Energy and Land Use:
A contribution to the UNCCD Global Land Outlook

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Introduction

- UN-CCD Global Land Outlook:
  several **background/working papers** https://global-land-outlook.squarespace.com/working-papers-1/#working-papers

- Land and Energy Paper:
  Overview of current knowledge, discuss interlinkages, outlook for integrated policies

- **Key issues and results** of the paper are presented

- Full paper:
  https://global-land-outlook.squarespace.com/s/Energy-and-Land-Use__U_Fritsche-t9tw.pdf

Energy, SDGs and relation to Land Use

SDG	Key wording	Driver	Safe-guard	Land relevance
1 No Poverty	End poverty in all its forms everywhere	(✔)	(✔)	moderate
2 Zero Hunger	**End hunger, achieve food security and improved nutrition and promote sustainable agriculture**	✔	✔	high
3 Good Health and Well-being	Ensure healthy lives and promote well-being for all at all ages	(✔)	(✔)	low
4 Quality Education	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all			
5 Gender Equality	Achieve gender equality and empower all women and girls			moderate
6 Clean Water and Sanitation	Ensure availability and sustainable management of water and sanitation for all	(✔)	(✔)	low
7 Affordable and Clean Energy	**Ensure access to affordable, reliable, sustainable and modern energy for all**	✔	(✔)	high
8 Decent Work and Economic Growth	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	(✔)	(✔)	moderate
9 Industry, Innovation and Infrastructure	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	(✔)		moderate
10 Reduced Inequalities	Reduce inequality within and among countries	(✔)		low
11 Sustainable Cities and Communities	**Make cities and human settlements inclusive, safe, resilient and sustainable**	✔	(✔)	high
12 Responsible Consumption and Production	**Ensure sustainable consumption and production patterns**	✔	(✔)	high
13 Climate Action	**Take urgent action to combat climate change and its impacts**	✔	✔	high
14 Life Below Water	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	(✔)	(✔)	low
15 Life on Land	**Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss**	✔	✔	high
16 Peace, Justice and Strong Institutions	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels		(✔)	low
17 Partnerships for the Goals	Strengthen the means of implementation and revitalise the global partnership for sustainable development	(✔)	(✔)	moderate

Source: Based on United Nations SDG web page at www.un.org/sustainabledevelopment/news/communications-material/
Notes: **Bold text** = SDG directly related to energy, high land relevance; (✔) = partially relevant.

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Land Use Intensity of Energy

Product	Primary energy source		Land use intensity [m²/MWh]				
			U.S. data[a]	U.S. data[b]	EU data[c]	UNEP[d]	Typical[e]
Electricity	Nuclear		0.1	0.1	1.0		0.1
	Natural gas		1.0	0.3	0.1	0.2	0.2
	Coal	Underground	0.6	0.2	0.2		0.2
		Surface ("open-cast")	8.2	0.2	0.4	15.0	5.0
	Renewables	Wind	1.3	1.0	0.7	0.3	1.0
		Geothermal	5.1		2.5	0.3	2.5
		Hydropower (large dams)	16.9	4.1	3.5	3.3	10
		Solar photovoltaic	15.0	0.3	8.7	13.0	10
		Solar – concentrated solar power	19.3		7.8	14.0	15
		Biomass (from crops)	810	13	450		500
Liquid Fuel	Fossil oil		0.6		0.1		0.4
	Biofuels	Corn (maize)	237		220		230
		Sugarcane (from juice)	274		239		250
		Sugarcane (residue)					0.1
		Soybean	296		479		400
		Cellulose, short rotation coppice	565		410		500
		Cellulose, residue			0.10		0.1

Source: Own compilation. Note that data include land use for spacing and from upstream life cycles (e.g., mining).
a) Trainor et al. (2016); b) Fthenakis and Kim (2009); c) IINAS (2017); d) UNEP (2016); e) own estimate for unspecified region (i.e., generic).
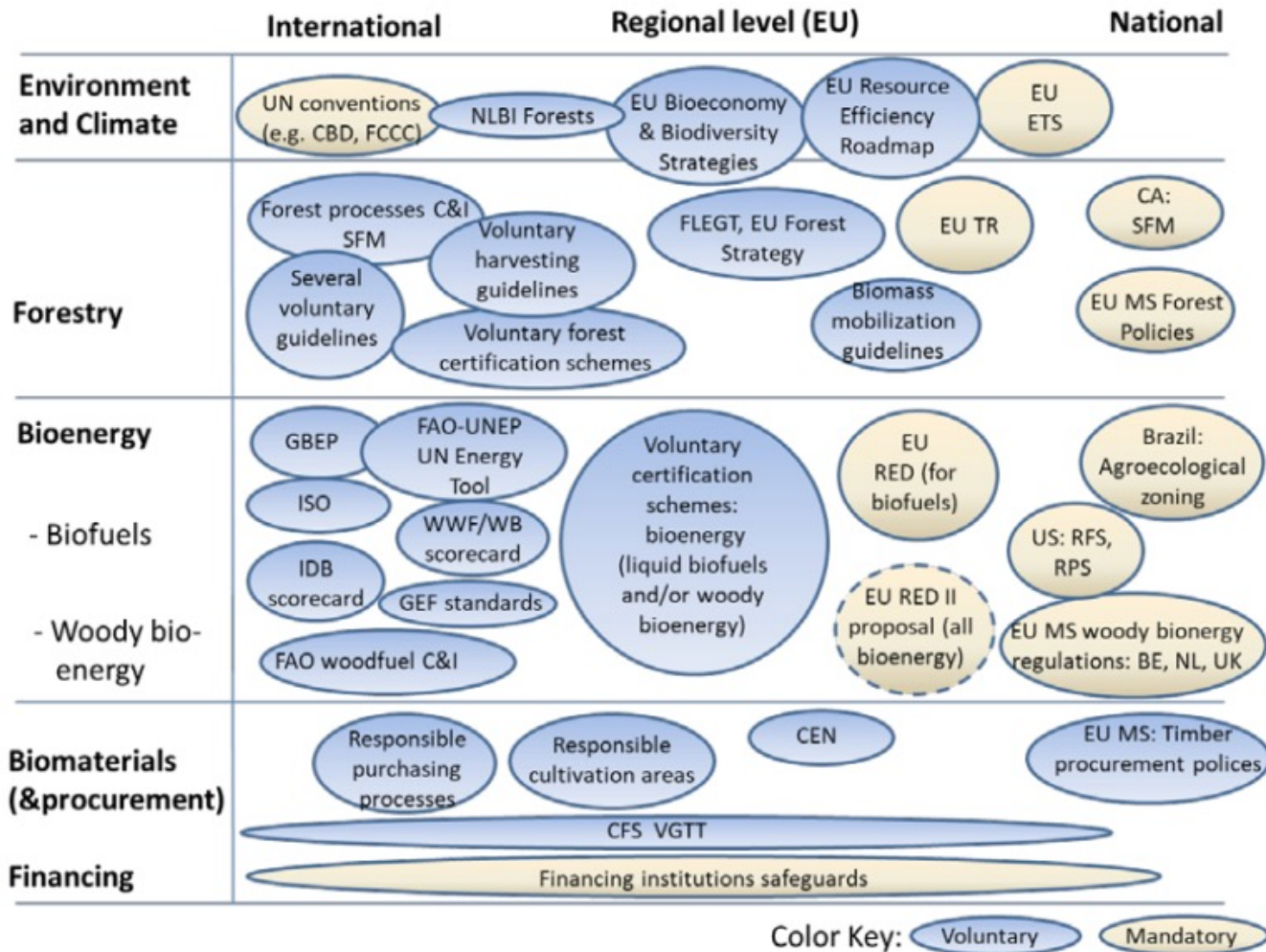
Overview of land-use intensities of hydroelectric systems

Name	Country	Annual generation [TWh$_{el}$]	Inundated area [km^2]	Land use intensity [m^2/MWh$_{el}$]
Itaipu	Brazil, Paraguay	91.7	1157	12.6
Three Gorges	China	79.9	853	10.7
Churchill Falls	Canada	30.8	4816	156.4
Cahora Bassa	Mozambique, Zimbabwe	15.8	2048	129.6
Nurek	Tajikistan	11.4	62	5.4
Sysenvatnet	Norway	4.8	11	2.3
Manapouri	New Zealand	3.3	133	40.3
Davis Bor	US	1.1	99	90.0

Source: own compilation based on Scherer & Pfister (2016)

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Opportunities for Bioenergy-Water-Land Synergies

Source: Berndes et al. (2015).

Sustainable biomass and bioenergy standards and certification

Source: Iriarte et al. (2015).

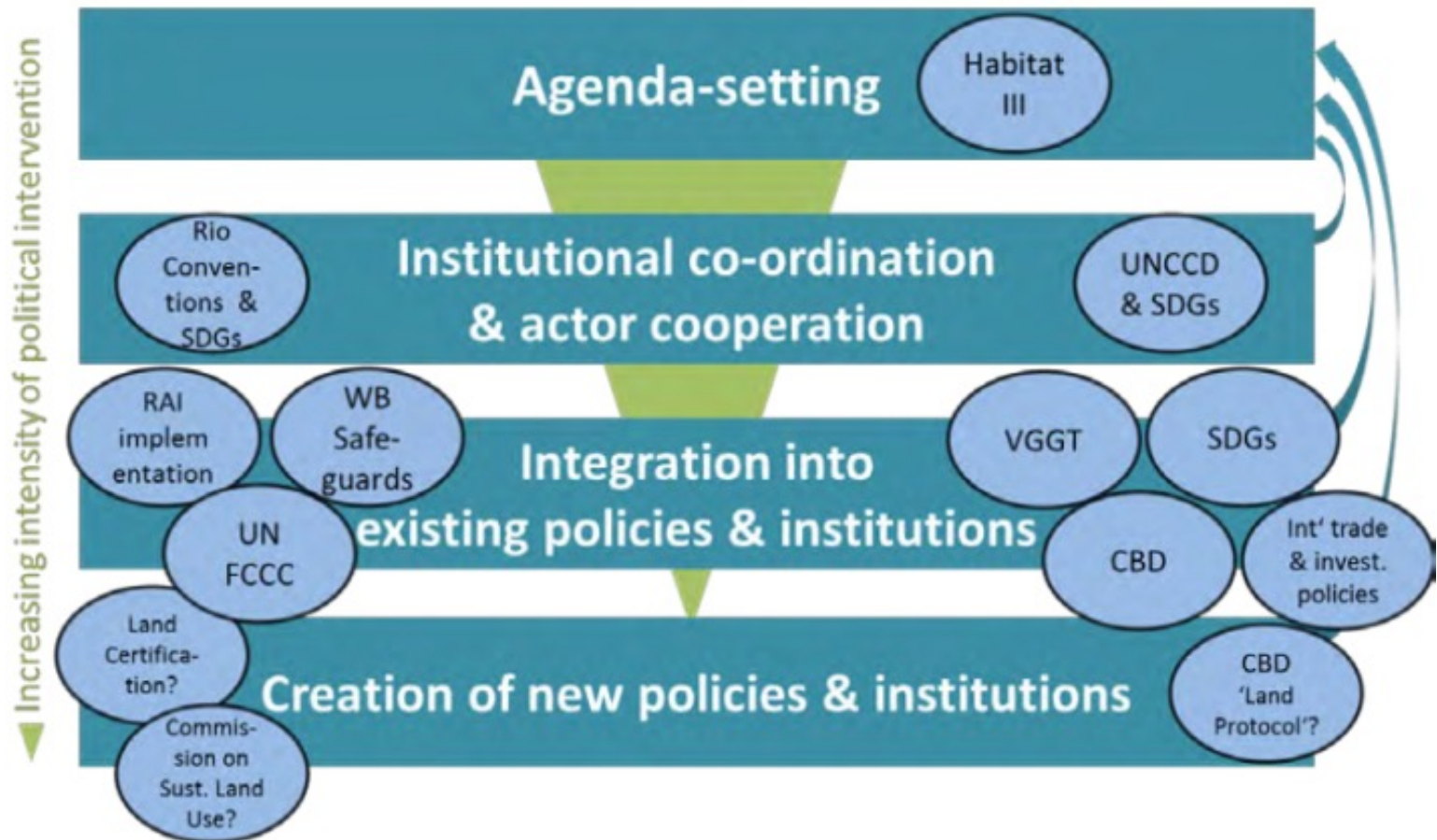# Prevalence of Land Use Planning
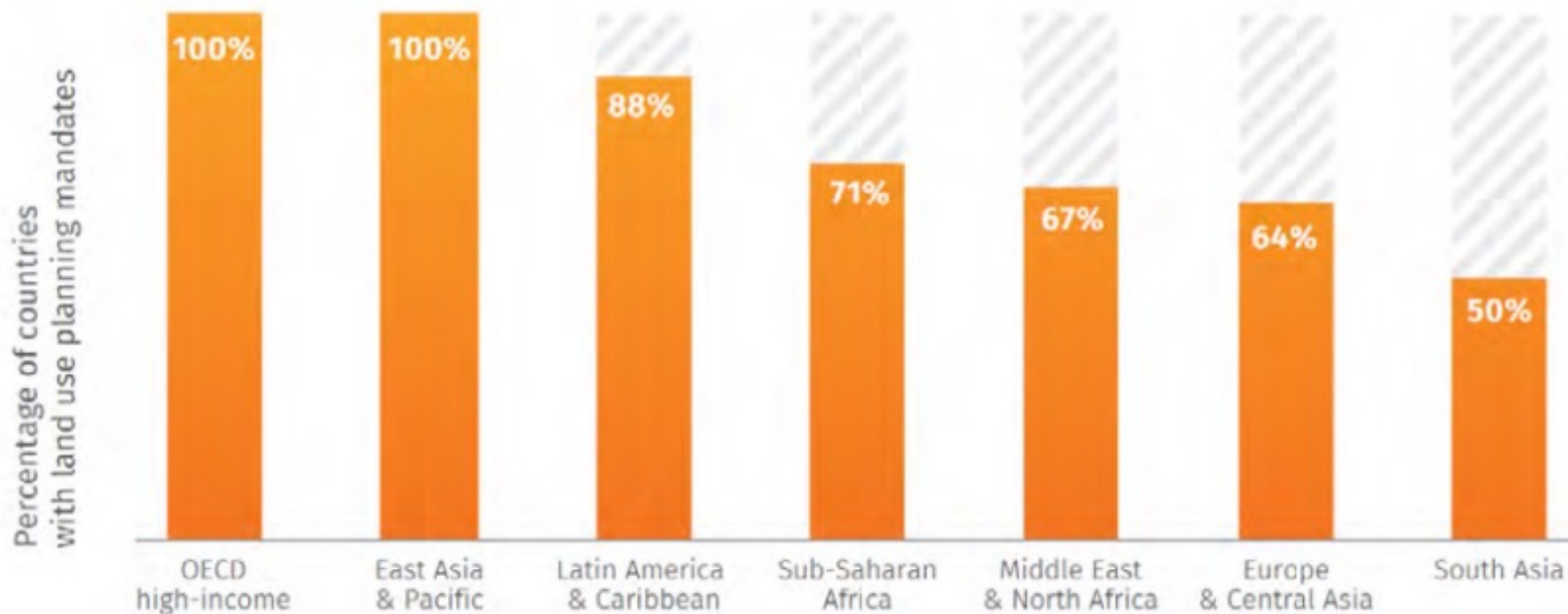
Source: World Bank (2017).

Land Degradation Neutrality and SDGs

Source: Akhtar-Schuster et al. (2017)

Way Ahead…

Source: Fritsche et al. (2015).

Conclusions (1)

- Land use for renewables can be significant; adequate planning & **integrative strategies** are essential. Among renewables, wind and geothermal lowest; solar and hydro moderate; dedicated bioenergy is highest.

- Land use requirements for non-renewables are low but the negative effects of fossil fuel extraction on landscapes and ecosystems are more severe.

- Dedicated bioenergy systems may require 10-50x as much land as other renewables, whereas wastes/residues require almost no additional land. Co-products also reduce effective land required.

- **RE mini/micro-grids can** foster rural electrification, improve agriculture and food processing, and benefit rural land use, businesses and livelihoods.

- Bioenergy **requires integration** into the landscape (e.g., agroforestry, intercropping) to ensure land use efficiency

- Bioenergy from **degraded land** (with sustainability safeguards) **is** key for LDN → economic incentives and regulation needed

Conclusions (2)

- **Governance** of sustainable land use remains fragmented in terms of public and private sector policies, and the integration of energy into land use policies is inadequate

- The 2030 SDG timeframe and aim of decarbonizing global energy by 2050 requires that knowledge and research of land-energy links be improved

- **Private sector** needs clear signals and guidance to include the land issues (IEA Bioenergy Roadmap)

- **Financing institutions** (WB, GEF, GCF, bilateral donors...) should develop projects and programs that **integrate land and energy** and **implement sustainability standards** that reflect potentials of sustainable bioenergy and other renewables

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More Information

GLOBAL
LAND
OUTLOOK WORKING PAPER

ENERGY AND
LAND USE

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