

Boosting Bioenergy: Sustainable Paths to Greater Energy Security

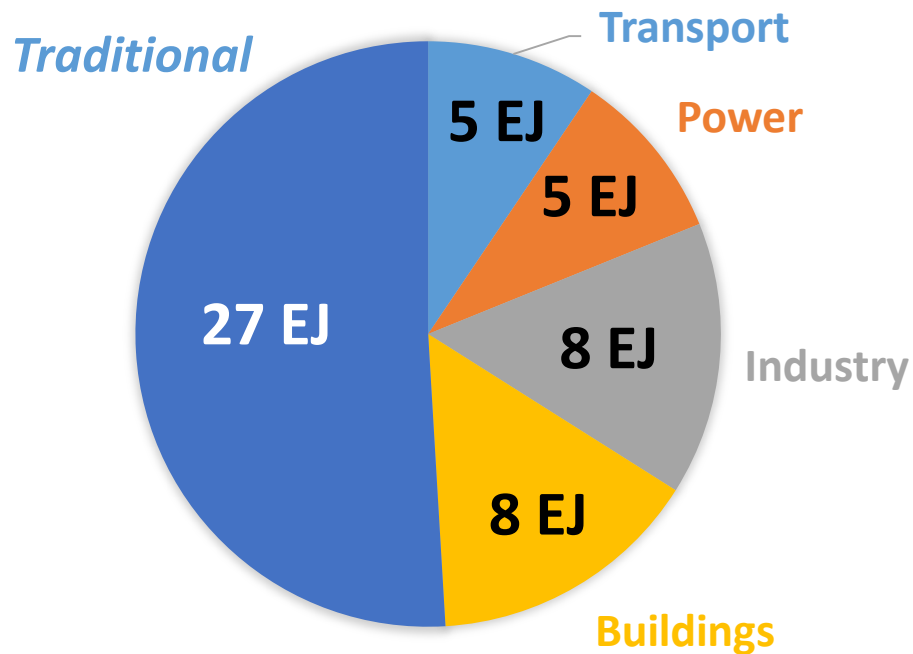


***IEA Bioenergy Workshop:
Mobilizing Sustainable
Bioenergy Supply Chains:
Opportunities for Agriculture
Rome, 17 May 2016***

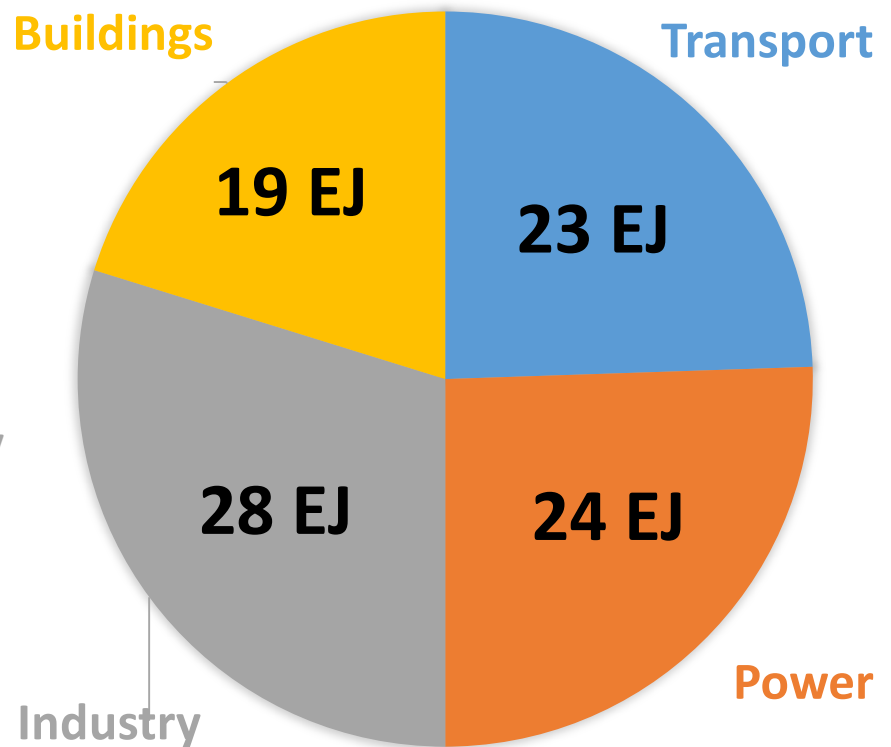
**Jeff Skeer
International Renewable
Energy Agency (IRENA)**



26 EJ in 2010



94 EJ in 2030

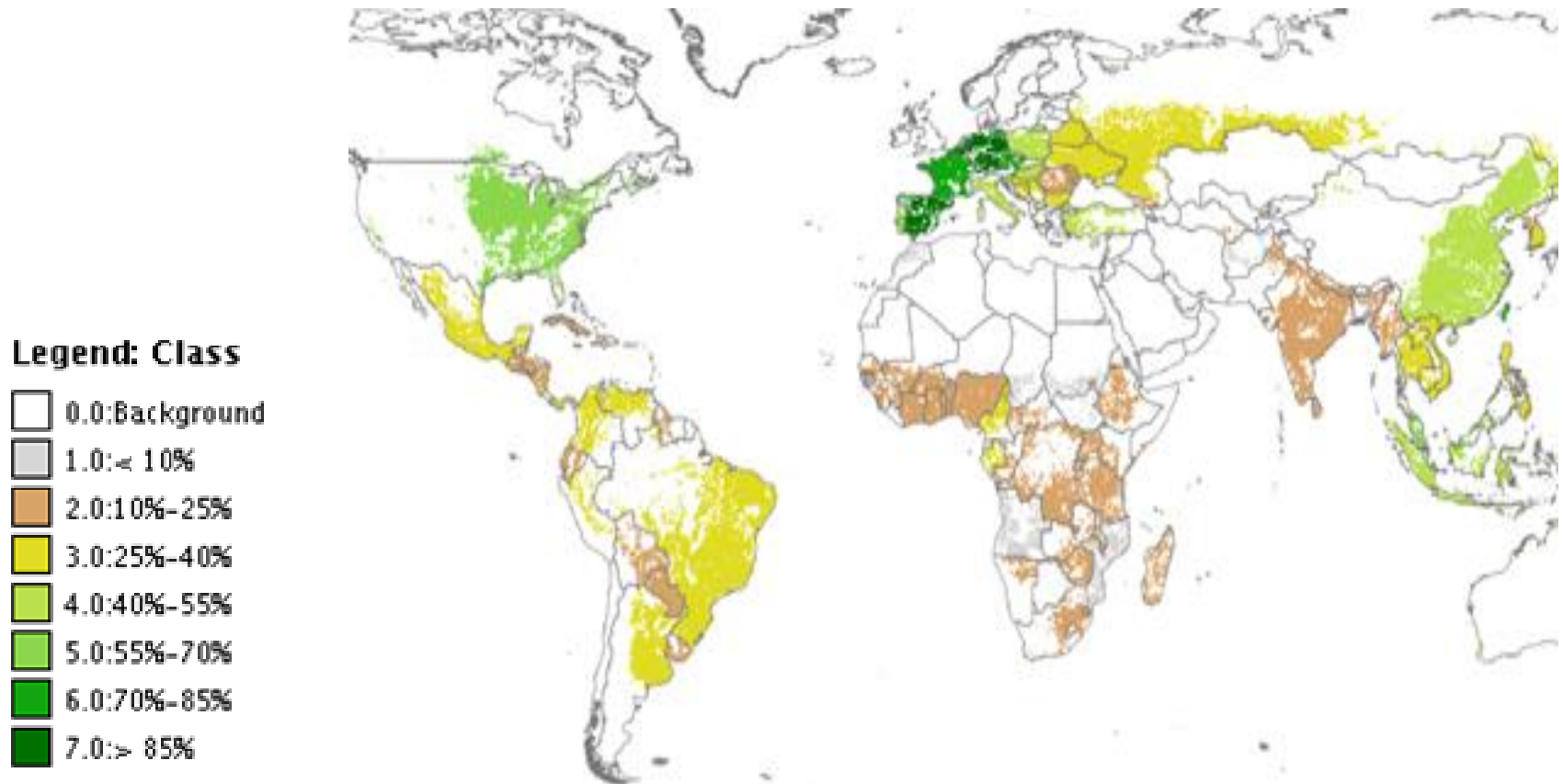


- Agriculture
 - Residues associated with growing food production
 - Higher yields on cropland (sustainable intensification)
 - Efficient livestock husbandry: freeing up pastureland
 - Reduced food losses and waste: freeing up farmland
- Forestry
 - Residues (complementary fellings on timberland)
 - Higher yields in planted forests (better management)
 - Afforestation of degraded forest and marginal lands
- Algae

- Two main types of agricultural residues
 - Harvest residues (sustainably collect 25% - 50%)
 - Processing residues (practically collect 90% or more)
- Potential for biofuels from the residues
 - 79 to 128 EJ of agricultural residues collectable by 2050
 - 33 EJ of residue projected to be needed for animal feed
 - 46 to 95 EJ remaining available for conversion to biofuel
 - 40% efficient process for converting lignocellulose
 - 18 to 38 EJ of advanced biofuel could be produced
 - (22 EJ used for marine shipping and aviation in 2012)

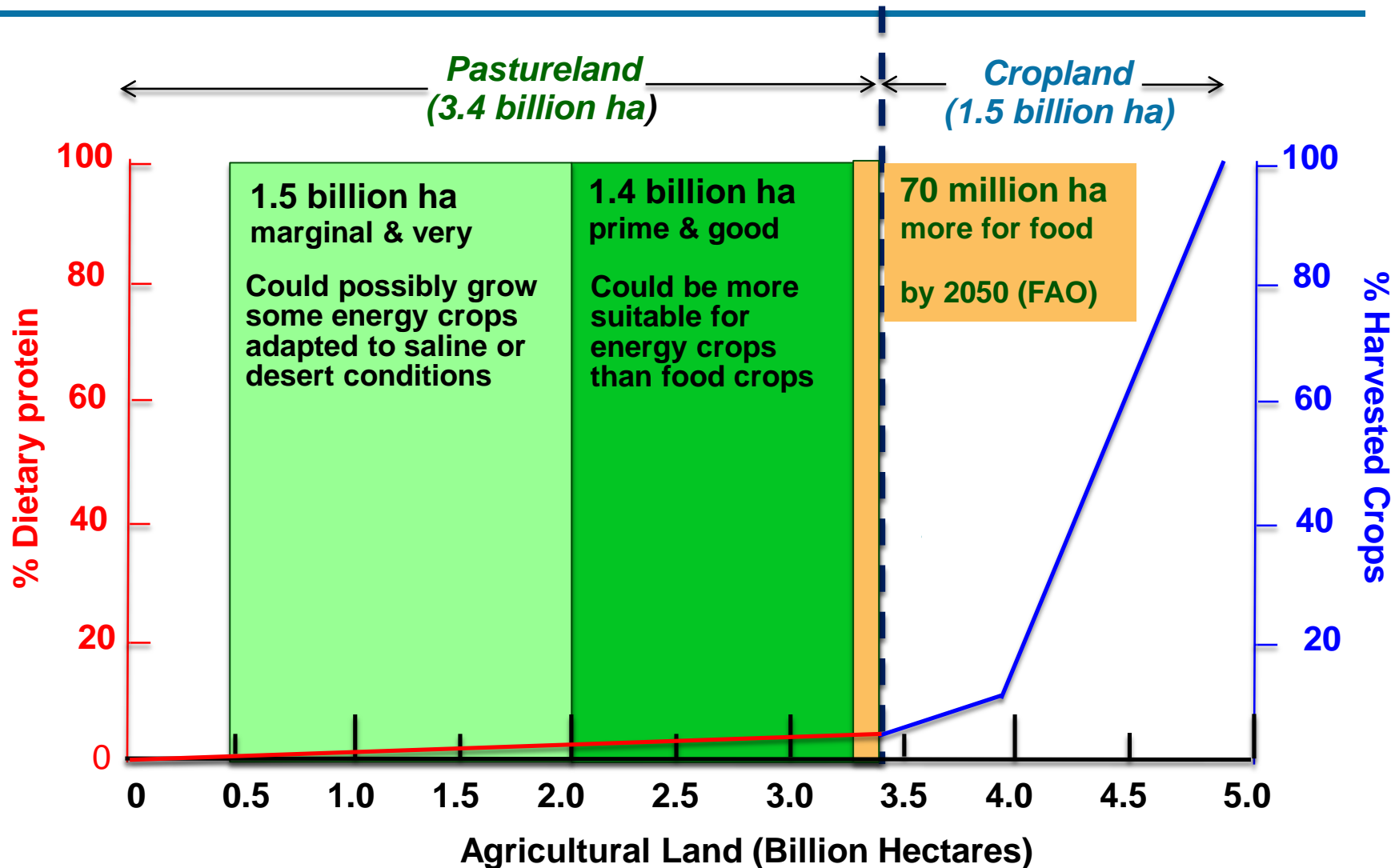
Yield Gap: Illustrated by Maize

Ratio of Actual to Potential Yield for Maize (Year 2000)



Source: Global Agro-Ecological Zones

Pastureland Available Globally for Biofuel Crops



Best Practice Losses by Food Chain Stage

Food Type	Agricultural Production	Postharvest Handling & Storage	Processing and Packaging	Distribution: Supermarket Retail	Consumption
Cereals	2%	2%	3.5%	2%	1%
Roots & Tubers	6%	7%	10%	3%	2%
Oilseeds & Pulses	6%	0%	5%	1%	1%
Fruits & Vegetables	10%	4%	2%	8%	5%
Meat	2.9%	0.2%	5%	4%	2%
Milk	3.5%	0.5%	0.1%	0.5%	0.1%

- **Closing the Yield Gap: 550 M ha**
- **Better Use of Pasture Land: 950 M ha**
- **Reduced Food Chain Losses: 270 M ha**
- **Reafforestation: 350 M ha**
- **TOTAL: OVER 2 BILLION HECTARES, 300 EJ**

How Large Is the Biofuel Potential?

Category	Primary Biomass Energy Content	End Use Bioenergy with 1st/3rd Generation Biofuel or Combined Heat and Power (80% Efficiency)	End Use Bioenergy with 2d Generation Biofuel Conversion (40% Efficiency)	REMAP 2030 Assumptions for Primary Biomass Energy (Reference)
Agricultural Residues	46 - 95 EJ	36 - 76 EJ	18 - 38 EJ	19 - 48 EJ
Higher Crop Yields	47 - 88 EJ	37 - 70 EJ	19 - 35 EJ	0 EJ
Pasture Land	71-142 EJ	57-114 EJ	28 - 57 EJ	33 - 39 EJ
Reduced Food Waste	40 - 83 EJ	32 - 66 EJ	16 - 33 EJ	18 EJ
Cultivating Forests	83-141 EJ	42-112 EJ	21 - 56 EJ	41 - 58 EJ
Total	287-549 EJ	204-438 EJ	102-219 EJ	112-162 EJ

- ***Accelerate improvement of crop yields*** by expanding extension services to spread modern farming techniques.
- Improve understanding of ***logistical approaches*** for cost-effective harvesting of farm and forest residues.
- Collect ***comprehensive data*** on land that could be used for sustainable ***wood and grass crops***, including likely yields.
- Conduct in-depth research on ***practices for cultivating rapidly growing trees and grasses*** on pastureland that could sequester carbon and enhance biodiversity.
- Institute ***more secure land tenure*** and ***better governance*** to provide incentives for more intensive land management.
- Provide Incentives to plant ***trees on degraded lands***.

BOOSTING BIOFUELS

Sustainable Paths
to Greater Energy Security

