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Efficient Use of Biomass for Energy in Developing Countries

IEA Bioenergy Task 38 Conference
Ostersund, Sweden September 30, 2003

Boris E. Utria, AFTEG

RPTES Program Manager / Co-Chair E&P TG
The World Bank





Presentation Outline

- 1. Biomass Energy Agenda (*AFTEG's New Vision*)**
- 2. Traditional Energy & Rural Development**
 - Senegal PROGEDE Example
 - AFTEG Portfolio Evolution
- 3. Modern Biomass Energy & Sustainable Development**
 - The Brazilian ProAlcool Program
 - AFR: Millennium Gelfuel Initiative
 - B-MESDV Vehicle
- 4. Biomass Energy & Poverty Alleviation “Model”**
- 5. Biomass Energy Inventory Methodology**

Request ! Q&A



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1. Biomass Energy Agenda *(AFTEG's New Vision)*



“Efficiency”:

- Economic (Cost/Benefit)**
- Social (Equity)**
- Environmental (Sustainability)**
- Technical (Performance)**



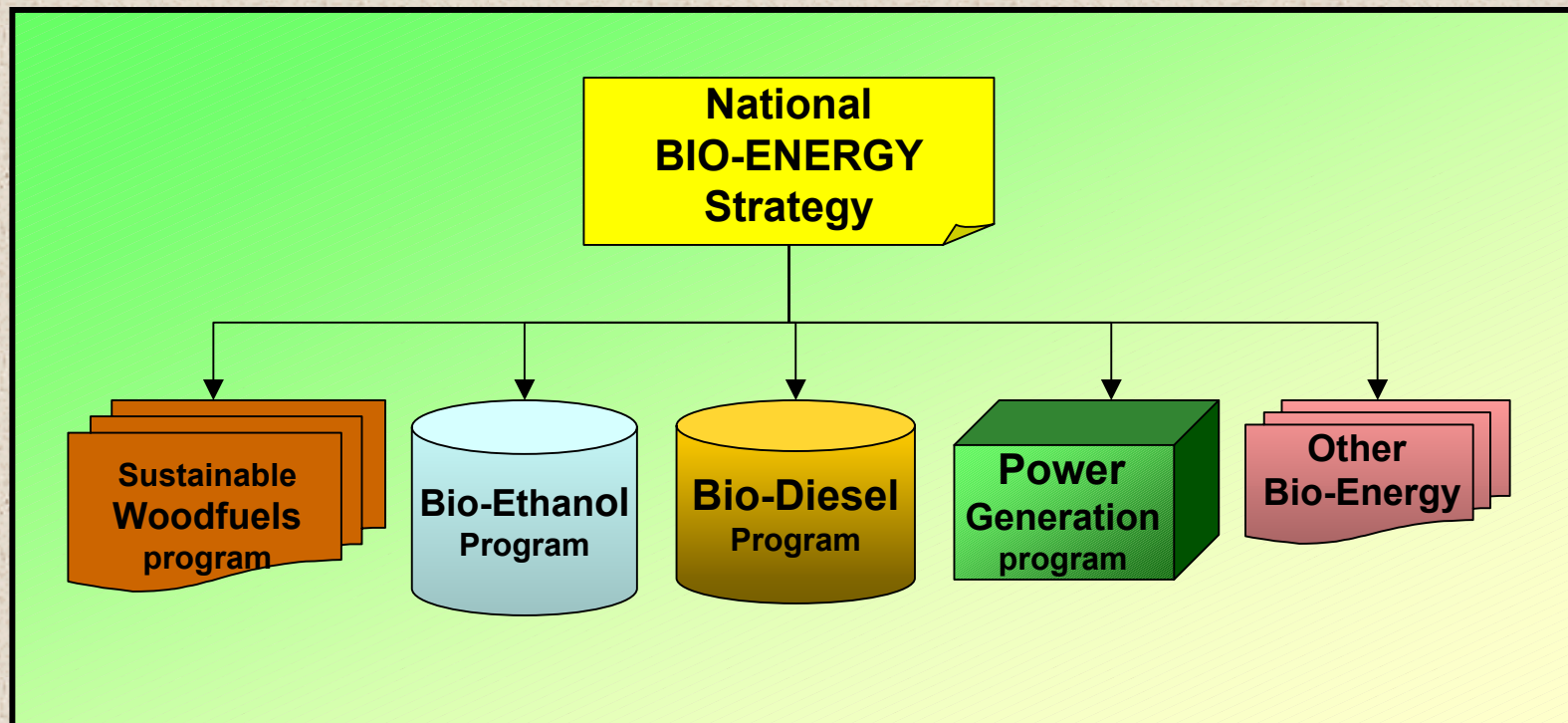
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Biomass Energy Agenda (FY04-07)

Vision: Contribute to Poverty Reduction and Sustainable Development in the Africa Region through the development of Comprehensive, Sustainable and “Efficient” biomass energy sector policies, strategies and investments.





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2. Traditional Biomass Energy & Rural Development

- Senegal PROGEDE Example

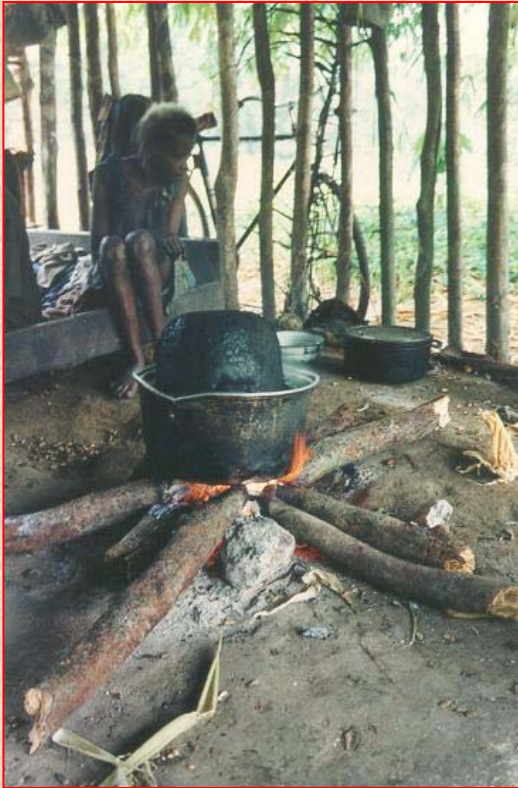


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Traditional Biomass Fuels



Rural

- TBF currently **70%+** of total energy consumed in Africa
- **80%** AFR households currently depend on biomass fuels
- **50%** AFR household will depend on TBF for next 2-3 decades

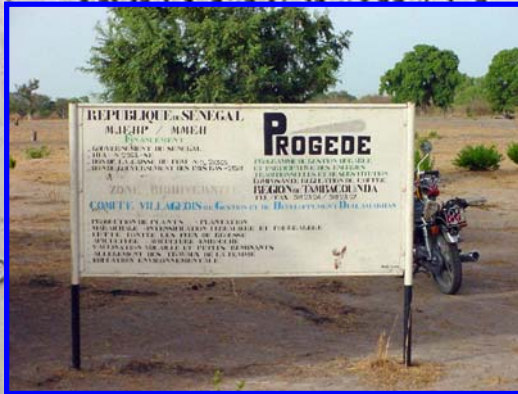


Urban



Senegal PROGEDE

“Sustainable & Participatory Energy Management Project”



GOUVERNEMENT DU SENEGAL

DU FEM N° 28365
N° 21581

PROGRAMME DE GESTION
ET PARTICIPATIVE DE
TRADITIONNELLES ET
COMPOSANTE REGULA
RÉGION DE TAMI
TEL / FAX 981 23 24 /

BIODIVERSITE

LAGEOIS DE GESTION ET DE DEVELOPPEMENT

PRODUCTION DE PLANTS - PLANTATION
MARAIAGE - INTENSIFICATION CEREALEERE ET FOURRAGERIE
LUTTE CONTRE LES FEUX DE BROUSSE
APICULTURE - AVICULTURE - ENBOUCHE
VACCINATION VOLAILE ET PETITS RUMINANTS
ALLEGEMENT DES TRAVAUX DE LA FEMME
EDUCATION ENVIRONNEMENTALE

Eco+Soc+Env+Tech Efficiency
Multi-sectorial / Assets-based Rural Development
Participatory NRM & CDD Approach
Environmental Sustainability / Climate Change



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Senegal PROGEDE: NR Assets Development



Sustainable Forest/NRM Management



Sustainable Fuelwood Production/sales



Improved Carbonization Methods



Sustainable Charcoal Production/Sale

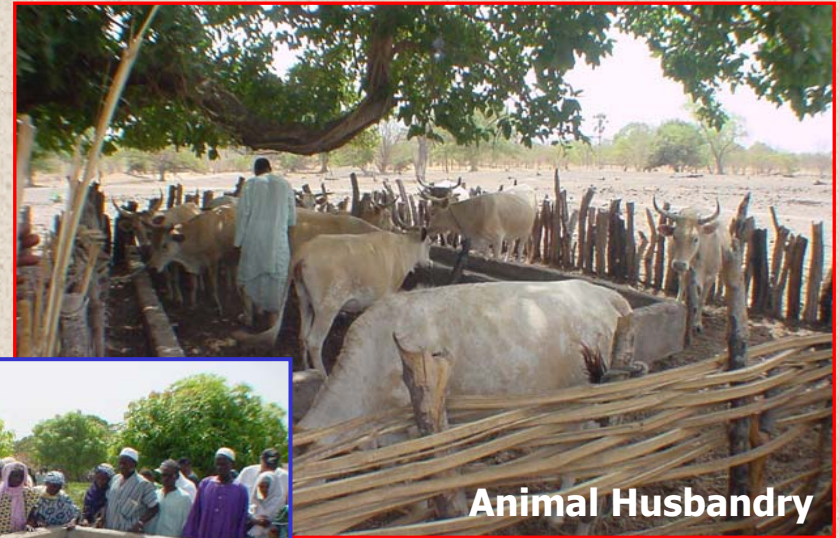


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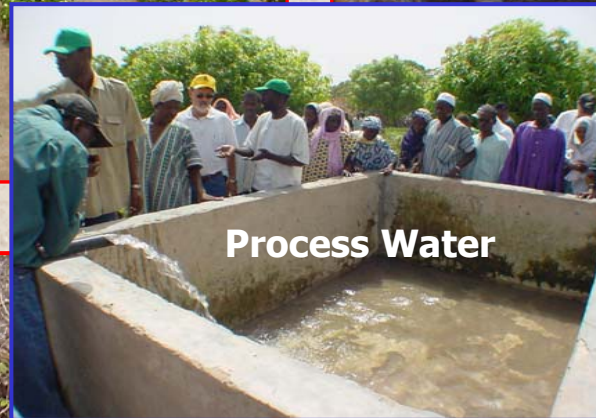
Senegal PROGEDE: Productive Assets



Crop Diversification



Animal Husbandry



Process Water



Honey Production



Value Added Products



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Senegal PROGEDE: Social Assets



Potable Water



Gender Capacity Development & Mobilization

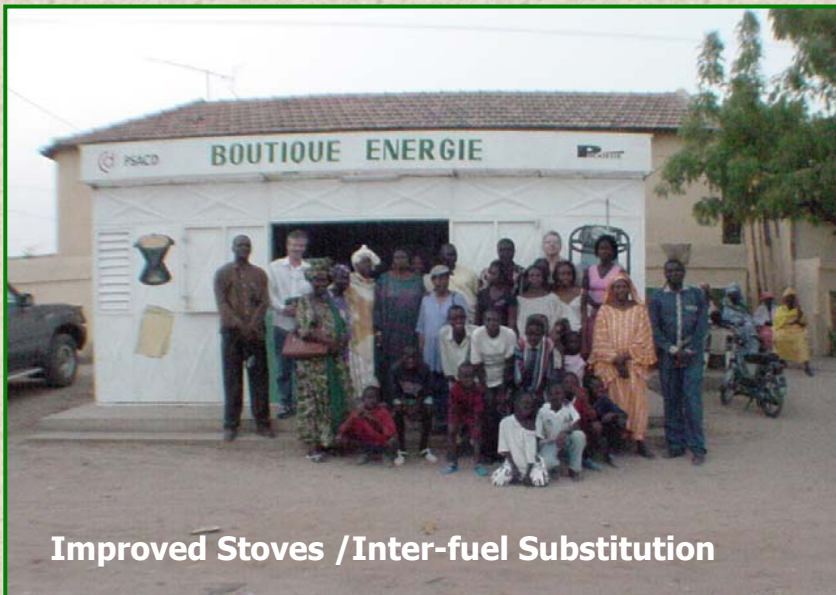


Children Family Health & Nutrition Education



Children/Youth Environmental & Energy Education

Senegal PROGEDE: Support Assets





3. Modern Biomass Energy & Sustainable Development

- The Brazilian ProAlcool Program
- AFR: Millennium Gelfuel Initiative
- B-MESDV Vehicle
- “Sustainable Development Engine” Concept
- Employment Generation Impacts



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Modern Biomass Energy

Ethanol, Bio-Diesel, other bio-fuels, Power, Etc.

- Large employment generation potential → **PR**
- Local production → import substitution
- Ecosystem rehabilitation
- Cleaner fuels → CO2 abatement
- Cleaner Hh fuels → reduced “in-door” pollution
- Potential exports → balance of payments
- Private Sector participation



BRASIL: PROALCOOL Main Achievements & Impacts

- ✓ **12 million m³ ethanol** (20X 1975);
Oil displacement: 200,000 barrels/day;
- ✓ **2.5 million neat ethanol cars** in operation
15.5 million cars using 22% anhydrous ethanol-gasoline blend; **> 1/3 of gasoline displaced;**
- ✓ **\$48 billion** FOREX expenditures avoided in 1975-02, with an investment of **\$5 billion** (2001 \$) in local currency.

BRASIL: PROALCOOL Main achievements & impacts

(Cont.)

- ✓ 320 million metric tons of sugarcane produced in 2002 (4 times more than in 1975); 20 million ton sugar (3X 1975);
- ✓ > 300 ethanol distilleries (200 annexed); 25,000 gas stations selling hydrous ethanol today;
- ✓ **700,000 permanent jobs** created in production chain @ US\$10-20K/job (4x lower than avg.)

BRASIL: PROALCOOL Main achievements & impacts

(Cont.)

- ✓ **Demonstration: massive biomass program established in a short term;**
- ✓ **Sugarcane/sugar/ethanol technology development demonstrated by productivity increases and cost reduction;**
- ✓ **Development of market based Ethanol price system;**
- ✓ **“Lessons Learned” for replication.**

BRASIL: PROALCOOL Environmental Impacts

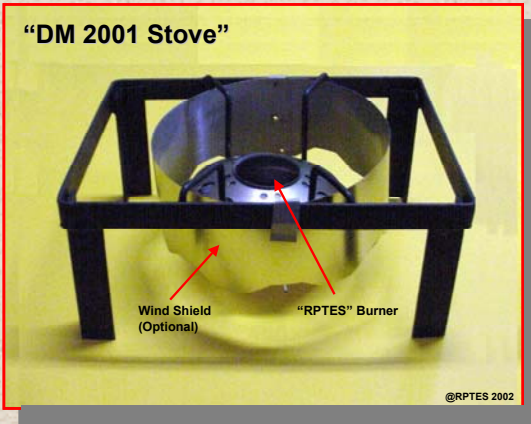
(Cont.)

- ✓ **Lead displacement** due to octane enhancement properties of ethanol: lead concentrations in São Paulo dropped **93%** from 1978 to 1991
- ✓ **NO_x, CO and Sulfur** emissions from ethanol fuels are reduced while HC (hydrocarbons) and aldehyde emissions are increased. However ethanol HCs and aldehydes are less toxic than gasoline's.
- ✓ The environmental impacts from ethanol production, particularly the **stillage** disposal, have been resolved
- ✓ **CO₂** emissions from ethanol vehicles are absorbed back by sugarcane growing in a closed cycle, making ethanol fuel eligible for CDM / Kyoto Protocol

AFR: Millennium Gelfuel Initiative



Development Marketplace 2000





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MGI: Status Report (Sept 03)



- **Technical R&D:** Fuel + Stoves completed
- **Private Sector:** 3 Commercial plants in operation (Zimbabwe, South Africa, Malawi)
- **IFC/GEF Medium Size Projects:** Malawi and Ethiopia (FY03/04)
- **EUBIA/China Project:** Guandong Province (80tn/Yr)
- 20+ countries interested on MGI (Africa, Asia & LAC)



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Bio-diesel Multi-Energy Service Delivery Vehicle



“Getting There - GT”



B-MESDV

- 4x4 Transport: Cargo & Passenger (low Speed)
- Mechanization
- Water Pumping
- Crop Grinding
- Basic DC Power
- Battery Charging

GreenTrac A/S (Norway)
PROGEDE (Senegal)
World Bank / DM2003



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Bio-diesel Multi-Energy Service Delivery Vehicle

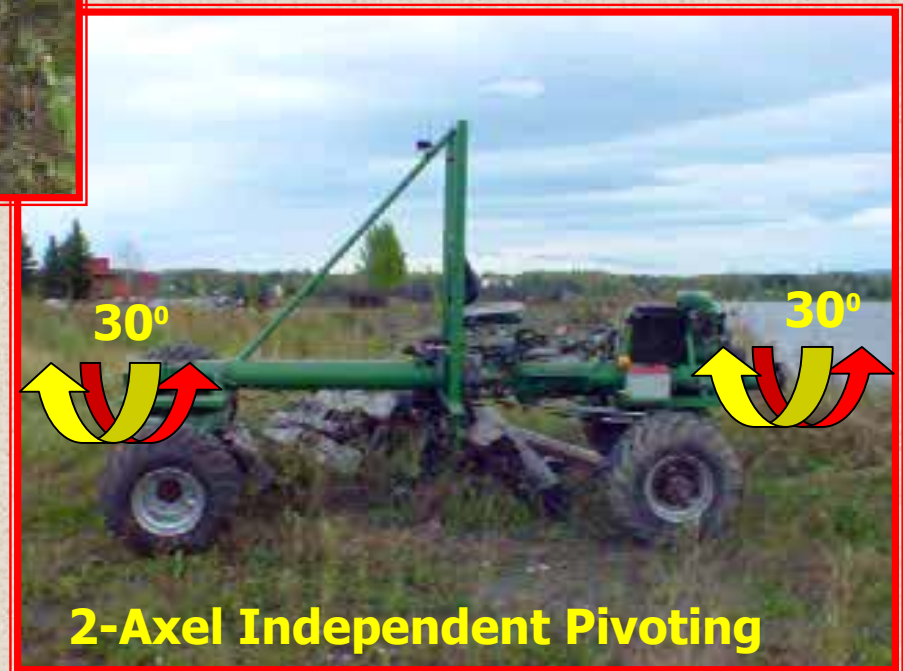


2-Axel Steering

GreenTrac A/S (Norway)
"Getting There - GT"
Vehicle Concept

B-MESDV

Development
Marketplace 2003



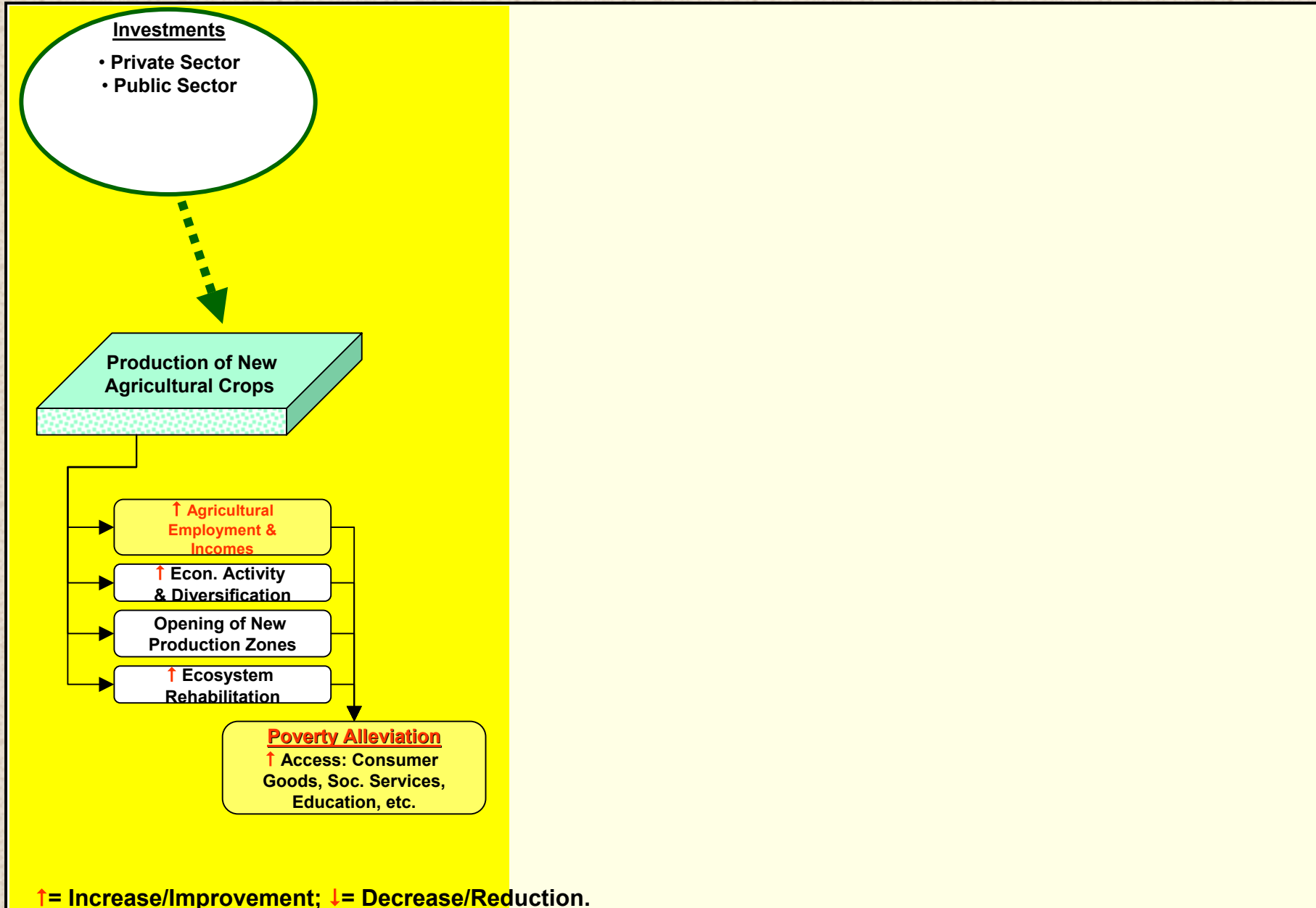
2-Axel Independent Pivoting



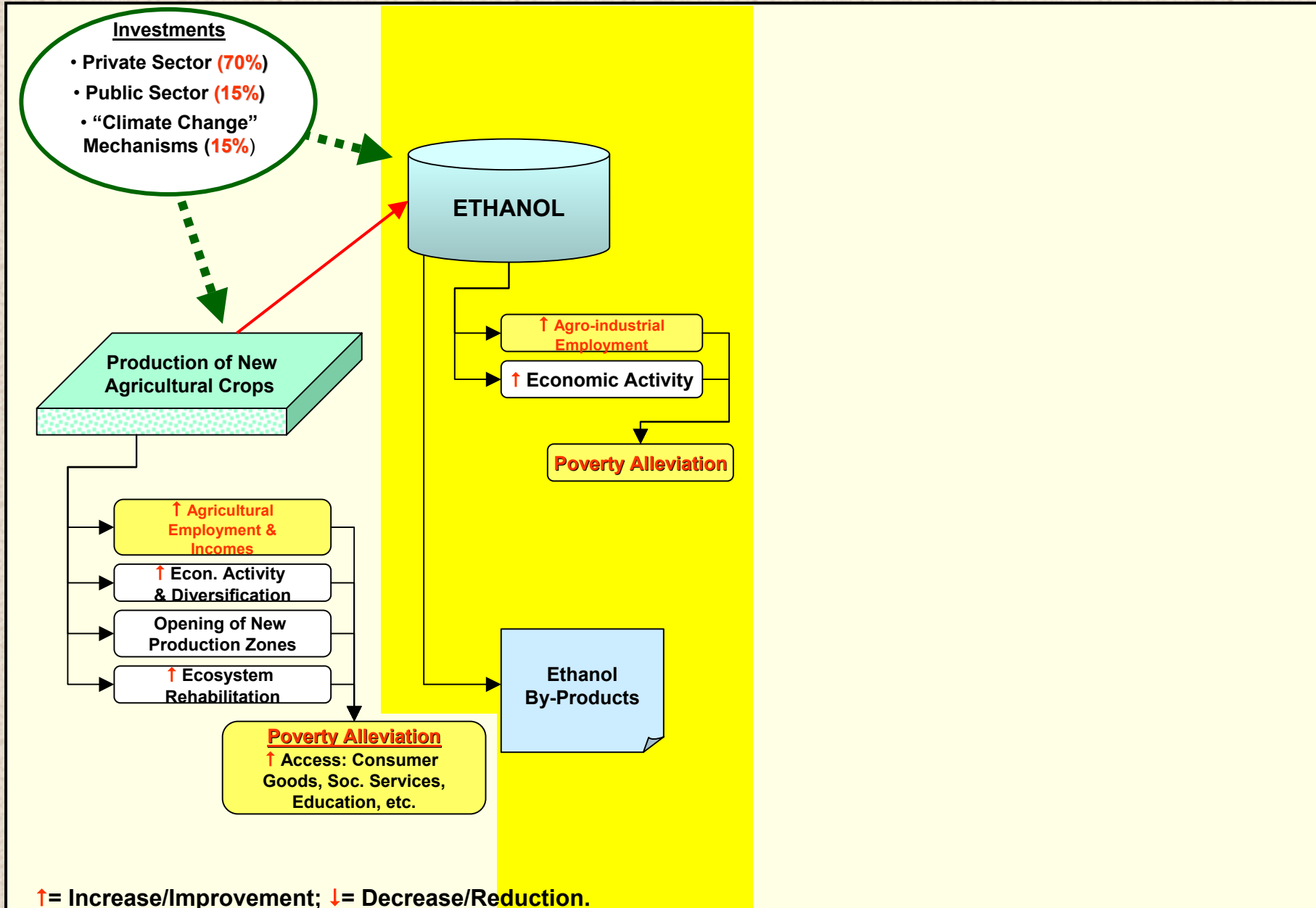
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- “Sustainable Rural Development Engine” Concept
- Employment Generation Impacts

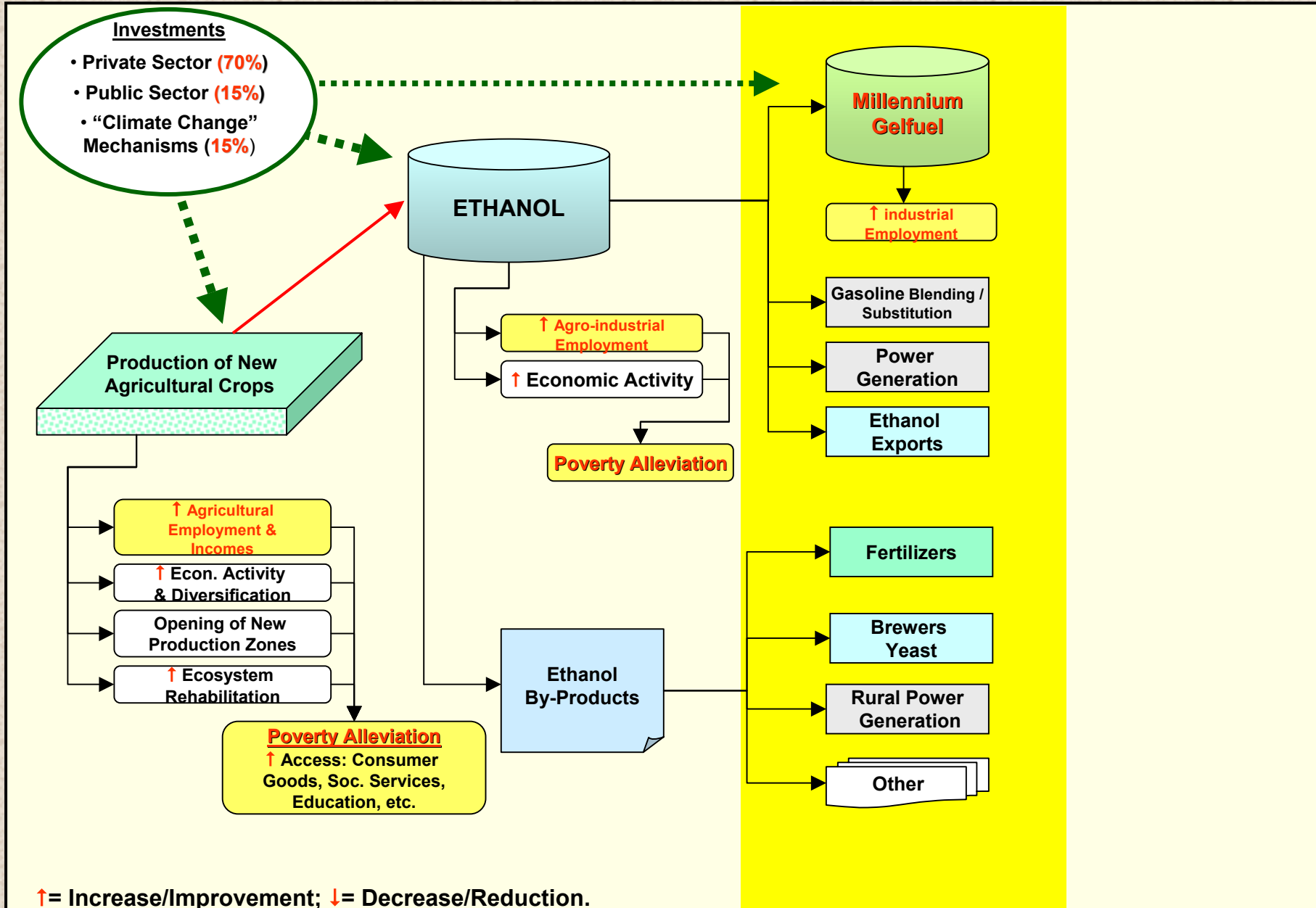
Ethanol/Millennium Gelfuel: A Sustainable Engine for Rural Transformation



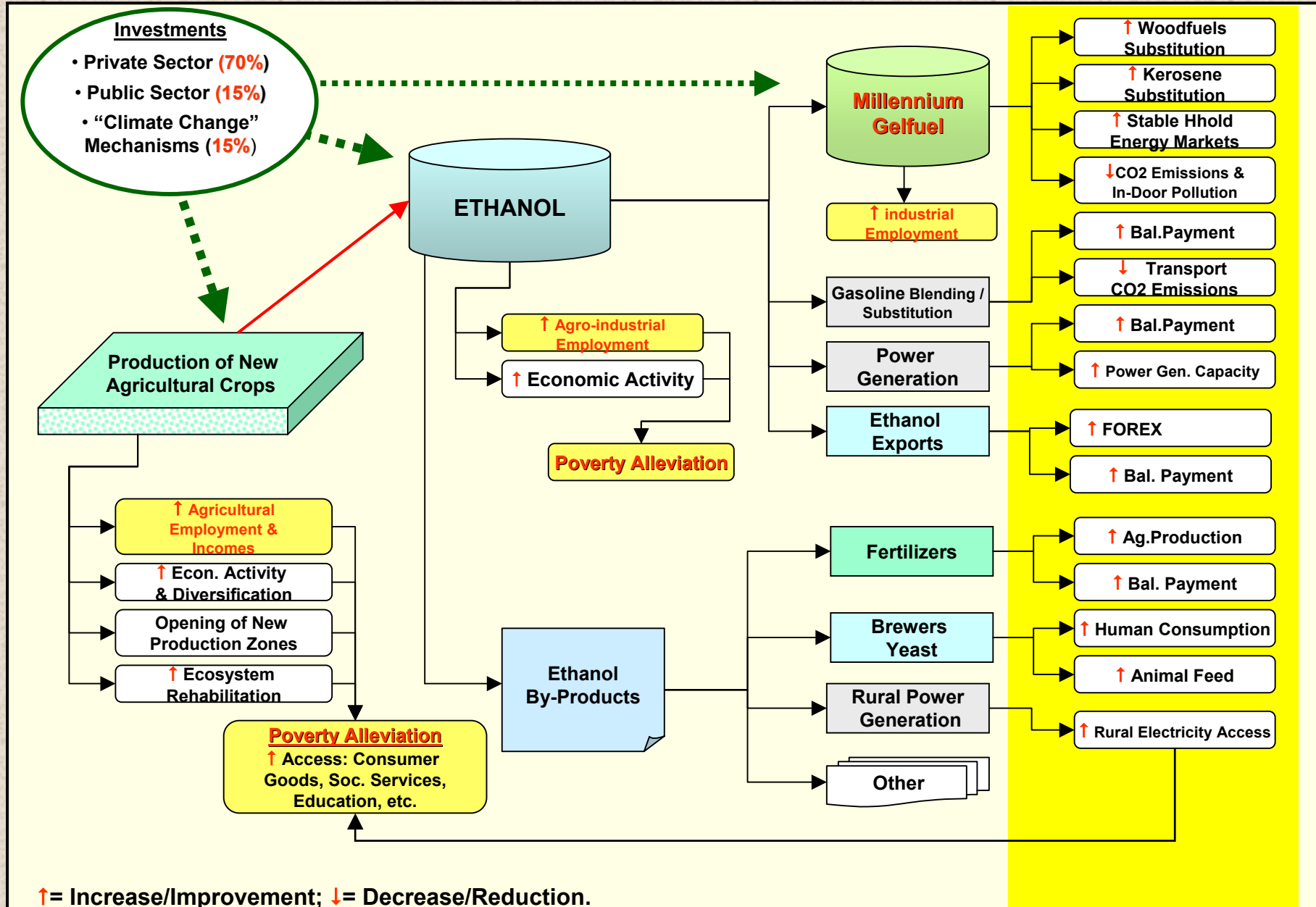
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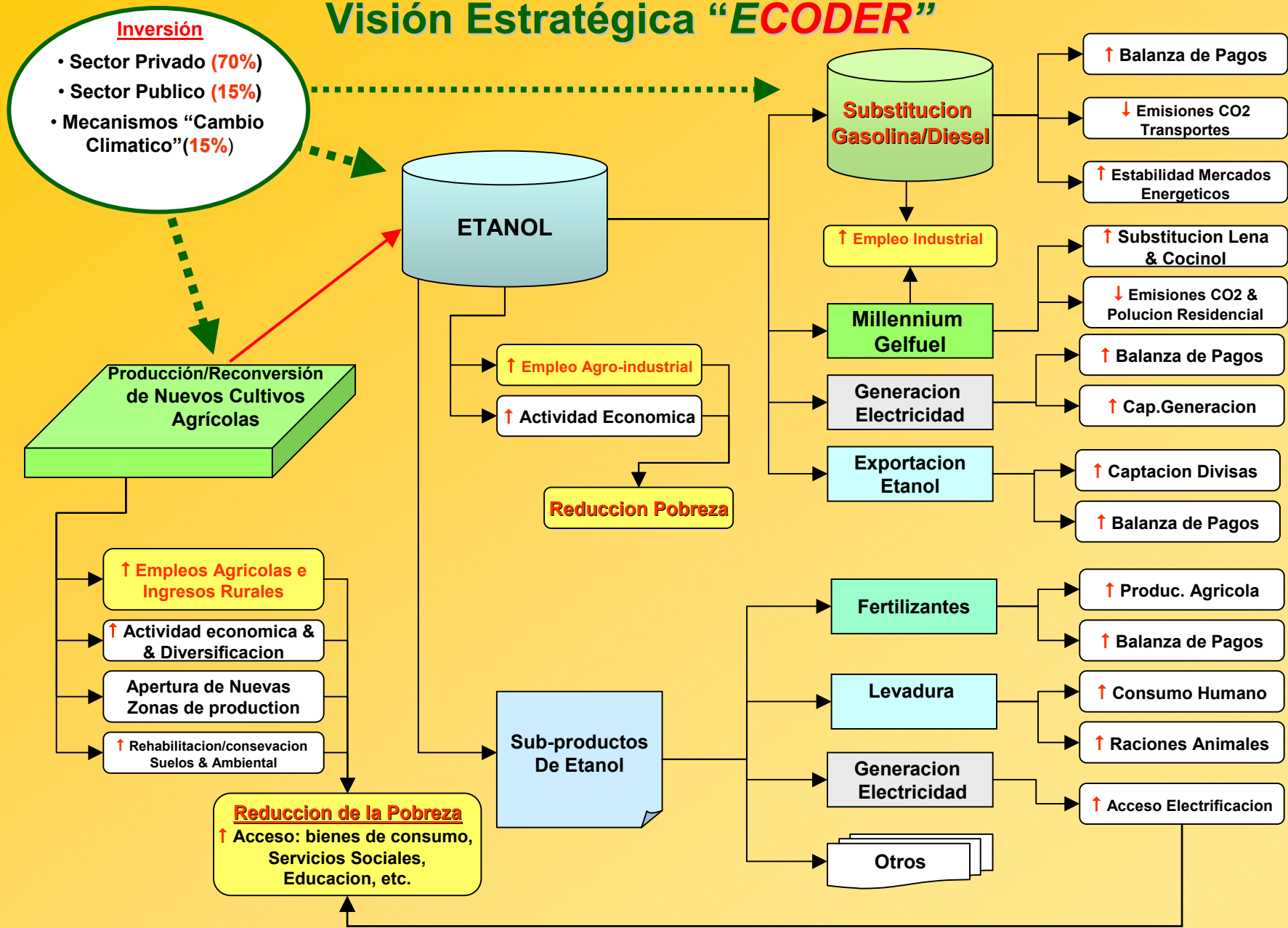
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Ethanol/Millennium Gelfuel: A Sustainable Engine for Rural Transformation



Visión Estratégica "ECODER"



↑ = Aumento/Mejoría; ↓ = Disminución/Reducción.



MILLENNIUM GELFUEL

A Renewable and Low-Cost Cooking Fuel for Africa

TABLE 2: Land Requirements, Rural Employment and Millennium Gelfuel Production From 25% and 50% Increase in Agricultural Crops in Africa ⁽¹⁾

25% Production Increase over Year '2000 Crop Levels	SUGAR CROPS						STARCH CROPS						ALL CROPS					
	SUGAR CANE			SWEET SORGHUM			CASSAVA			MAIZE			SWEET POTATOES			TOTALS		
	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)	(2)	(3)	(4)
REGION	Ha (10 ⁶)	Jobs (10 ⁶)	Gelfuel (10 ⁶ Lt)	Ha (10 ⁶)	Jobs (10 ⁶)	Gelfuel (10 ⁶ Lt)	Ha (10 ⁶)	Jobs (10 ⁶)	Gelfuel (10 ⁶ Lt)	Ha (10 ⁶)	Jobs (10 ⁶)	Gelfuel (10 ⁶ Lt)	Ha (10 ⁶)	Jobs (10 ⁶)	Gelfuel (10 ⁶ Lt)	Ha (10 ⁶)	Jobs (10 ⁶)	Gelfuel (10 ⁶ Lt)
Central Africa	0.1	0.0	93.3	0.4	0.2	122.3	0.6	0.2	1,257.7	0.7	0.2	385.6	0.0	0.0	39.8	1.7	0.7	1,898.5
Eastern Africa	0.1	0.1	437.1	0.8	0.4	301.7	0.8	0.4	1,250.7	2.7	0.9	1,989.6	0.3	0.1	275.5	4.8	1.8	4,254.6
Southern Africa	0.1	0.0	583.4	0.1	0.0	54.1	0.0	0.0	0.0	0.9	0.3	1,611.1	0.0	0.0	2.5	1.1	0.4	2,251.1
Western Africa	0.0	0.0	89.3	3.0	1.3	1,116.0	1.2	0.5	2,610.9	1.8	0.6	1,331.0	0.1	0.1	134.4	6.2	2.5	5,281.6
Total ->	0.3	0.1	1,203.1	4.3	1.8	1,594.1	2.6	1.1	5,119.3	6.1	2.1	5,317.2	0.5	0.2	452.2	13.8	5.4	13,685.9
50% Increase																		
Central Africa	0.1	0.1	186.5	0.8	0.3	244.5	1.1	0.5	2,515.4	1.4	0.5	771.2	0.1	0.0	62.6	3.4	1.4	3,780.1
Eastern Africa	0.2	0.1	874.2	1.7	0.7	603.3	1.6	0.7	2,501.4	5.4	1.9	3,979.2	0.7	0.3	551.0	9.6	3.7	8,509.2
Southern Africa	0.2	0.1	1,166.8	0.1	0.1	108.3	0.0	0.0	0.0	1.9	0.7	3,222.2	0.0	0.0	5.1	2.2	0.8	4,502.3
Western Africa	0.0	0.0	178.7	6.1	2.5	2,232.0	2.4	1.0	5,221.8	3.6	1.3	2,662.0	0.3	0.1	268.7	12.3	5.0	10,563.2
Total ->	0.5	0.3	2,406.1	8.7	3.6	3,188.1	5.1	2.3	10,238.6	12.2	4.3	10,634.5	1.0	0.4	887.4	27.5	10.8	27,354.8

Source: Phillips, T., "Agro-Economic Assessment of the Potential to Produce Fermentation Ethanol Alcohol In Africa", RPTES Program, 2002.

- Notes:** (1) Projections based on 25 and 50 percent of 2001 and production of the specific crop. It is assumed that yields remain constant and that labour inputs will increase in proportion to production increases. Required land expansion was constrained by availability of suitable land. Sources: (a) for Production data: FAO, Agricultural Production, FAOSTAT (<http://apps.fao.org/>); (b) for Suitability data: IIASA and FAO. (2000); and, (c) for Global Agro-Ecological Zones <http://www.fao.org/ag/AGL/agll/gaez/index.htm>.
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COLOMBIA:

Scenario: 180,000 Empleos/500,000 Ha. *

Land Requirements, Ethanol Production, Employment and Investment Envelope

CULTIVOS	Hectareas	Biomasa Ton/Yr (Millones)	Alcohol Etanol Lt/Yr (Millones)	GENERACION DE EMPLEOS DIRECTOS				Total	INVERSION REQUERIDA	
				Nivel Capacitacion			# Empleos Permanentes		Baja	Alta
				Bajo	Medio	Alto				
				60%	10%	30%		100%	(Millones US \$)	
				(Millones Persona/Dia/ha.)						
Cana de Azucar	100,000	5	350	6	1	3	10	37,037	91	156
Sorgo Sacarino	150,000	14	745	11	2	5	18	66,667	1,236	2,120
Maiz	150,000	1	333	7	1	3	11	40,833	86	148
Yuca	100,000	1	216	6	1	3	9	34,815	56	96
Total	500,000	21	1,644	29	5	15	48	179,352	1,470	2,519

(*) Target proposed by national government within the “Plan Colombia” Context is of 380,000 ha. for the 2002-2006 period.

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Biomass Energy: Summary of Impacts

■ **Economic Benefits**

- Rural employment in TBF, MBE and NRM
- Significant income generation Agriculture & Agro-industry
- Mobilization & enhancement of existing “Rural Assets”

■ **Social Benefits (Rural & Urban)**

- POVERTY REDUCTION opportunities
- Households welfare & Health
- Gender development and equity

■ **Environmental Impacts**

- Forests/natural resource conservation (NR Assets)
- Eco-sustainability / Ecosystem rehabilitation
- Reduced Co2 emissions, air & “in-door” pollution
- Climate Change mitigation



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5. Biomass Energy Inventory & Poverty Impact Assessment Methodology

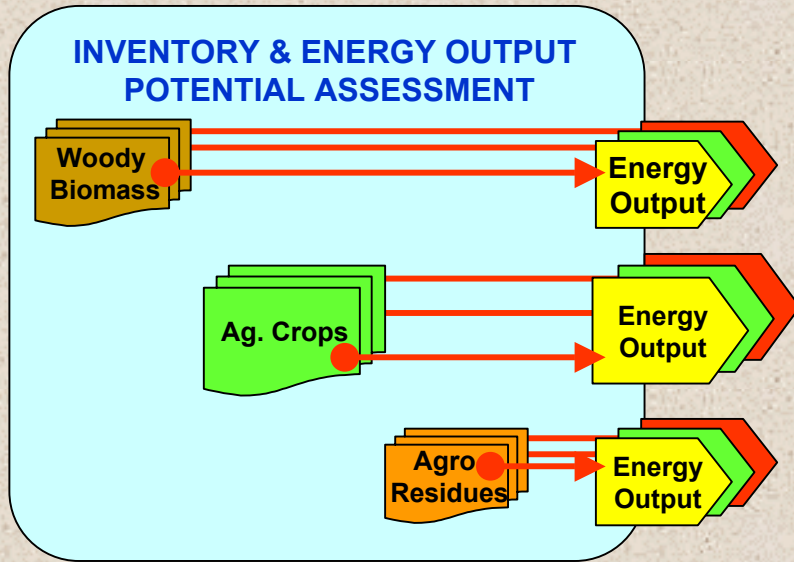


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AFTEG/BEWP (FY04-07)



Biomass Energy Inventory & Assessment



- **Biomass Energy Inventory**: establish potential bio-energy scenarios (carriers and output levels).

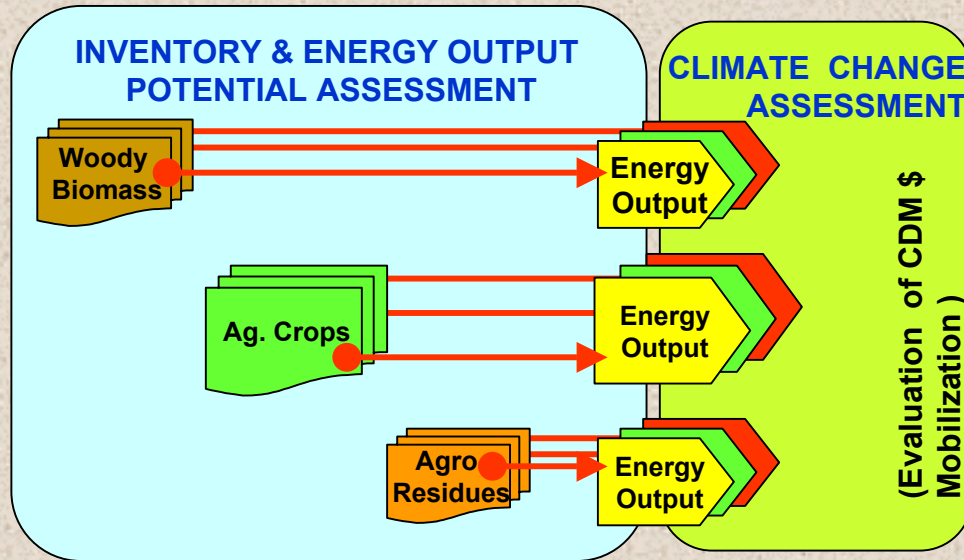


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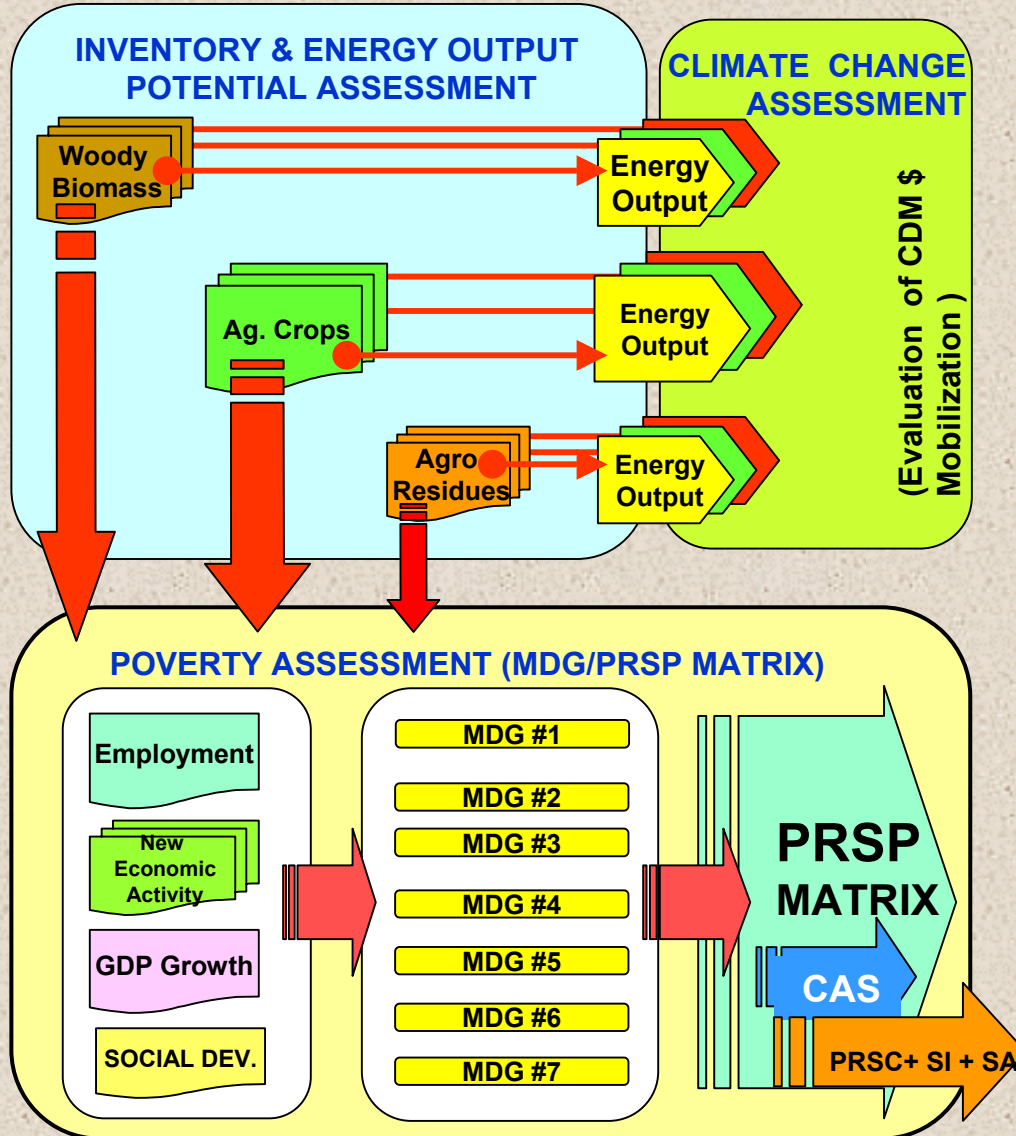
Biomass Energy Inventory & Assessment



- **Biomass Energy Inventory:** establish potential bio-energy scenarios (carriers and output levels).
- **Climate Change Assessment:** establish compliance of potential bio-energy scenarios with Agenda 21 and UNCCC and estimate possible mobilization of CC funding.



Biomass Energy Inventory & Assessment



- **Biomass Energy Inventory:** establish potential bio-energy scenarios (carriers and output levels).
- **Climate Change Assessment:** establish compliance of potential bio-energy scenarios with Agenda 21 and UNCCC and estimate possible mobilization of CC funding.

- **Poverty Assessment:** estimate impacts of potential bio-energy scenarios with respect to MDGs and WB poverty alleviation objectives, and elaborate PRSP energy sector coefficients to assist in definition of CASes and operational instruments.



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Request to the

IEA Bioenergy Task 38 & Co.:

- 🕒 Comprehensive Biomass Energy Environmental/CC relevant data
- 🕒 CDM Qualification Standards for Biomass Energy/fuels
- 🕒 “Translated” Assessment Toolkits
- 🕒 Technical Assistance Support

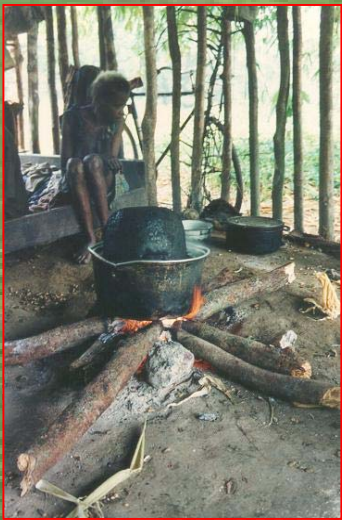


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Biomass Energy

- ✓ Poverty Reduction
- ✓ Energy Access
- ✓ Rural/Agricultural Development
- ✓ Environmental Sustainability



An aerial photograph of a vast, green agricultural field, likely a cornfield, with rows of crops stretching across the landscape. A small, dark structure or building is visible in the center of the field. The text "Thanks For Your Attention." is overlaid in white in the upper left quadrant.

Thanks For Your Attention.

The End.