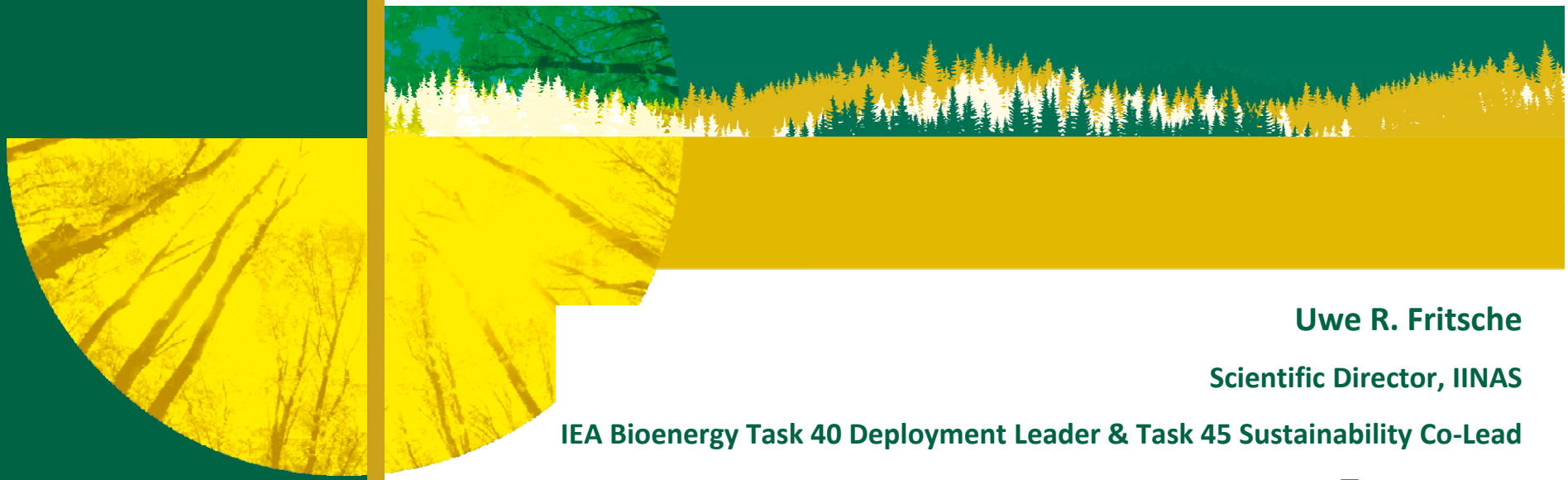
IEA Bioenergy

Biomass and biofuels: Options for a sustainable future?

Presentation at the FAIRMODE Expert meeting on "Addressing the unforeseen impact of structural changes on European air quality“ Feb 11-12, 2019 in Warsaw



Uwe R. Fritsche

Scientific Director, IINAS

IEA Bioenergy Task 40 Deployment Leader & Task 45 Sustainability Co-Lead

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Before we start…

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- Who is a biomass or bioenergy producer?
- Who is a biomass or bioenergy user?
- Who wants sustainable development?

Biomass: the stuff of life

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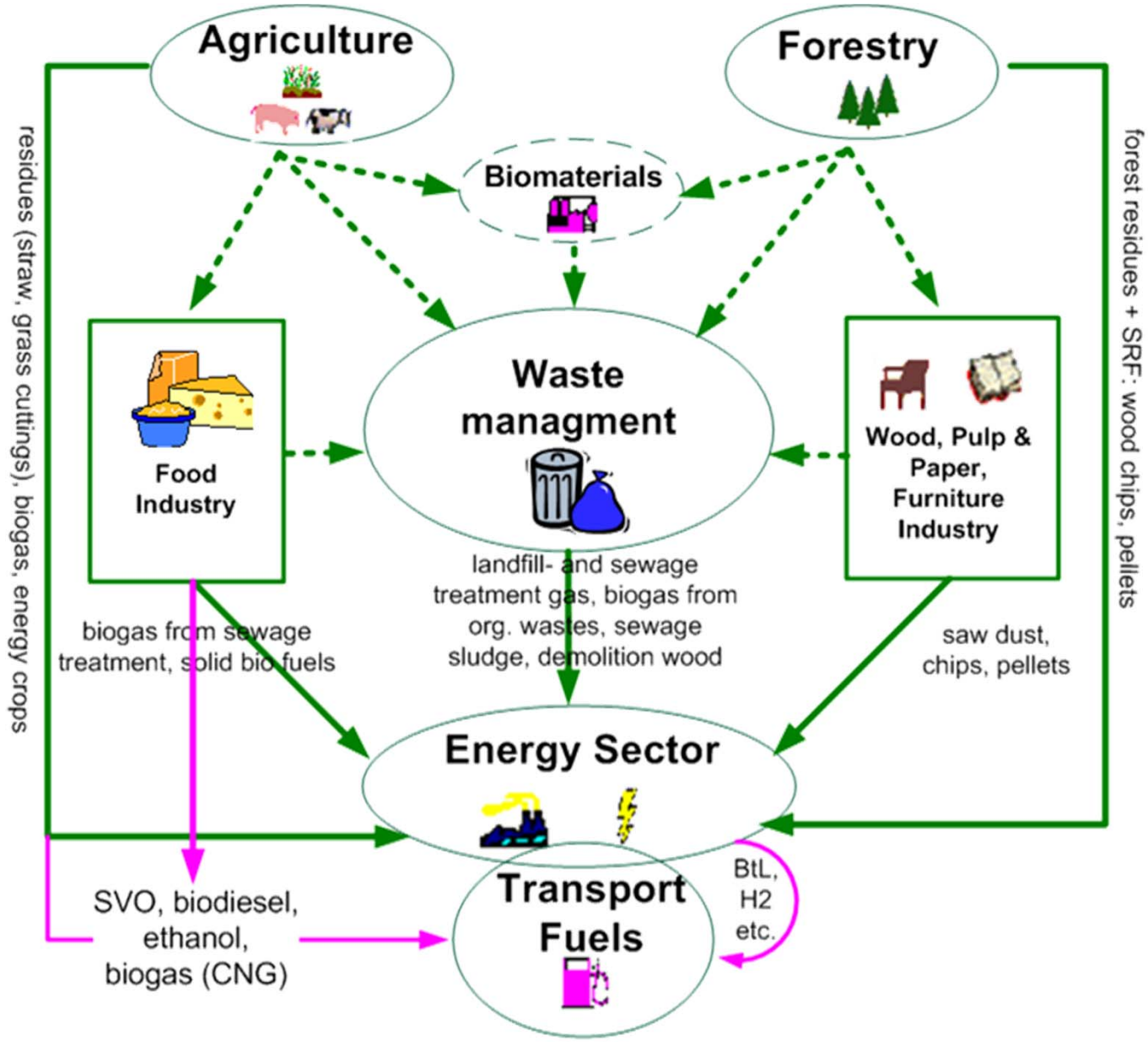

A Matter of Scale: Biomass & Energy

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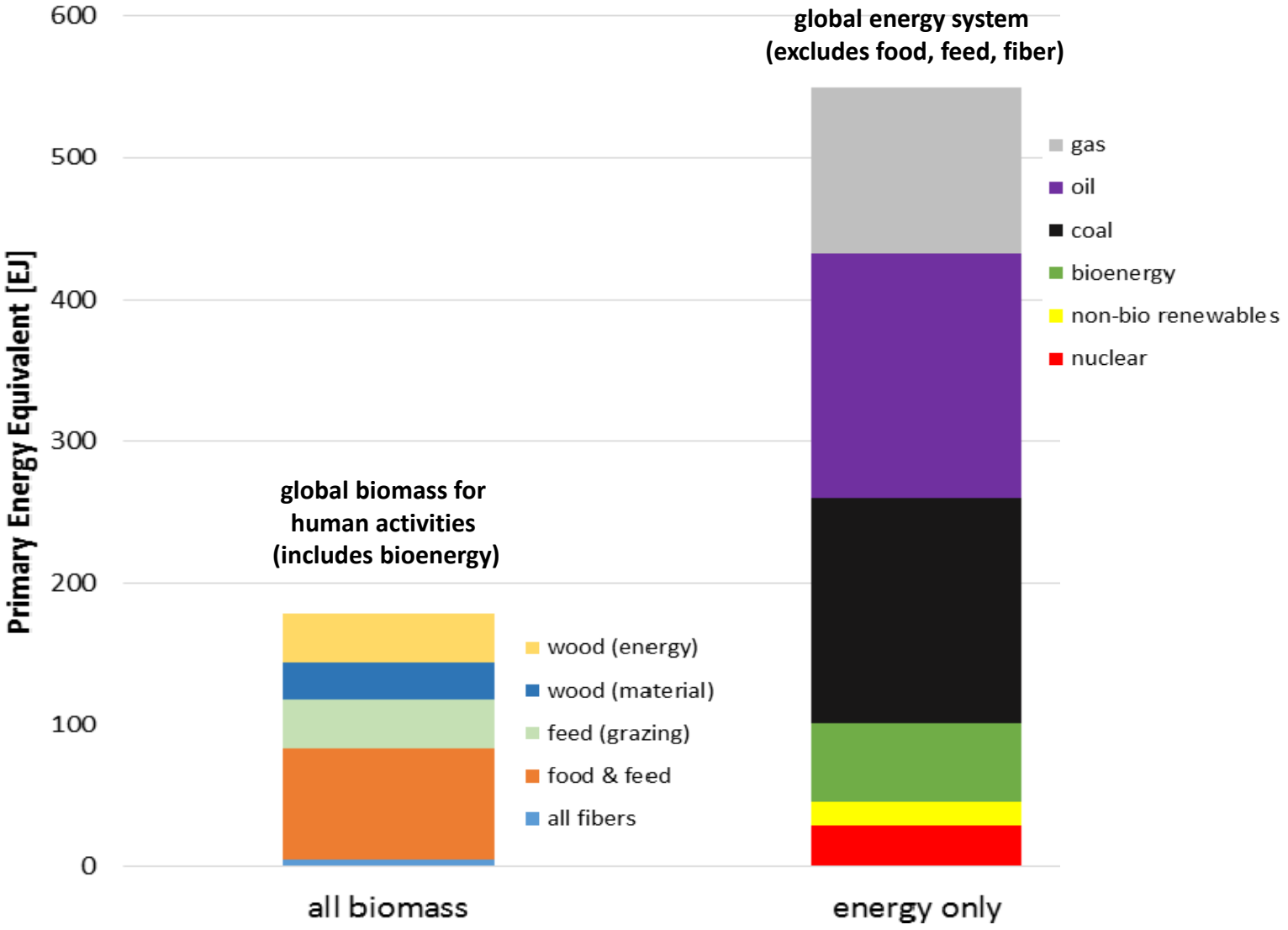

Source: IINAS calculation for 2010 based on data from IEA and nova

Biomass: Cascading!?

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Biomass crops

1st priority: food & (high-value) materials

Residues/wastes

End of cascade: energy use

Consistent with EU **circular economy** concept – but not as a criterion for certification, see
IEA Bio (2016) Cascading of woody biomass: definitions, policies and effects on international trade
http://task40.ieabioenergy.com/wp-content/uploads/2013/09/t40-cascading-2016.pdf

The IEA Bioenergy Roadmap

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IEA **Technology Roadmap on Bioenergy**: Delivering Sustainable Bioenergy

- Earlier roadmaps on biofuels (2011) and bioenergy (2012) **integrated** and **updated**
- **Global scenarios** (ETP 2017, WEO 2018)
- Role bioenergy for **2 °C** and **decarbonization** (Paris) of the global energy systems until 2050
- Roadmap explicitly mentions role of **bioeonomy** ("Bioenergy in the bioeconomy") and addresses **sustainability** of biomass

Organizations related to sustainable bioeconomy governance

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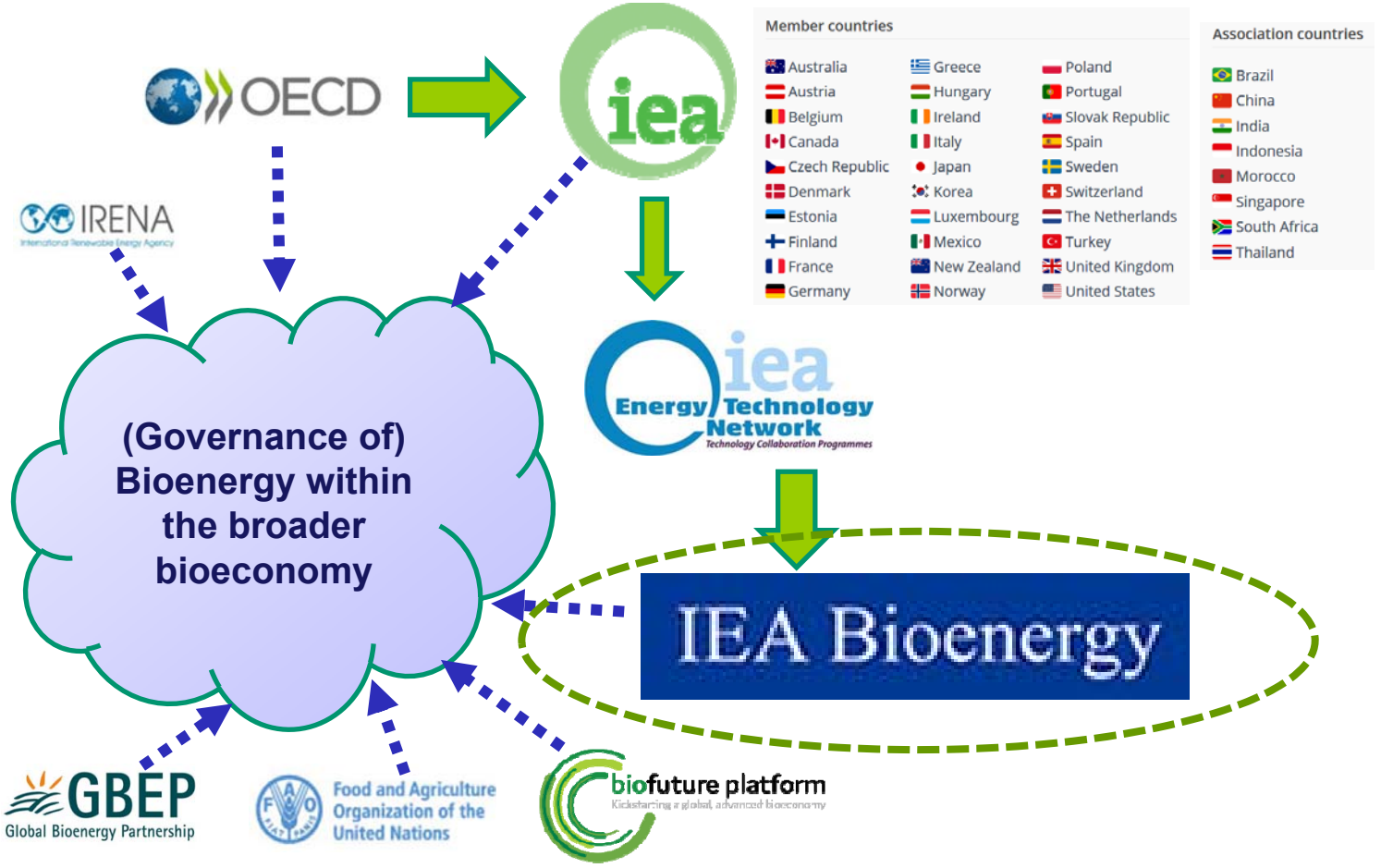

Biomass in the IEA Roadmap

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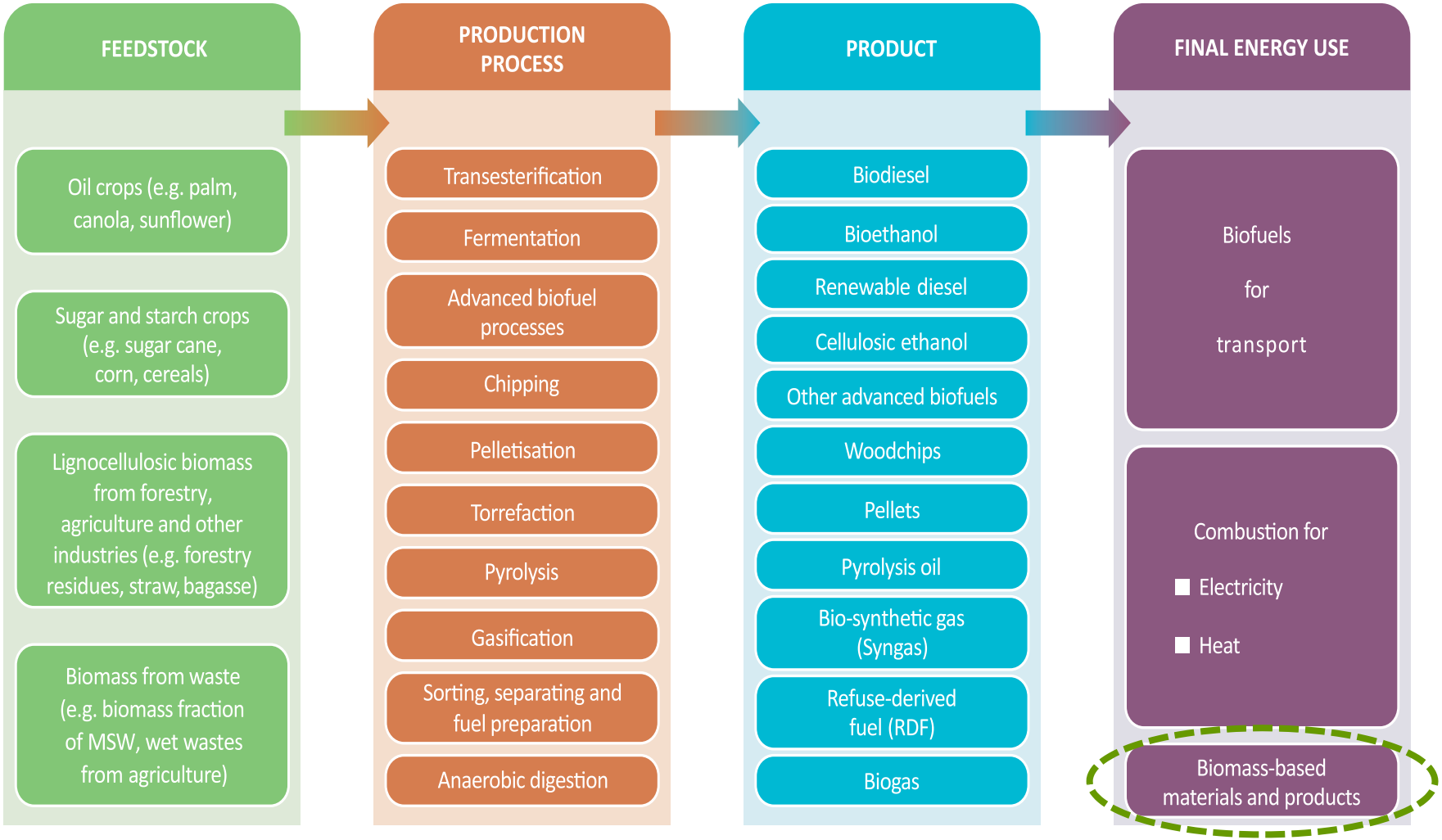

Source: IEA (2017) Technology Roadmap: Delivering Sustainable Bioenergy. Paris

Global bioenergy use 2060

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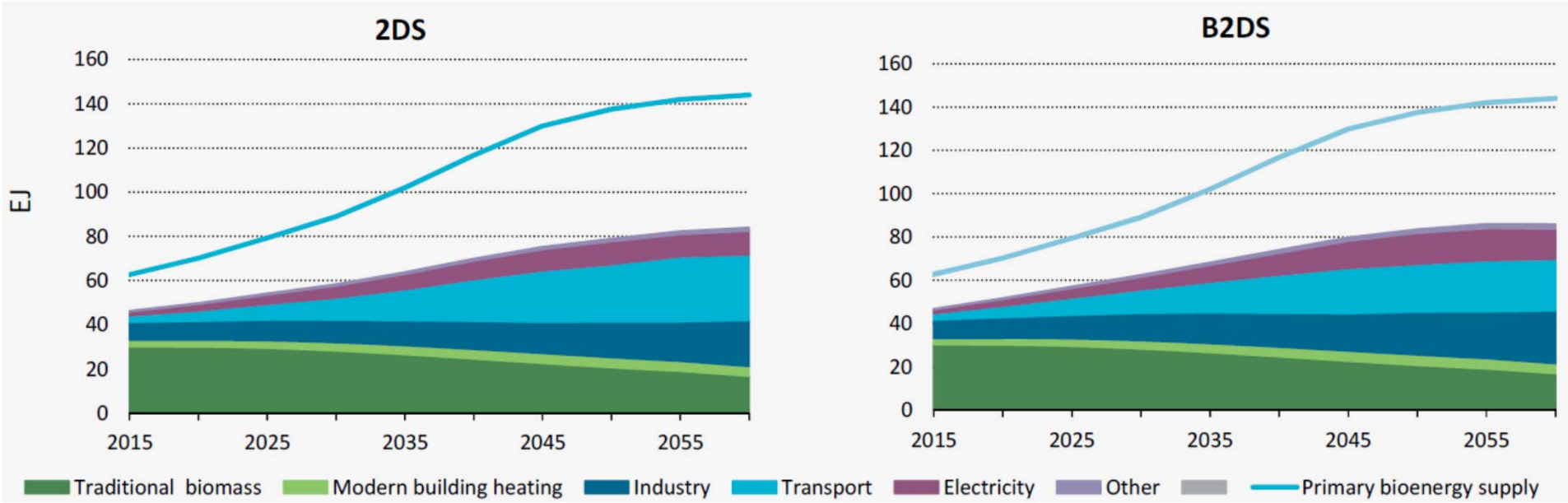
Contribution of bioenergy to final and primary energy demand, IEA ETP scenarios



Source: IEA (2017) Energy Technology Perspectives. Paris

B2DS vs. 2DS scenario: Bioenergy for electricity increases, biofuels decrease

Global biofuel use

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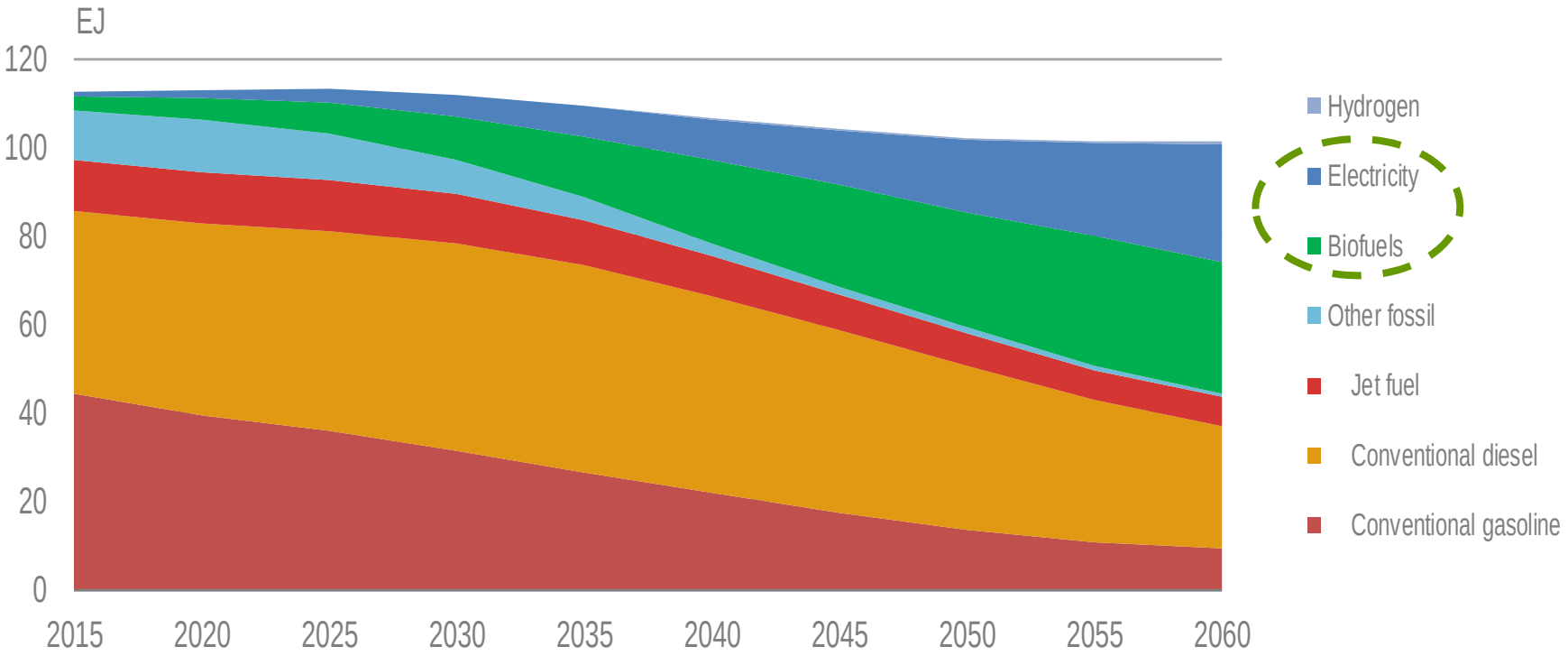
Global **final** energy demand **in transport**, 2DS scenario



Source: IEA (2017) Technology Roadmap: Delivering Sustainable Bioenergy. Paris

Biofuels until 2050 higher than fast-growing electric transport…

Global biofuel supply

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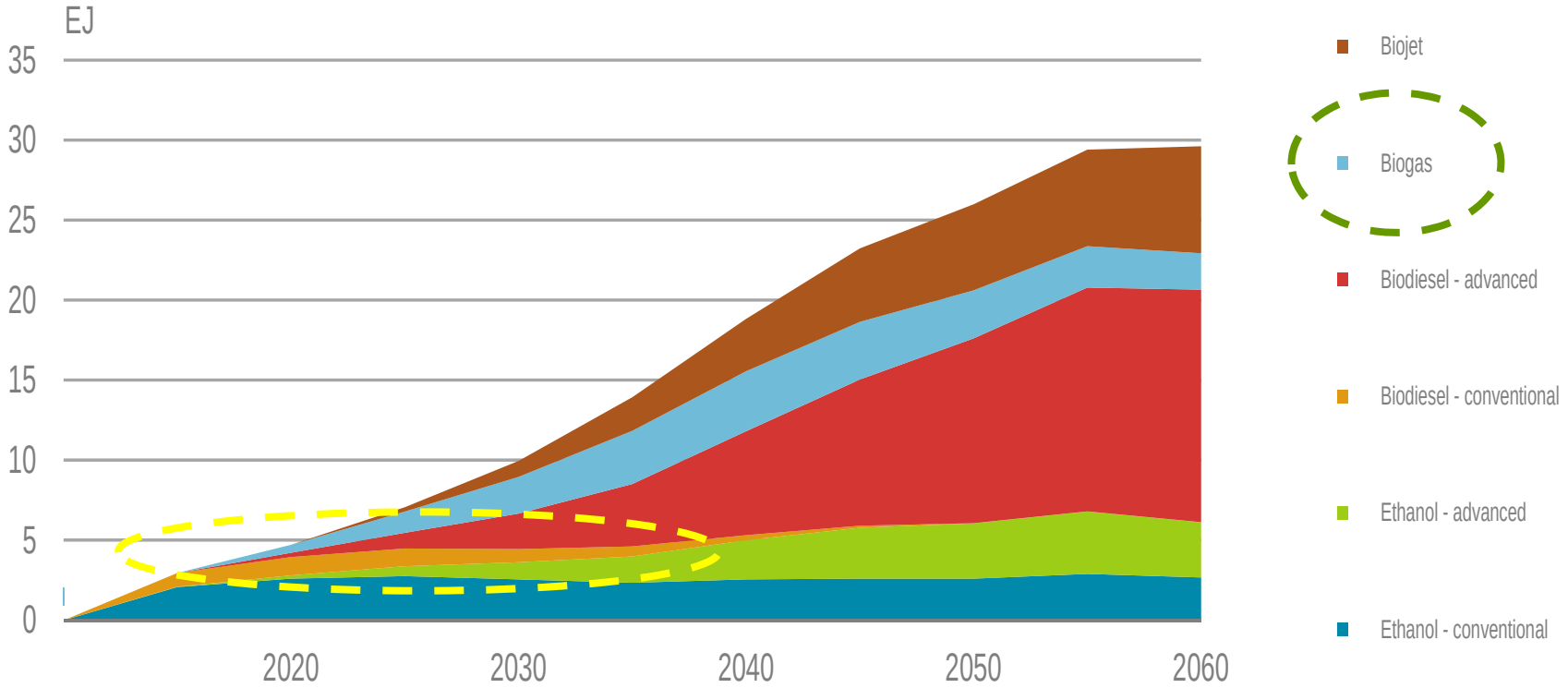
Global **final** energy supply of biofuels **in transport**, 2DS scenario



Source: IEA (2017) Technology Roadmap: Delivering Sustainable Bioenergy. Paris

Phase-out 1G-Biodiesel, strong increase: 2G EtOH, biojet + biogas

Biomethane: local & global

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Biomethane from compressed biogas in New Delhi, India

Biofuels: cost…

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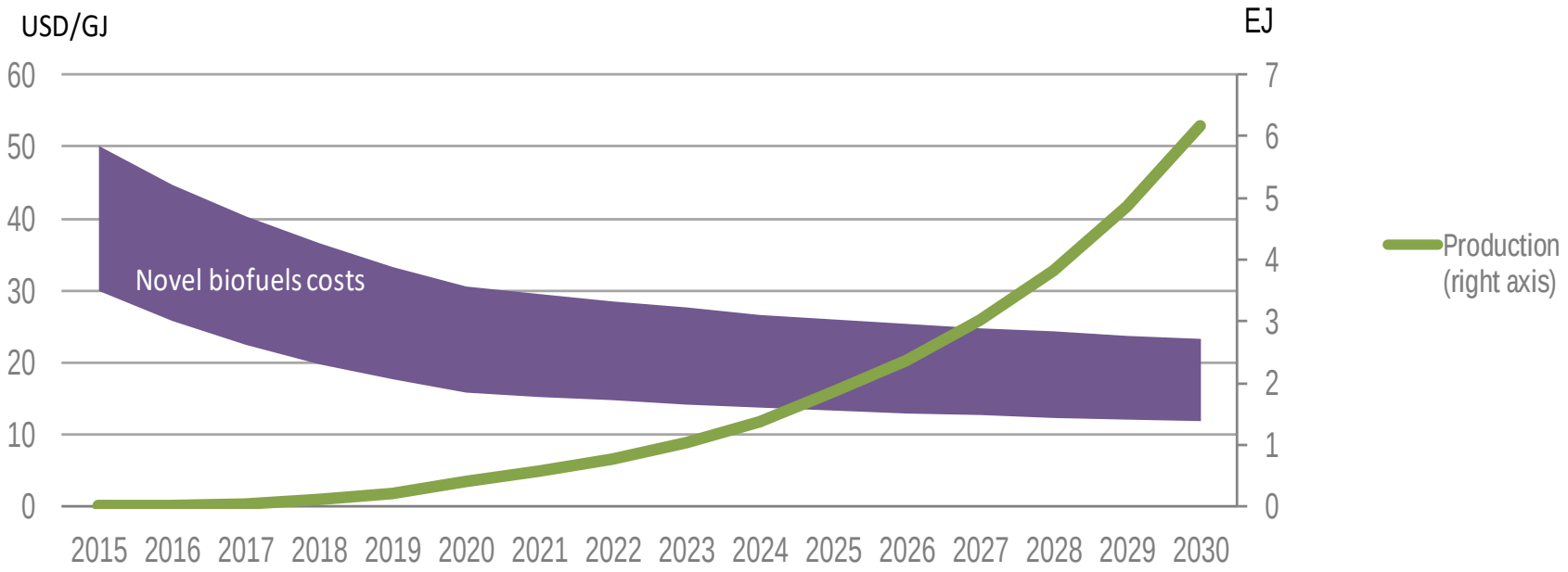
Possible cost dynamic for 2G biofuels @ 15% learning curve



Souce: IEA (2017) Technology Roadmap: Delivering Sustainable Bioenergy. Paris

Cost parity with fossil fuels in 2030 @ **50 $/t CO_2**

Biofuel Costs: 2030 outlook

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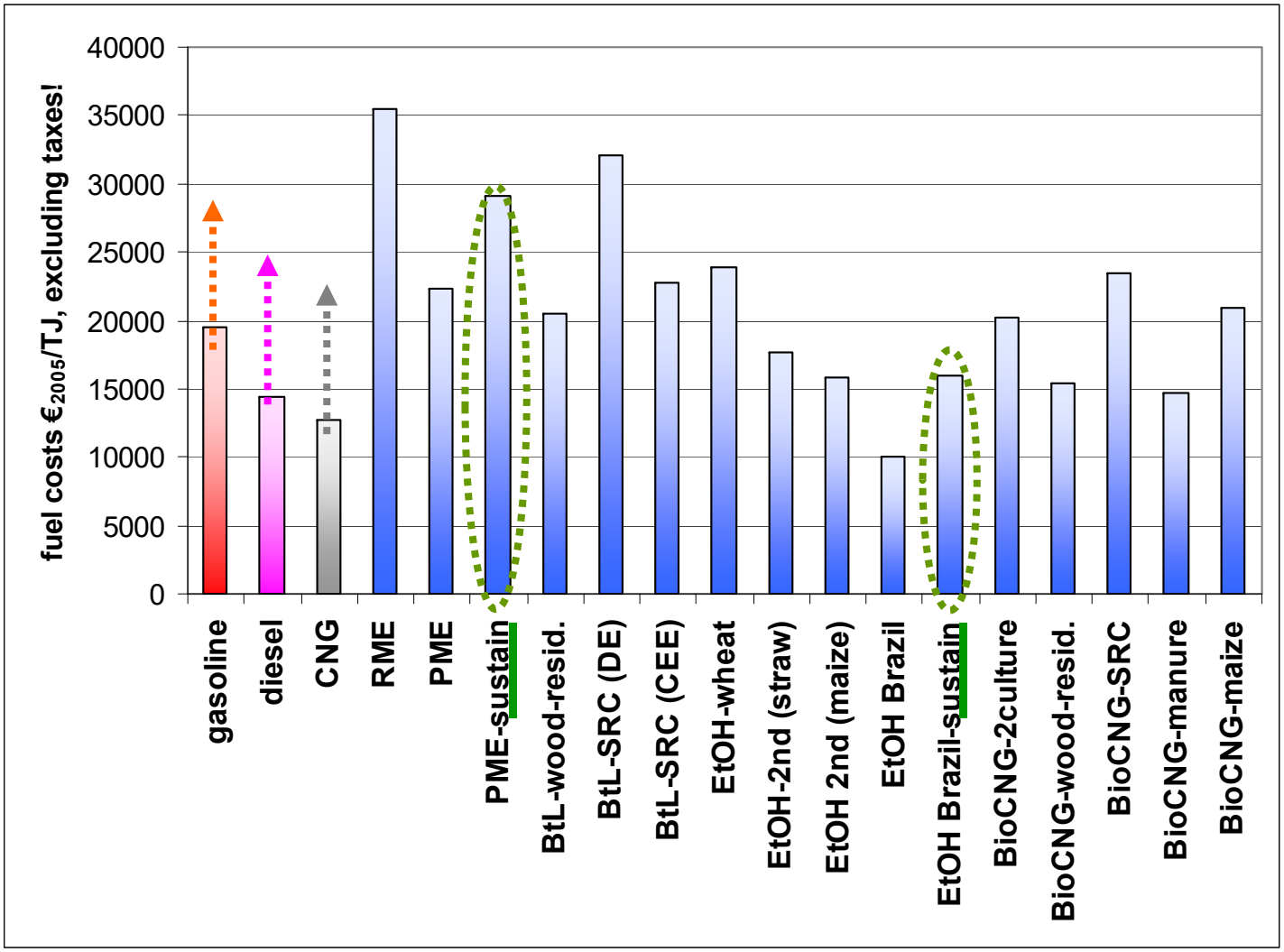

Crude oil @ 65 US$/bbl; taxes excluded;
interest rate for capital: 5%

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It may not be cost-effective to save the world,
but we may decide to do so anyway.

Jørgen Nørgaard

Medium-term Bioenergy Corridor?

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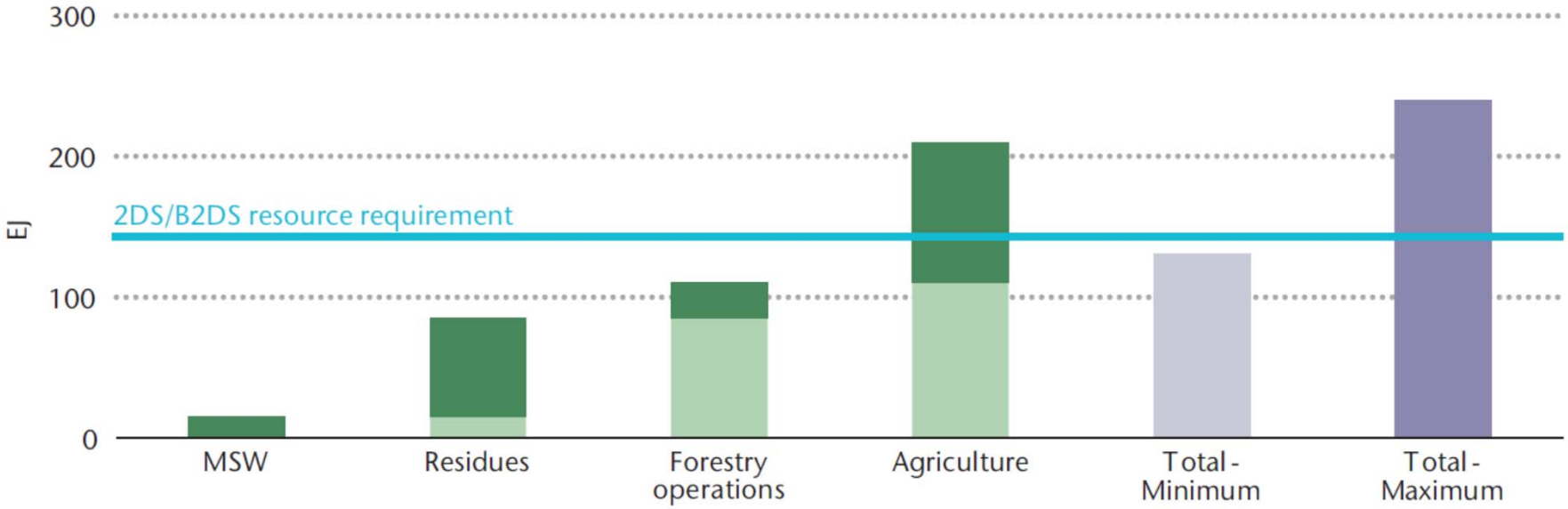
IEA Roadmap: Delivering **Sustainable** Bioenergy



- Sustainable global bioenergy potential enough for IEA scenarios, but **role of BECCS remains disputed**
- To reduce risk of negative tradeoffs between SDGs, consider an "**agreeable corridor" of sustainable global bioenergy use until 2030**, e.g. 70 – 90 EJ (excluding BECCS)

Material Flow Analysis

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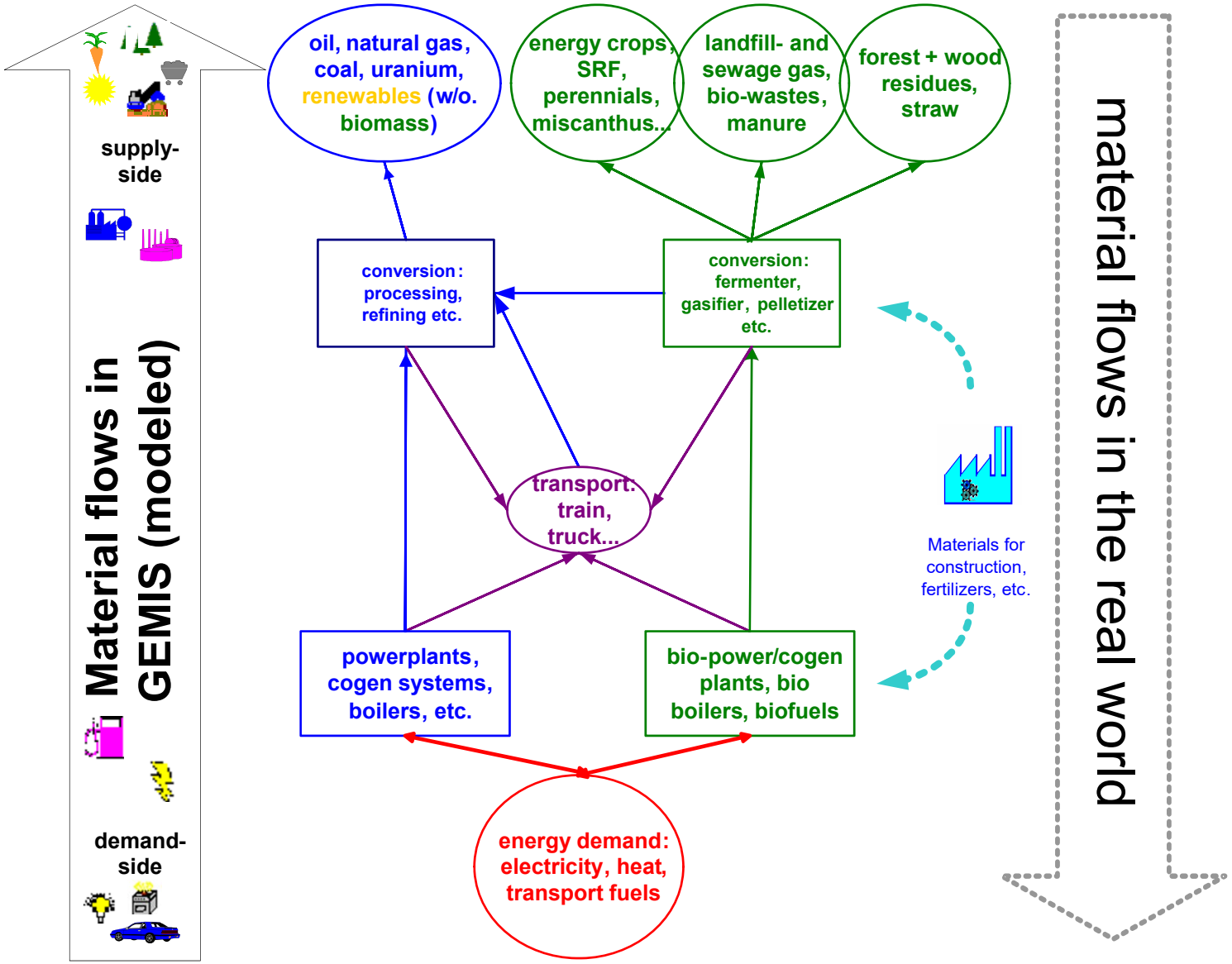

Employment Balance

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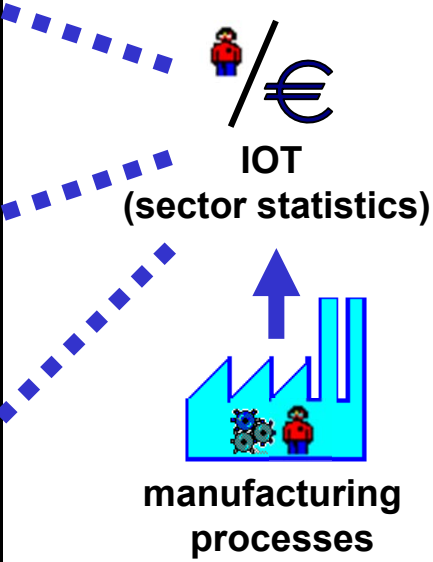
	Process	direct	indirect*
	farming/ harvest		
	transport		
	processing, conversion		
	transport		
	use		



* = from invest costs; operating costs neglected

Model: GEMIS (freely available)

Bio-Heat (Wood)

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	costs 2010	2030	jobs	CO_2-eq.	SO_2-eq.
	c/kWh$_{th}$		pers./TWh$_{th}$	g/kWh$_{th}$	
gas heating 10 kW	**10,2**	11,4	**266**	**296**	**0,36**
oil heating 10 kW	**10,6**	11,2	**333**	**383**	**0,42**
wood residues					
chips heating 10 kW	7,6	7,5	378	29	0,5
chips heating 50 kW	6,1	6,1	289	29	0,5
pellet heating 10 kW	11,3	11,5	446	34	0,4
pellet heating 50 kW	10,9	11,1	420	33	0,4
pellet heatplant 0.5 MW + grid	8,3	8,7	796	40	0,4
chips heatplant 1 MW + grid	5,3	5,3	340	33	0,4
chips heatplant 5 MW + grid	5,4	4,8	358	32	0,4
SRF-poplar/Miscanthus					
pellet heating 10 kW	13,7	14,1	1.322	56	0,6
pellet heating 50 kW	13,2	13,7	1.277	55	0,6
pellet heatplant 0.5 MW + grid	10,8	11,4	1.728	64	0,6
chips heatplant 1 MW + grid	6,9	7,1	1.275	52	0,6
chips heatplant 5 MW + grid	6,7	7,0	1.272	50	0,6
miscanth.heatplant 1 MW + grid	6,4	6,6	413	53	1,5
miscanth.heatplant 5 MW + grid	7,0	7,3	430	47	1,0

Cost data @ 7% real interest

Biofuels (Transport)

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	person transport	costs 2010 €cent/kWh$_{input}$	2020	jobs pers./TWh$_{input}$	CO_2-eq. g/kWh$_{input}$	SO_2-eq.
DIESEL-CAR	**fossil diesel with tax**	**12,0**	14,0	**9**	**326**	**0,5**
	dito, without tax	**5,4**	6,3			
	biodiesel DE	7,7	8,2	314	65	1,0
	biodiesel from palmoil	5,6	6,0	-	275	1,0
	BtL wood-residue DE	6,9	5,3	153	-131	0,6
	BtL wood-SRF DE	8,8	7,7	1757	-100	0,8
	BtL wood-SRF from PL	4,1	5,2	-	-222	-0,6
OTTO-CAR	**fossil gasoline, with tax**	**15,0**	17,0	**9**	**343**	**0,5**
	dito, without tax	**6,8**	7,7			
	EtOH wheat DE	7,2	7,8	217	197	0,7
	EtOH lignocellulosic DE	6,5	6,1	83	79	0,5
	EtOH wheat from PL	3,3	3,4	-	219	0,8
	EtOH sugarcane from BR	3,4	3,4	-	108	1,0
	Biogas (maize)	6,9	6,7	220	87	0,6
	Biogas (double-cropping)	6,0	5,0	1.870	89	0,5

biofuels **excluding** taxes; **incl. credits** for couple products (glycerine; electricity…)

preliminary data for palmoil, and lignocellusose EtOH (from whole plant)

Biofuels and bioheat, 2015

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GEMIS 5.0 data for Germany – see www.gemis.de

vehicle type, avg. med-sized	Greenhouse Gas Emissions [g/kWh]				Air pollutants [g/MWh]				Jobs per GWh
	$CO_{2\ eq}$	CO_2	CH_4	N_2O	$SO_{2\ eq}$	SO_2	NO_x	PM_{10}	
Diesel incl. bio	305	293	0,13	0,031	562	110	458	21,7	6,0
Diesel **excl. bio**	309	305	0,07	0,007	410	106	433	18,1	5,9
Otto incl. bio	305	299	0,08	0,017	350	117	163	18,3	3,3
Otto **excl. bio**	309	306	0,08	0,003	230	121	154	17,1	6,7

heating system	Greenhouse Gas Emissions [g/kWh]				Air pollutants [g/MWh]				Jobs per GWh
	$CO_{2\ eq}$	CO_2	CH_4	N_2O	$SO_{2\ eq}$	SO_2	NO_x	PM_{10}	
oil	373	369	0,10	0,004	400	222	248	27,2	0,7
gas	286	262	0,79	0,003	141	12	182	7,5	0,6
gas condensing	247	226	0,68	0,002	123	11	158	6,7	0,7
electric-storage	576	546	0,62	0,041	902	313	528	40,5	0,9
el. heatpump air	202	192	0,22	0,014	322	112	191	16,2	1,4
el. heatpump soil	162	154	0,18	0,011	265	92	162	14,7	1,6
el. heatpump water	148	140	0,17	0,010	248	88	153	15,1	1,6
district heating (coal)	254	237	0,41	0,017	419	144	365	20,7	0,5
wood-logs	25	7	0,50	0,009	420	188	288	277,3	0,5
wood-chips	25	18	0,16	0,006	452	123	448	58,5	0,7
wood-pellets	28	25	0,05	0,007	400	147	337	46,5	0,8
solar-hot water flat	24	21	0,05	0,001	72	37	42	17,0	3,3
solar-hot water vacuum	34	29	0,07	0,002	105	56	57	27,3	2,0
local-heat biogas-CHP	95	64	0,38	0,075	968	77	280	9,9	0,7
district heat wood-CHP	77	65	0,22	0,021	540	117	574	35,1	0,4
district heat SRC-CHP	59	46	0,18	0,031	525	118	507	51,1	15,3

Sustainable Bioeconomy: A Vision

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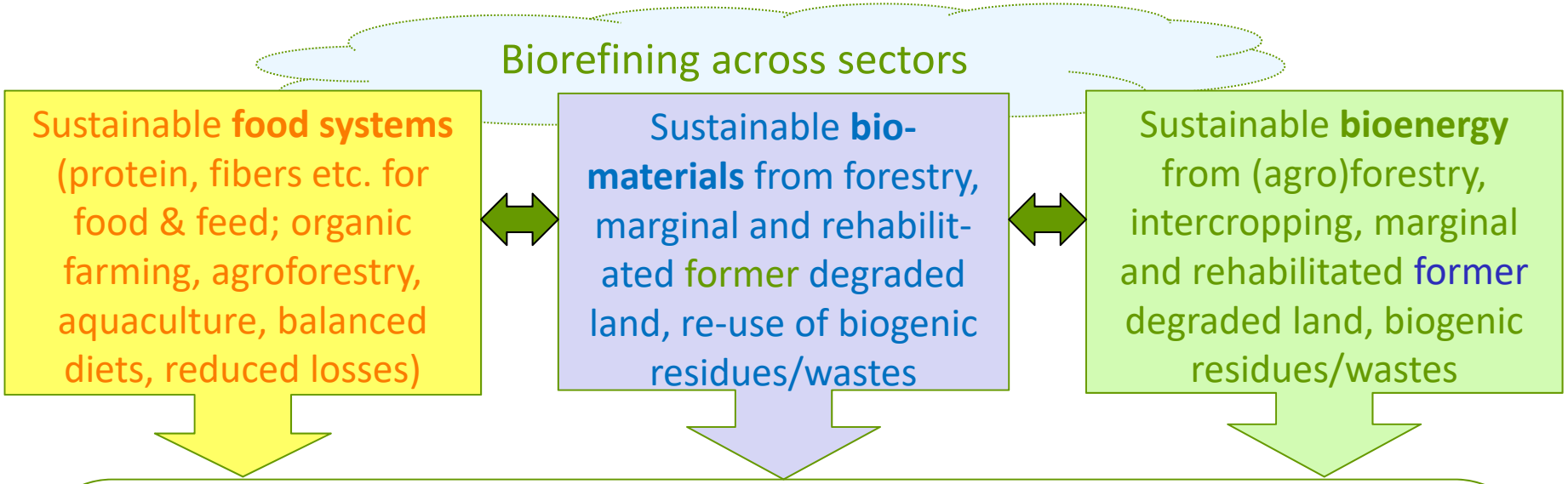

- Global food security, secure land tenure
- Regional/local employment and rural development
- Sustainable production in agriculture, fishery and forestry
- Reduction of food losses, recycling of wastes (circularity)
- Provision of ecosystem services (biodiversity, C sequestration, recreation, soil fertility, water…)

Steps towards the vision…

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Works on bioenergy & bioeconomy sustainability and governance in new Task 45 (with Task 40):
Dialogue on bioenergy and FLR with various partners*
Joint kickoff workshop on bioeconomy sustainability governance 23 May 2019 in Utrecht
JRC is (contributing) observer to IEA Bio Tasks 40 & 45

GBEP
Global Bioenergy Partnership

Discusses "bioenergy in the context of the broader bioeconomy" in its Sustainability Task Force, see **www.globalbioenergy.org – IEA Bio will contribute**

iea

Continues working with IEA Bioenergy, BioFutures Platform, GBEP, OECD, WBCSD and others to foster bioenergy & bioeconomy governance

* = see http://iinas.org/flr-bio_dialogue_glf_bonn.html

Way ahead: Transformation!

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Oxford Dictionary:

English Oxford *Living* Dictionaries

- A marked change in form, nature, or appearance.
- A sudden dramatic change of scenery on stage.
- A metamorphosis during the life cycle of an animal.

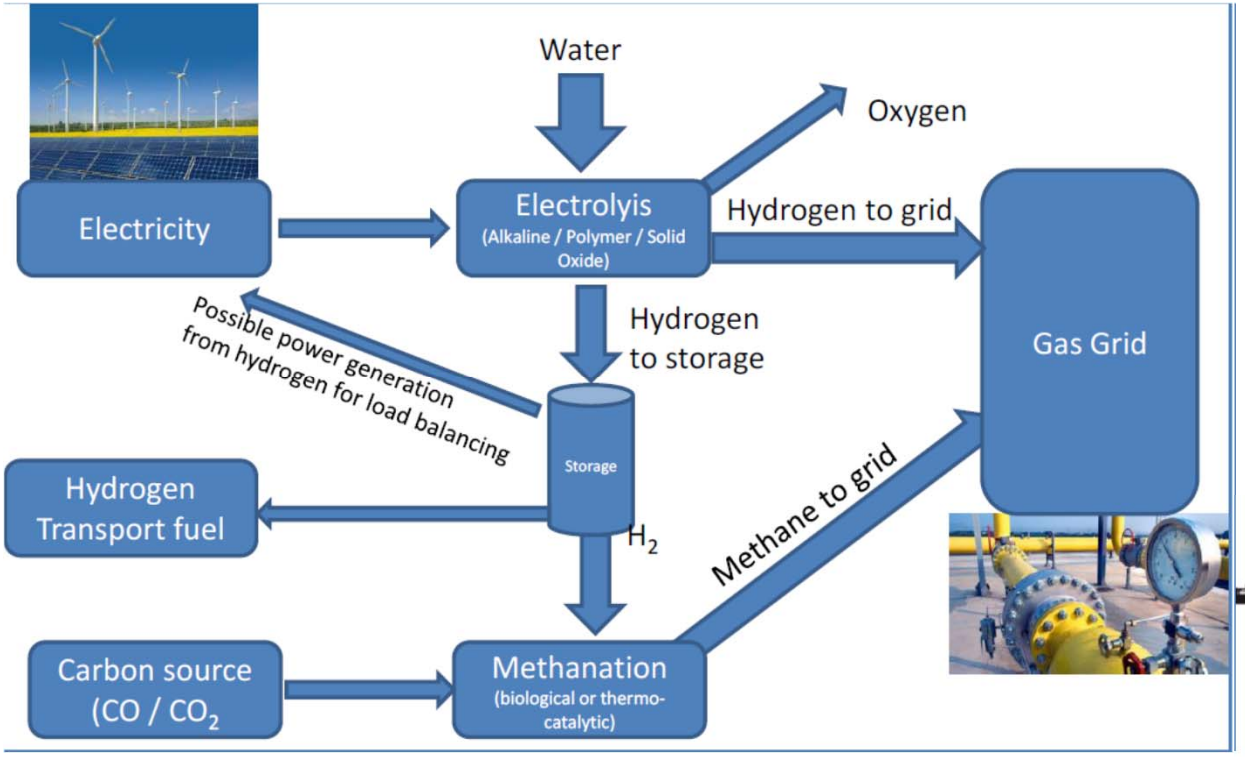
Examples:

– From degraded (e.g. **post-mining**) or abandoned land to providing biomass and ecosystem services

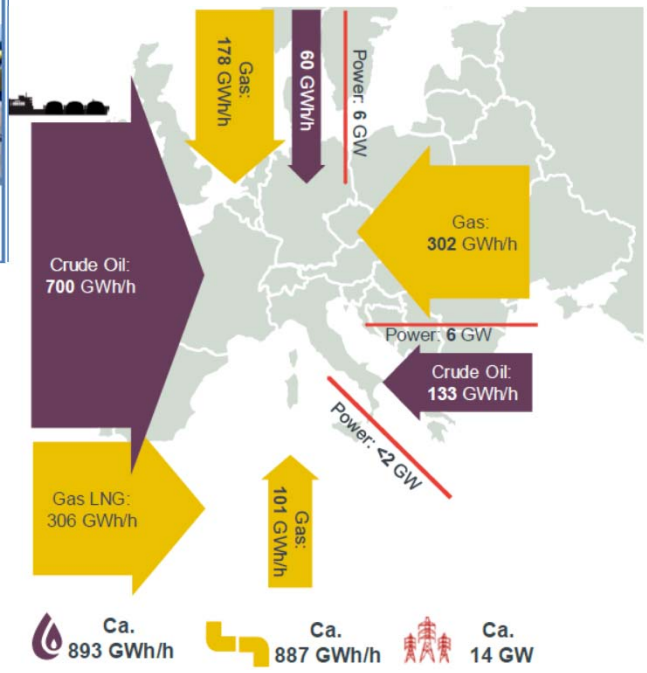
– From waste streams to energy carriers

– Pipelines: from fossil power to open networks for **renewable gases**

Transforming infrastructure: Gas!



Source: Lambert, M. (2018) Power-to-Gas: Linking Electricity and Gas in a Decarbonising World? Oxford Institute for Energy Studies. Oxford Energy Insight: 39



Source: Perner, J. & Bothe, D. (2018) International aspects of a Power-to-X roadmap. Report by Frontier Economics on behalf of the World Energy Council Germany. Berlin

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It always seems impossible until it's done

Nelson Mandela

More information and contact

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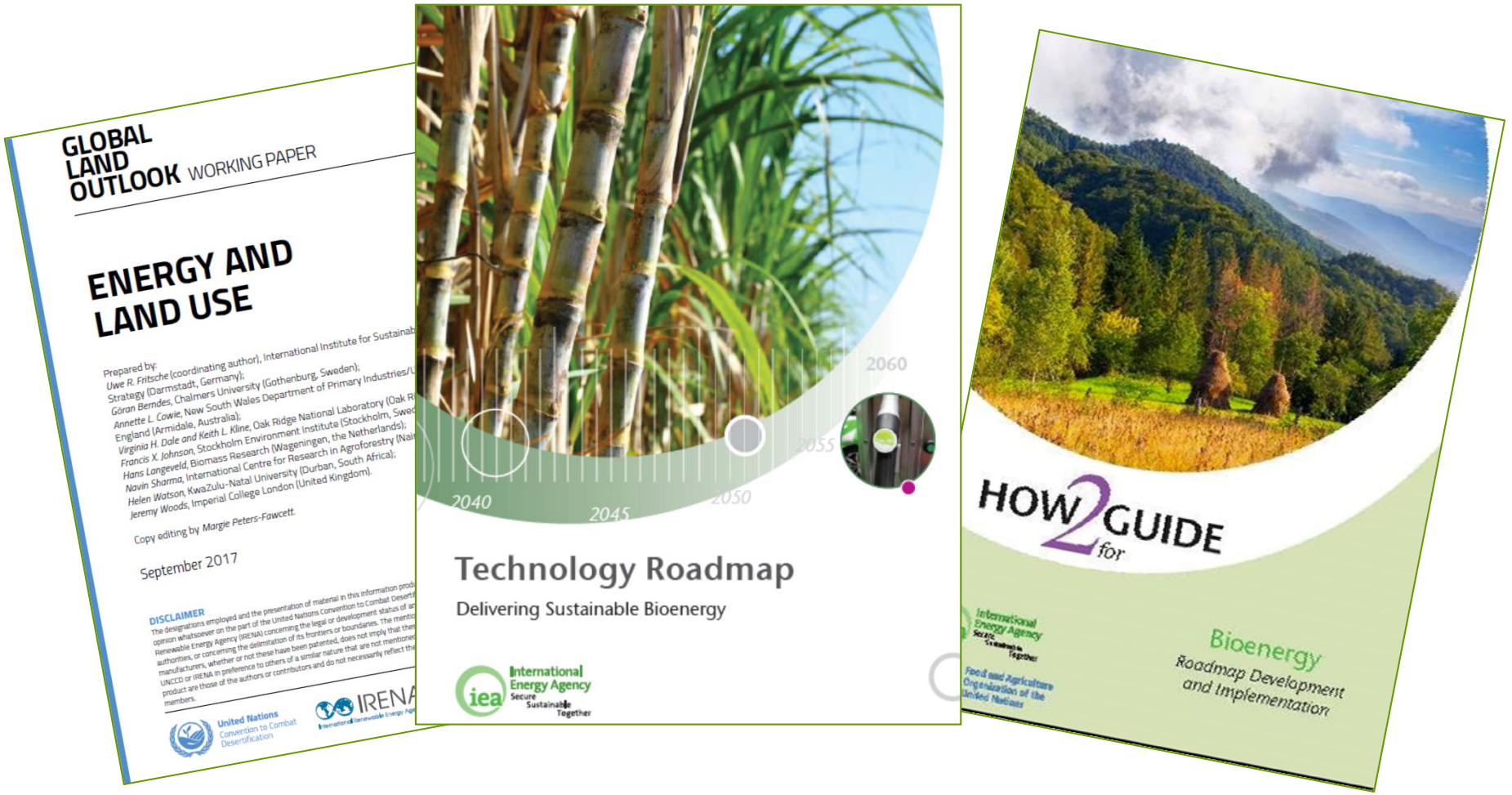

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www.task40.ieabioenergy.com & www.task45.ieabioenergy.com