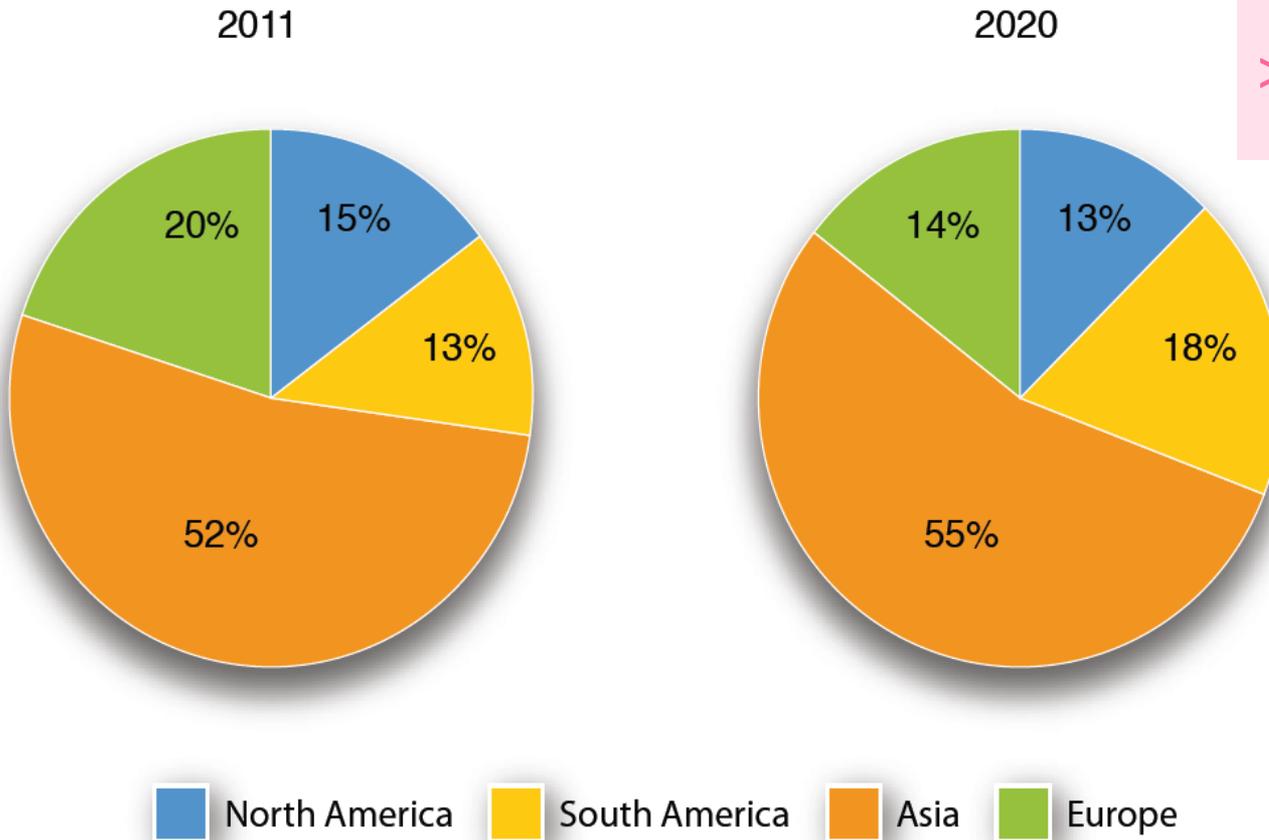


Source: European Bioplastics | University of Applied Sciences and Arts Hanover

# Bioplastics and biobased economy

Bio-based polymers in the world, nova-Institut 2013

## Evolution of the shares of bio-based production capacities in different regions (without Cellulose acetate and Thermosets)



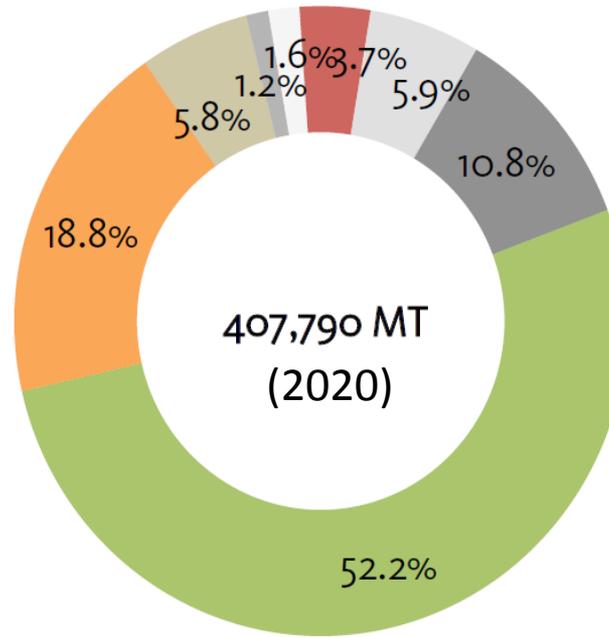
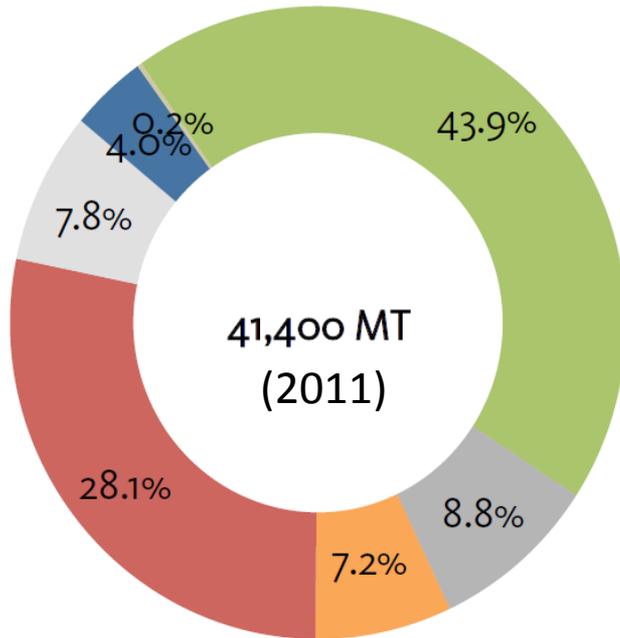
> and more !!!!!!!

# Bioplastics and biobased economy

Bioconcept.eu, WP 8.1 Market potential for selected platform chemicals, 2012 (Weastra s.r.o.)



## MARKET SHARE Itaconic acid by applications in 2011 and projected in 2020



> Market is expected to increase 10-fold in 2020

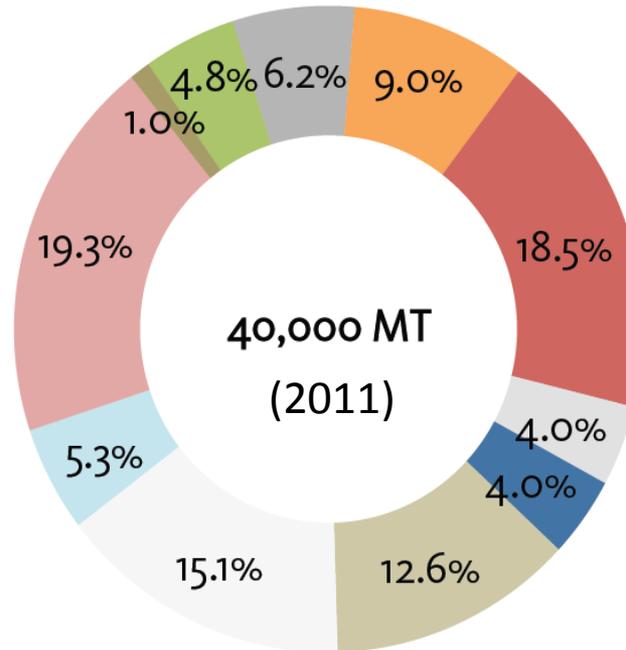
- SBR latex
- Synthetic latex
- Chelant dispersant agents
- Others
- Superabsorbent polymers
- Methyl methacrylate
- Unsaturated polyester resins

# Bioplastics and biobased economy

Bioconcept.eu, WP 8.1 Market potential for selected platform chemicals, 2012 (Weastra s.r.o.)



## MARKET SHARE Succinic acid by applications in 2011



BDO

Others

Food

Resins, coatings, pigments

Polyester Polyols

Plasticizers

Pharmacy

De-icer solutions

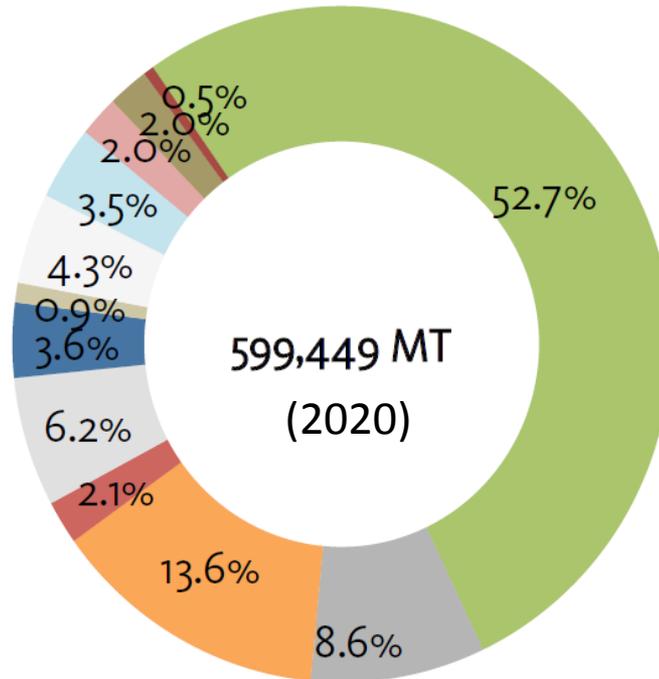
PBS, PBST

Solvents & lubricants

Cosmetics

# Bioplastics and biobased economy

Bioconcept.eu, WP 8.1 Market potential for selected platform chemicals, 2012 (Weastra s.r.o.)



> MARKET SHARE  
Succinic acid is expected to increase with 1500% up to 2020

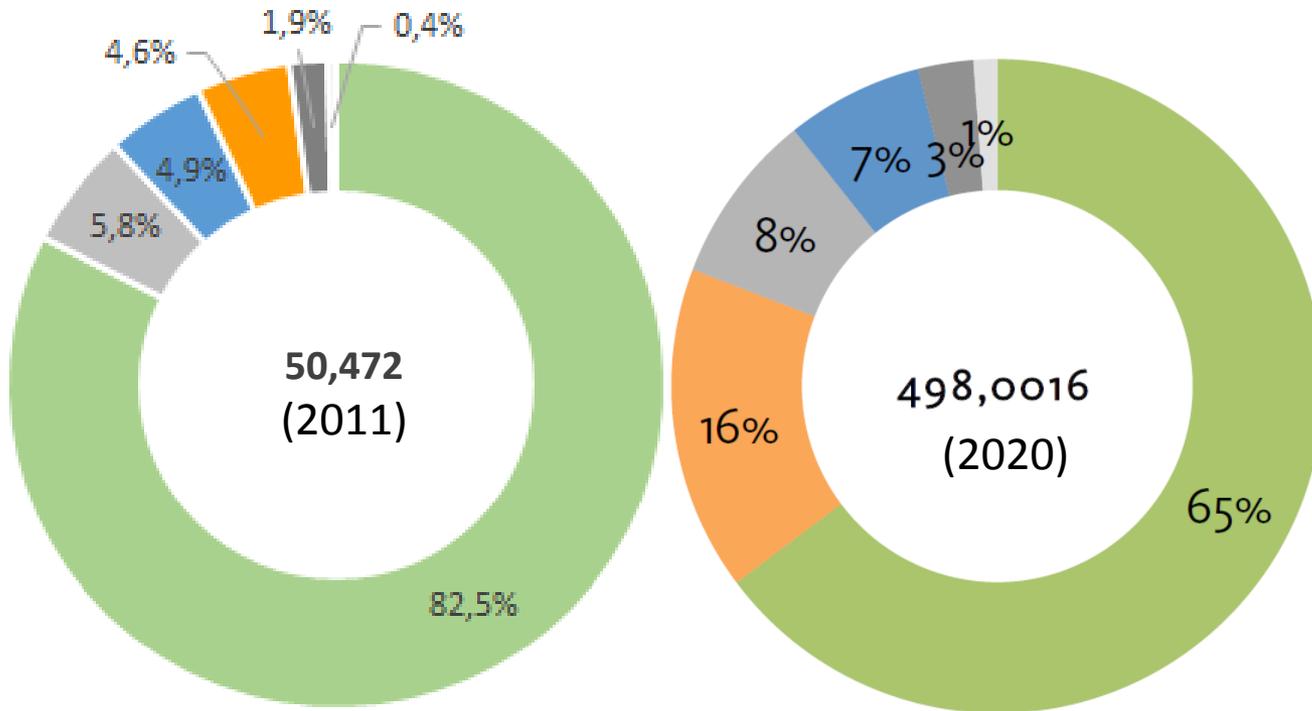
- BDO
- Others
- Solvents & lubricants
- Cosmetics
- Polyester Polyols
- Plasticizers
- Food
- Resins, coatings, pigments
- PBS, PBST
- Alkyd resins
- Pharmacy
- De-icer solution

# Bioplastics and biobased economy

Bioconcept.eu, WP 8.1 Market potential for selected platform chemicals, 2012 (Weastra s.r.o.)



## MARKET SHARE 2,5 – FURANDICARBOXYLIC acid (FDCA) by applications in 2011 and projected in 2020



> Market is expected to increase 10-fold in 2020

PET Polyamides Polycarbonates Plasticizers Polyester polyols Solvents

# Opportunities and Market trends

## *Chapter 7*

## Expert opinions (selection) on opportunities and market trends

- > **Electric power infrastructure:** Developing countries will need to build “lots of infrastructure” in the next 10 years; “on” and “off-grid” options.
- > **Diesel generator replacement** with renewable-hybrid alternatives will become increasingly competitive. Many cited the use of hybrid wind-diesel systems or biomass powered systems.
- > **Shift away from traditional biomass cookstoves** to more modern forms of stoves and fuels, including efficient biomass stoves and stoves burning biogas or biofuels
- > **Strong growth in modern biomass use:** (1) expanding wood chip/pellet markets in countries such as Argentina, Brazil, Chile, the Philippines, and Sri Lanka; (2) greater use of biogas for cooking, heating, and electricity generation in countries such as Nepal, Vietnam, and Kenya (in addition to China and India); and (3) continued expansion of biomass power generation and cogeneration in countries such as Brazil, the Philippines, and Thailand, and throughout Africa (e.g. Kenya, Mauritius, Tanzania, Uganda, and Zimbabwe)

## Expert views on the future of biomass

- > **Biomass becomes a mainstream commodity** in standard forms like pellets or bio-heating oil (from pyrolysis/torrefaction).
- > **Increased production of biogas** from sewage plants, manure, and organic waste, and cheaper biogas plants made with new materials. Biogas maybe also used for transport.
- > **Much greater use of biomass heating technologies**, including CHP plants, district heating systems, cooling systems for commercial and public buildings, and industrial process heat, predominantly at “small or medium scale” of 5–10 MW.
- > **Integration into agricultural and forestry industries** through integrated “bio-refineries.” Trend toward multi-purpose co-production systems, which co-produce biofuels, sugar, electricity, and biogas, and also utilize leftover waste for fertilizer, chemicals, biofuels, animal feed, and other chemicals.



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References can be found at the projects reference list [rvo.nl/biomass](http://rvo.nl/biomass)

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E4Tech, EU biofuel Roadmap to 2030, November 2013	068
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Bio-based polymers in the world, nova-Institut 2013	049
Bio-based Economy in EU-27, nova-Institut 2013	062
Bioconcept.eu, WP 8.1 Market potential for selected platform chemicals, 2012 (Weastra s.r.o.)	031