Energy and Land Use:

A contribution to the UNCCD Global Land Outlook

Lead author: Uwe R. Fritsche, IINAS

Co-Authors:

Göran Berndes, Chalmers University, Sweden

Annette L. Cowie, New South Wales Department of Primary Industries, Australia

Virginia H. Dale & Keith L. Kline, ORNL, USA

Francis X. Johnson, Stockholm Environment Institute (SEI)

Hans Langeveld, Biomass Research, Netherlands

Navin Sharma, ICRAF; Helen Watson, KwaZulu-Natal University, South Africa

Jeremy Woods, Imperial College London, UK

Presenting author: ***Francis X. Johnson, SEI***

Land and Poverty Conference 2018: Land Governance in an Interconnected World

March 19-23, 2018, World Bank, Washington, DC

SEI

IINAS www.iinas.org

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

SEI

IINAS
www.iinas.org

Energy, SDGs and relation to Land Use

SDG	Key wording	Driver	Safe-guard	Land relevance
	End poverty in all its forms everywhere	(✓)	(✓)	moderate
	**End hunger, achieve food security and improved nutrition and promote sustainable agriculture**	✓	✓	high
	Ensure healthy lives and promote well-being for all at all ages	(✓)	(✓)	low
	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all			
	Achieve gender equality and empower all women and girls			moderate
	Ensure availability and sustainable management of water and sanitation for all	(✓)	(✓)	low
	**Ensure access to affordable, reliable, sustainable and modern energy for all**	✓	(✓)	high
	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all	(✓)	(✓)	moderate
	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation	(✓)		moderate
	Reduce inequality within and among countries	(✓)		low
	**Make cities and human settlements inclusive, safe, resilient and sustainable**	✓	(✓)	high
	**Ensure sustainable consumption and production patterns**	✓	(✓)	high
	**Take urgent action to combat climate change and its impacts**	✓	✓	high
	Conserve and sustainably use the oceans, seas and marine resources for sustainable development	(✓)	(✓)	low
	**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
	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
	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.

SEI

IINAS
www.iinas.org

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).

SEI

IINAS
www.iinas.org

Overview of land-use intensities of hydroelectric systems

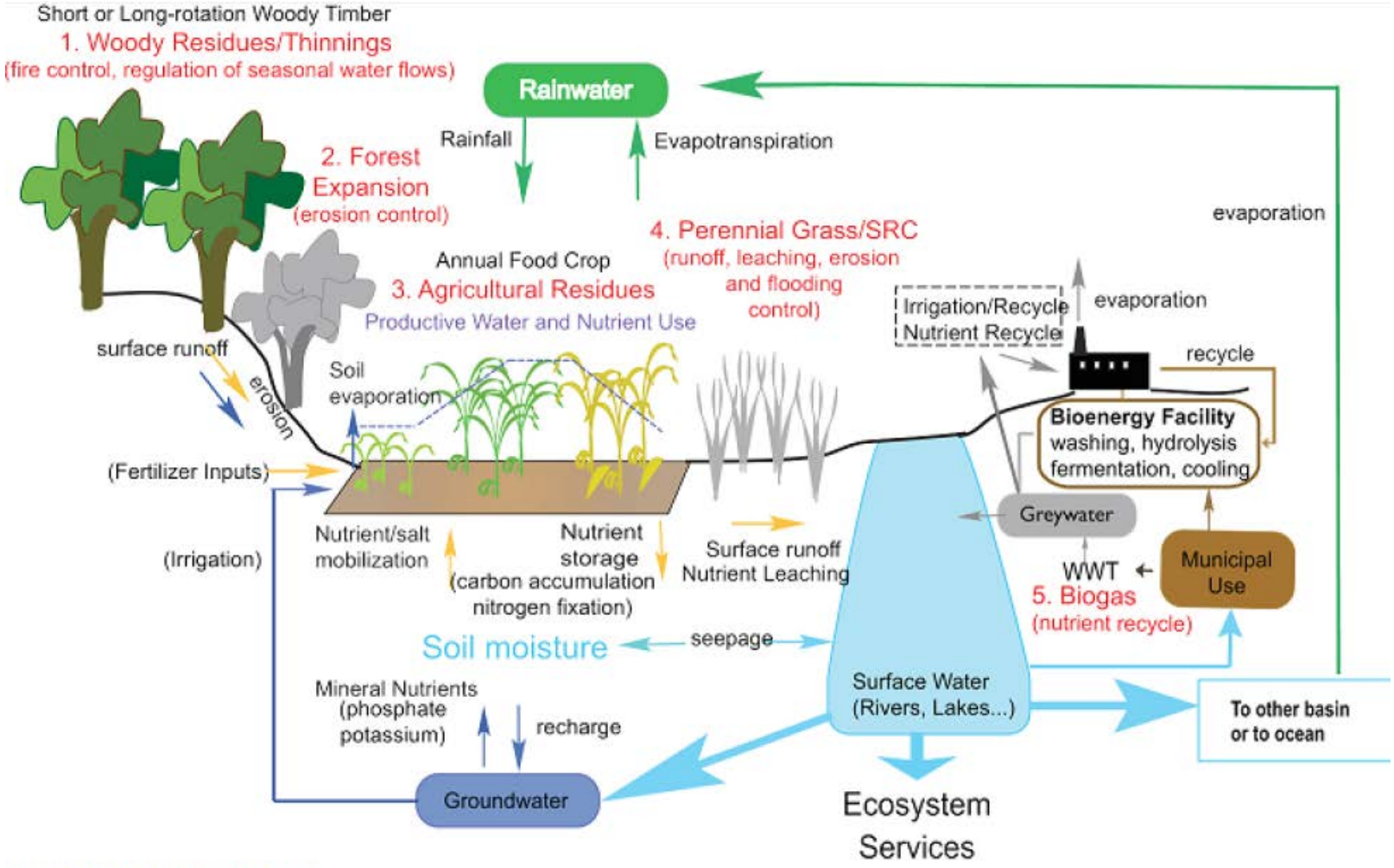
Name	Country	Annual generation [TWh_{el}]	Inundated area [km^2]	Land use intensity [m^2/MWh_{el}]
Itaipu	Brazil, Paraguay	91.7	1157	12.6
Three Gorges	China	79.9	853	10.7
Churchill Falls	Canada	30.8	4816	156.4
Cahora Bassa	Mozambique, Zimbabwe	15.8	2048	129.6
Nurek	Tajikistan	11.4	62	5.4
Sysenvatnet	Norway	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)

SEI

IINAS
www.iinas.org

Opportunities for Bioenergy-Water-Land Synergies

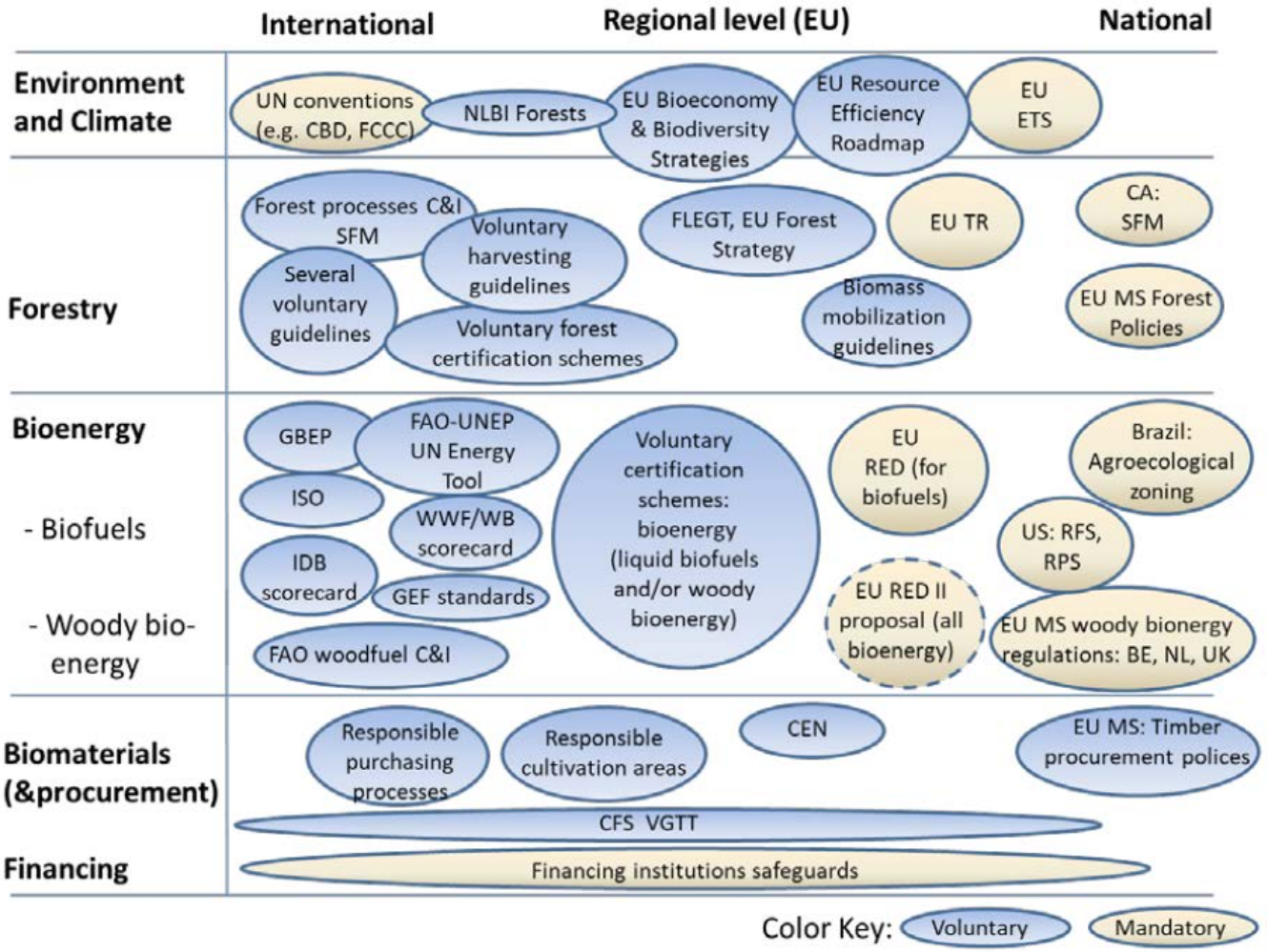


Source: Berndes et al. (2015).

SEI

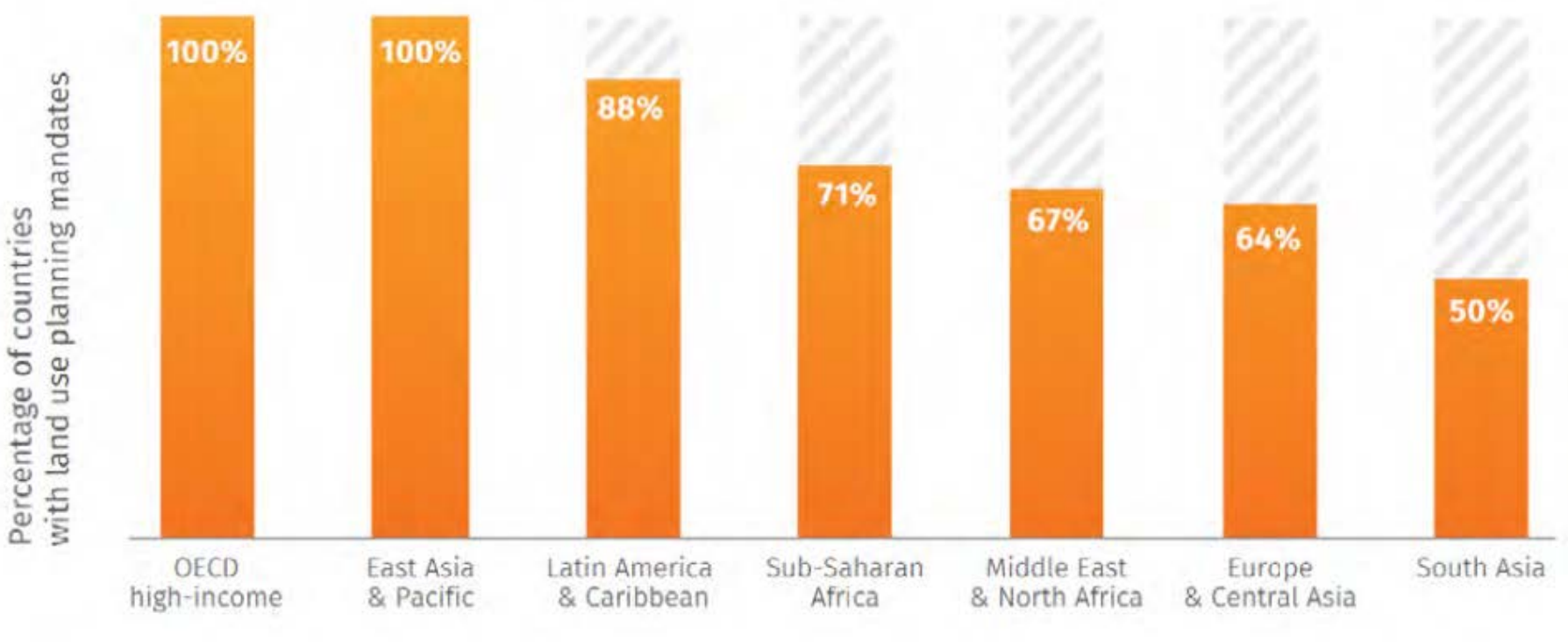
IINAS
www.iinas.org

Sustainable biomass and bioenergy standards and certification



Source: Iriarte et al. (2015).

Prevalence of Land Use Planning



Source: World Bank (2017).

SEI

IINAS
www.iinas.org

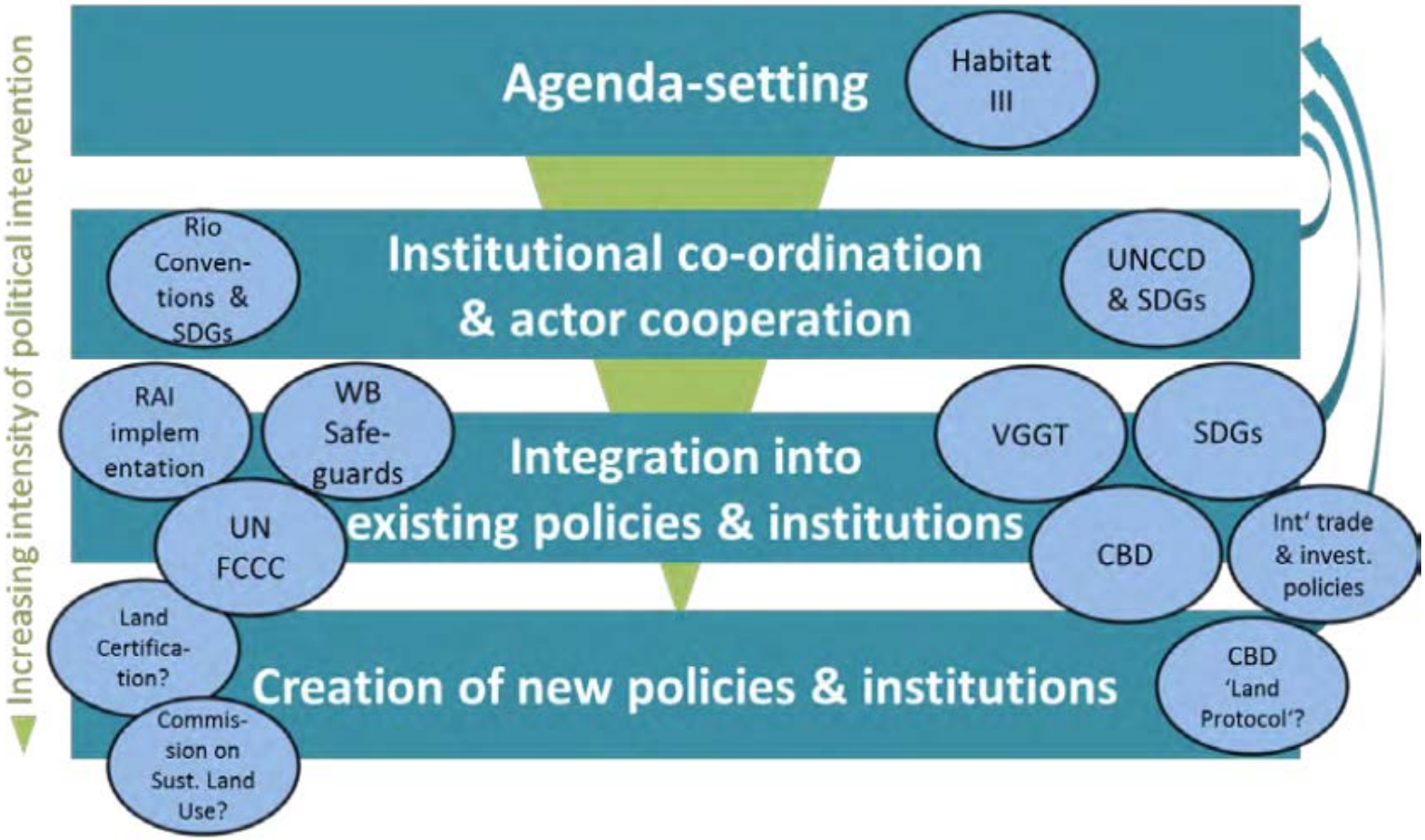
Land Degradation Neutrality and SDGs

Source: Akhtar-Schuster et al. (2017)

SEI

IINAS
www.iinas.org

Way Ahead…



Source: Fritsche et al. (2015).

SEI

IINAS
www.iinas.org

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

SEI

IINAS
www.iinas.org

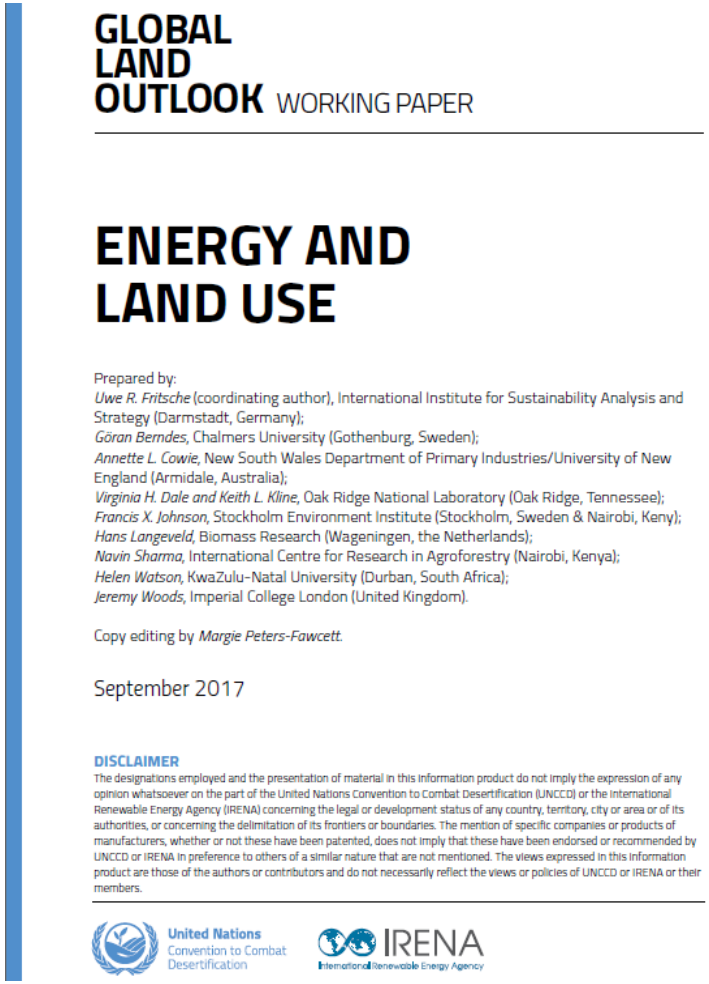
Conclusions (2)

- **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

SEI

IINAS
www.iinas.org

More Information



GLOBAL
LAND
OUTLOOK WORKING PAPER

ENERGY AND LAND USE

Prepared by:
Uwe R. Fritsche (coordinating author), International Institute for Sustainability Analysis and Strategy (Darmstadt, Germany);
Göran Berndes, Chalmers University (Gothenburg, Sweden);
Annette L. Cowie, New South Wales Department of Primary Industries/University of New England (Armidale, Australia);
Virginia H. Dale and Keith L. Kline, Oak Ridge National Laboratory (Oak Ridge, Tennessee);
Francis X. Johnson, Stockholm Environment Institute (Stockholm, Sweden & Nairobi, Keny);
Hans Langeveld, Biomass Research (Wageningen, the Netherlands);
Navin Sharma, International Centre for Research in Agroforestry (Nairobi, Kenya);
Helen Watson, KwaZulu-Natal University (Durban, South Africa);
Jeremy Woods, Imperial College London (United Kingdom).

Copy editing by *Margie Peters-Fawcett*.

September 2017

United Nations Convention to Combat Desertification

IRENA International Renewable Energy Agency

Contacts:

uf@iinas.org
francis.johnson@sei-international.org

SEI

IINAS www.iinas.org