Modernizing Bioenergy

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Modernizing Bioenergy

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Sustainable Energy for All: Powering Africa
Eigtveds Pakhus
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Modernizing bioenergy

- Introduction
  - Resources
  - Technologies
- Cogeneration cases
  - Cogen – Malaysia
  - Cogen Africa
  - Rice straw in Mali
- Challenges
- Recommendation

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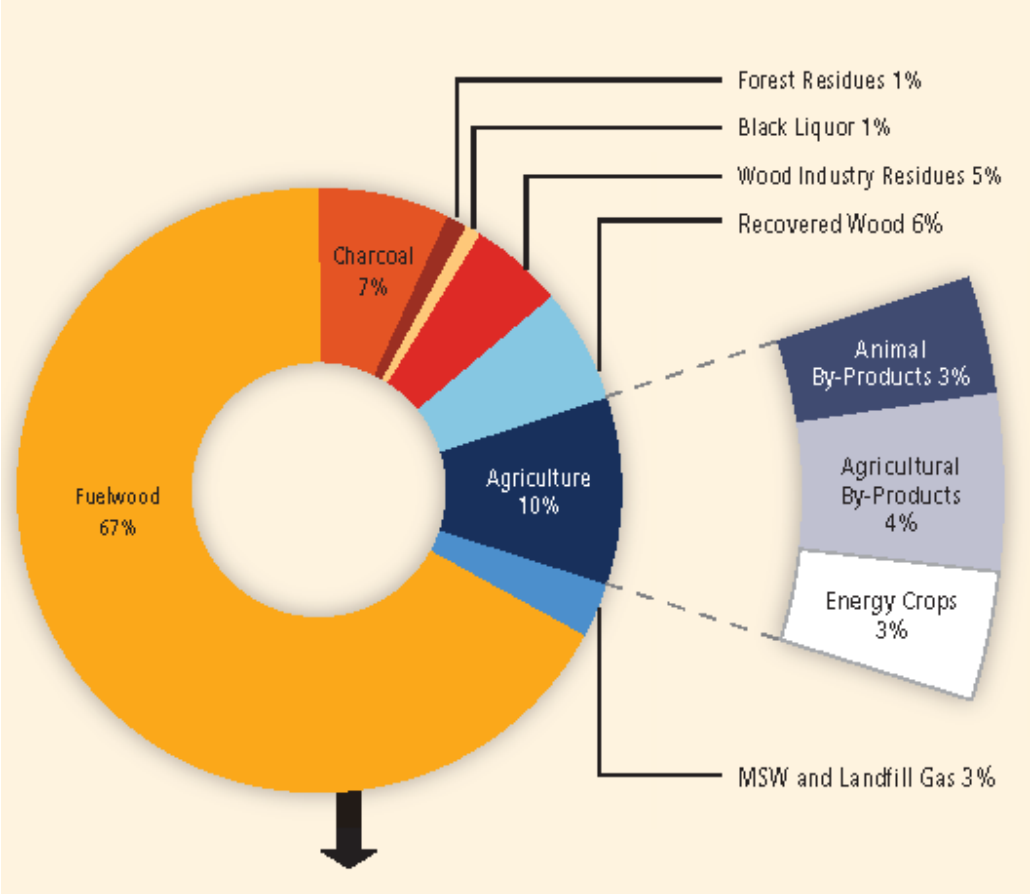
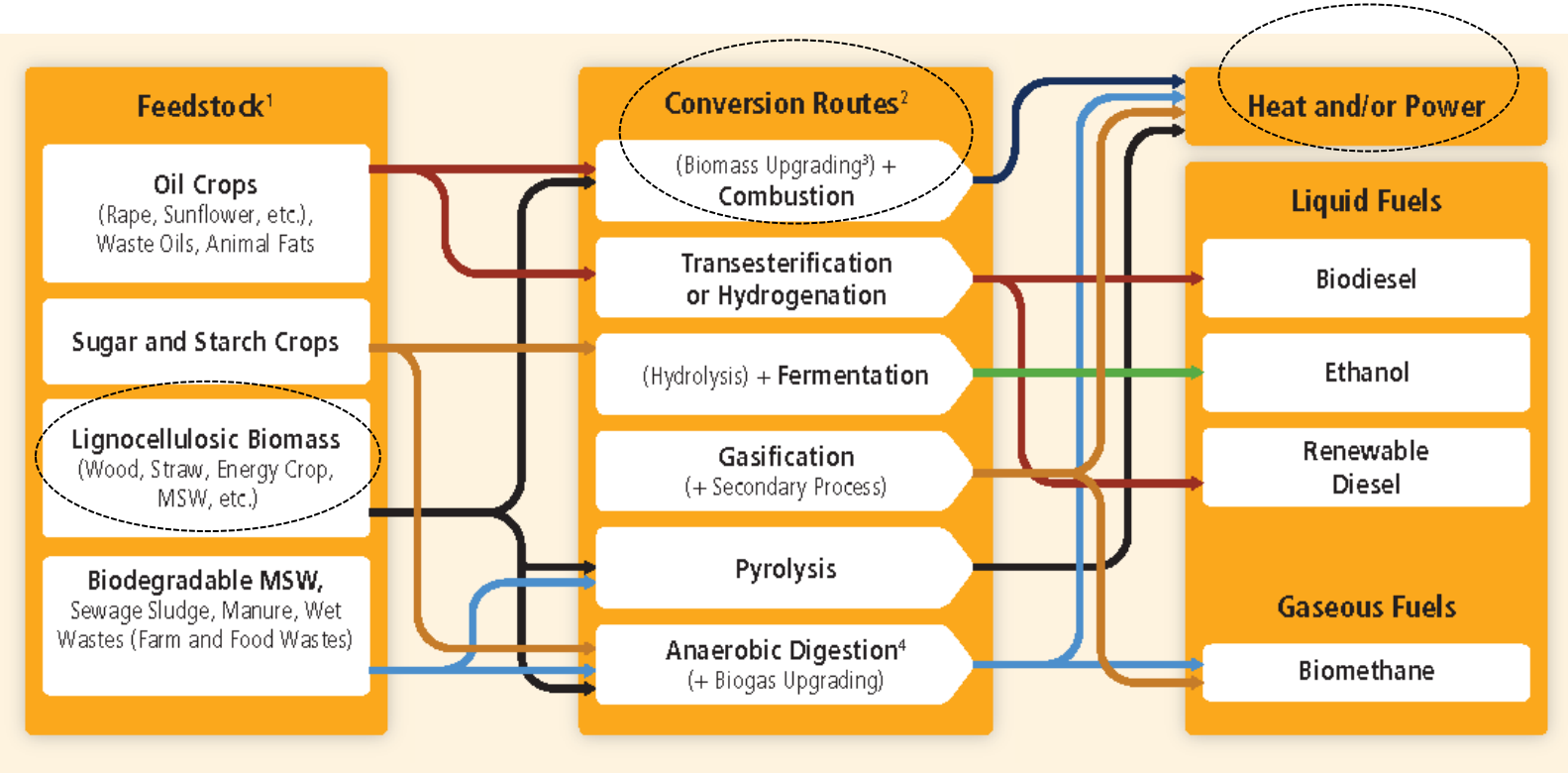
Modern vs. traditional biomass



Source: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation, 2011

Biomass technologies



Source: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation, 2011

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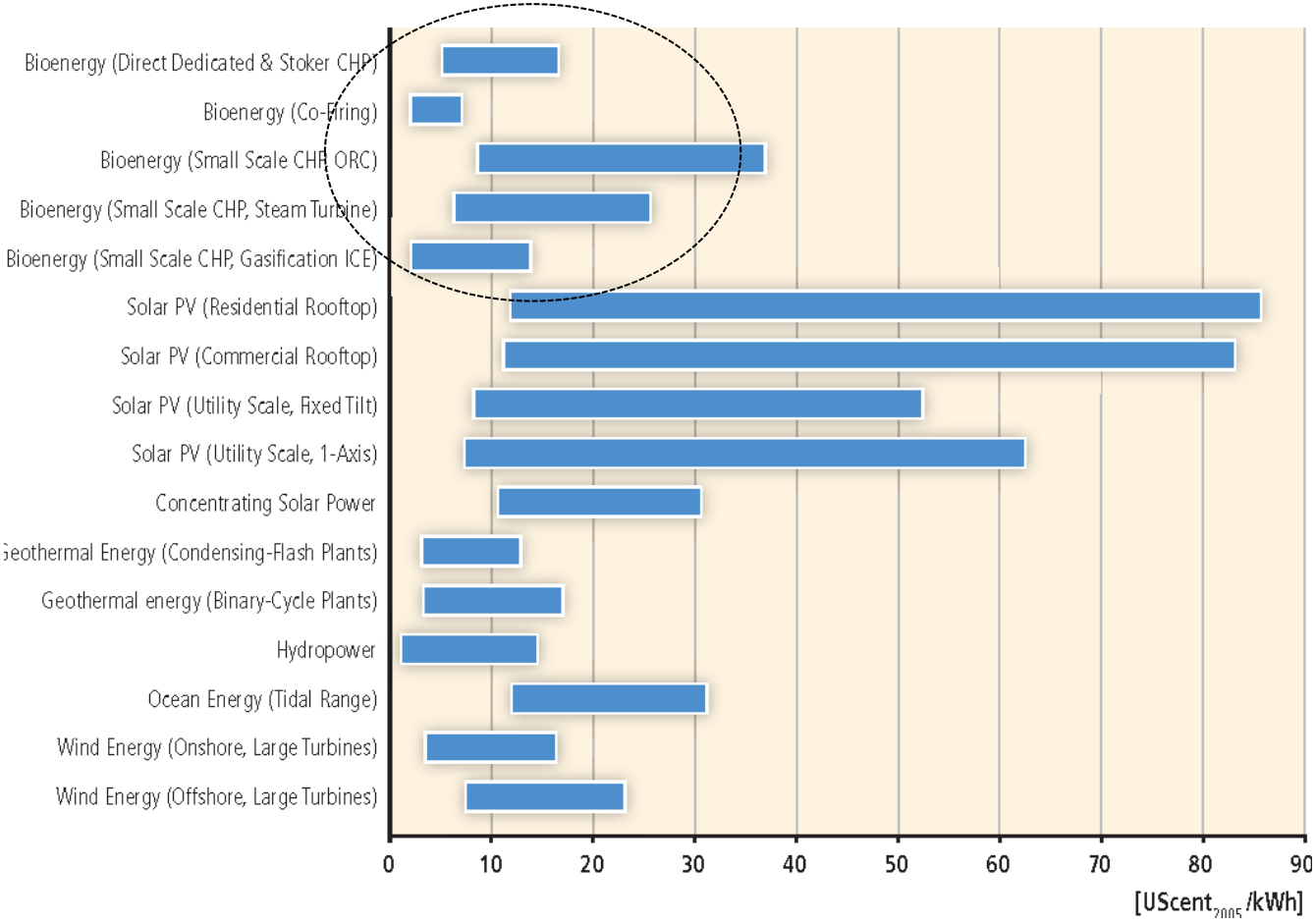
Production costs for electricity



Source: IPCC Special Report on Renewable Energy Sources and Climate Change Mitigation, 2011

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Co-generation on biomass

- CDM projects registered (MW electricity)

Region/subregion	Agricultural residues				Sugar	Palm oil	Paper	Forestry		Total
	Mustard	Poultry lit	Rice husk	Other	Bagasse	Palm oil	Black Liqu	Sawmill	Other	
East Africa					35					35
Southern Africa									13	13
West Africa					25				4	29
Africa					**60**				**17**	**77**
Central America					160	3				163
South America			24	10	1,009		130	185	30	1,388
Latin America			**24**	**10**	**1,169**	**3**	**130**	**185**	**30**	**1,551**
East Asia		24	361	1,343	15				92	1,838
Southeast Asia			81	45	150	162		15	22	475
Southern Asia	56	10	403	489	769	5	6		28	1,766
Asia & Pacific	**56**	**34**	**845**	**1,877**	**934**	**167**	**6**	**15**	**142**	**4,079**
Grand Total	**56**	**34**	**869**	**1,887**	**2,163**	**170**	**136**	**200**	**188**	**5,707**

Source: Based on UNEP Risø – CDM pipeline: http://www.cdmpipeline.org/, 21.09.12

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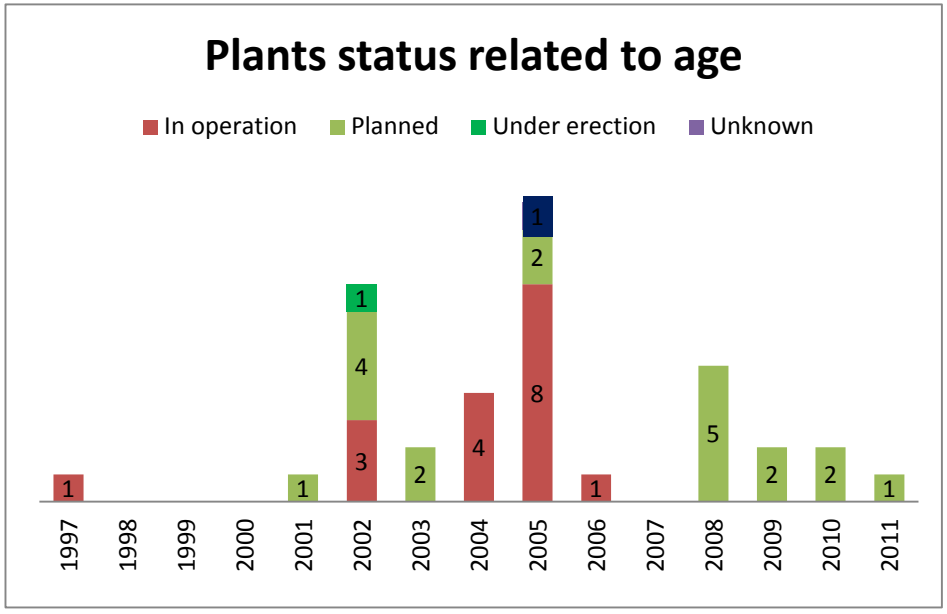
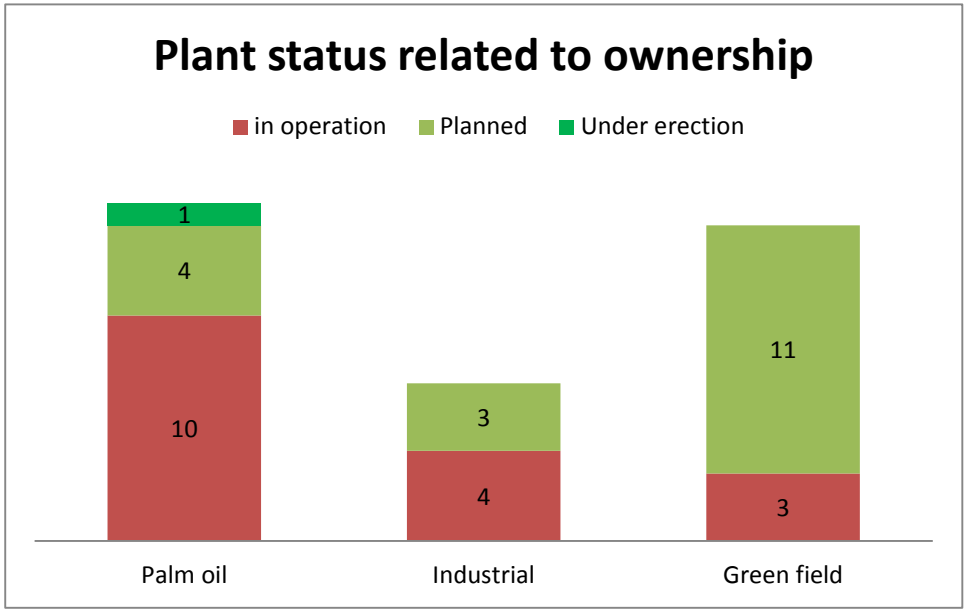
Cogeneration in Malaysia

Program / Year	1990	1995	2000	2005	2011
COGEN (1,2,3)					
DANCED/DANIDA					
SREP					
BIOGEN					
CDM					
GTFS					





Hansen U.; Nygaard I. (forthcoming): Sustainable energy transitions in emerging economies: The formation and up-scaling of a palm oil biomass waste-to-energy niche in Malaysia 1990-2011

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Lessons learned in Malaysia

Intervention areas

- Technical assistance
- Institutional support (Malaysia energy Centre)
- Policy analysis
- Awareness raising
- Full scale demonstration projects
- Measures:
  - Energy policy documents setting targets
  - Power Purchase agreement (Willing seller/willing buyer)
  - Direct financial support
  - Tax exemption
  - Financing schemes
  - Feed in Tariff (2011)

Challenges

- Instability of donor progr/funding
- National commitment
- PPA was an achievement but too weak
- Lack of General Feed in Tariff
- Energy production not seen as a core business for industry
- Demand for short pay back time
- Poor performance of plants for EFB
- Increasing costs of biomass due to alternative use
- Disappointment due to high expectations raised by campaigns

Lessons

- Long term involvement is necessary
- External support to policy making is challenging

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Co-gen for Africa

Cogeneration potential in the sugar industry in selected African countries

Country	Installed national power generation capacity from all sources (MW)	Current Cogeneration Installed Capacity (MW)	Cogen potential as percentage of total installed national power generation (%)
Ethiopia	814	13.4	1.65%
Kenya	1,197	73.0	6.10%
Sudan	1,023	55.3	5.41%
Tanzania	1,080	33.3	3.08%
Uganda	380	20	5.26%
Total	**4494**	**195**	**4.34%**

Sources: Gwang'ombe, 2004; Yuko et al, 2004; Kamese, 2004, Engorait, 2004; Wolde-Ghiorgis 2004; Kagucia, B., 2005; Mbithi, J.M.P., 2005; Isingoma, J.B., 2005

Funded by: Global Environmental Facility (GEF), **5.3 M USD**
Implementation period: **2007-2013**
Co-implemented by: United Nations Environment Programme-Division of Global Environment Facility (UNEP-DGEF), and **African Development Bank (AfDB)**
Executed by: Energy, Environment and Development Network for Africa (AFREPREN/FWD)

Source: http://cogen.unep.org/

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Achievements September 2012

Commissioned and planned:

- Constructed and commissioned
  - 3.8 MW Electric (17 MW Thermal)
- Planned in Tea (Kenya) and Sugar (Uganda)
  - 74 MW Electric (146 MW Thermal)

Identified Potential: 197 plants, 927 MW el, Investment 1400 MUSD

Studies commissioned

- 7 Full Feasibility Studies in Kenya (4 in Tea & 3 in Sugar Sector), 2008/2010
- 2 Full Feasibility Studies in Uganda (1 in Tea & 1 in Sugar Sector), 2009/2012

Contribution to policy formulation on Feed in tariffs:

- Kenya (2008/2010)
- Tanzania (2009)
- Malawi (2011)
- Uganda (2011)

Source: http://cogen.unep.org/

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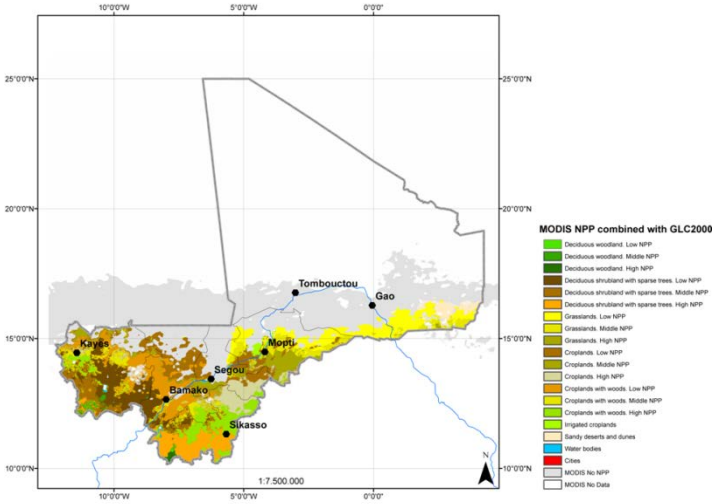
Experiences from study of straw fired power plant in Mali

- Project: (UNEP Risø Centre)
  - Feasibility of Renewable Energy Resources in Mali
- Resource Mapping:
  - Wind,
  - Solar and
  - **Agricultural residues**
- Screening of potential use of renewable energy resources in Mali
  - Solar and wind for grid connection
  - **Rice straw for electricity**
  - Cassava for biofuel
- Funding:
  - Danida (3 MDKK)
- Webpage:
  - http://fremali.org

  (to be launched 1. October 2012)



- Local partners:
  - DNE, CNESOLER, ENI, MFC
- Danish and International partners:
  - DTU Wind, DTU Electrical Engineering,
  - Geographic Resource Analysis & Science A/S (GRAS),
  - Department of Geography and Geology (DGG), University of Copenhagen,
  - Ea Energy Analyses,
  - 3E, Belgium

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Practices in rice cultivation in Mali

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Decentralised hulling of rice

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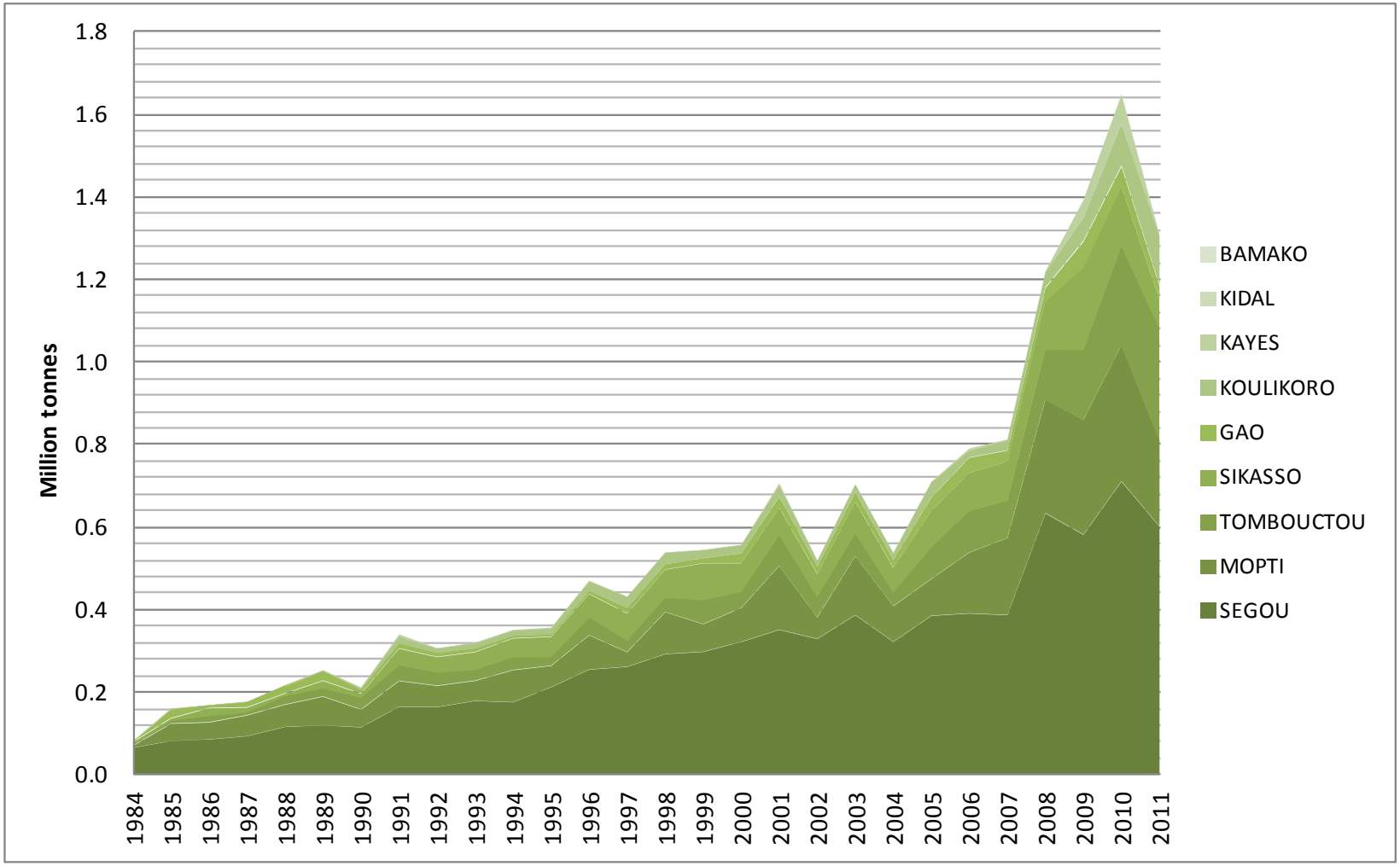
Technical potential of rice straw in Mali



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From technical to sustainable resources

Zone	Inter-views	Burnt in the field	Incorpo-rated into soil	Fodder for own cattle	Fodder for other cattle	Other uses	Total
Niono	62/20	22%	11%	31%	35%	-	100%
N'debougou	61	19%	10%	12%	59%	0%	100%
Molodo	60	12%	7%	18%	61%	2%	100%
Macina	80	2%	35%	38%	21%	4%	100%
Mopti nord	40	3%	0%	25%	72%	0%	100%

Zone	Macina	Bewani	Niono	Molodo	Kourou-mari	N'debou-gou	Total
Harvest avr. 2009-2010	105,455	70,153	85,640	52,081	104,699	85,522	503,549
Grain to straw ratio	0.75	0.75	0.75	0.75	0.75	0.75	0.75
Technical resource	**79,091**	**52,614**	**64,230**	**39,060**	**78,524**	**64,141**	**377,660**
Share being burned	2%	18%	22%	12%	18%	19%	15%
Sustainable resource	**1,582**	**9,471**	**14,131**	**4,687**	**14,134**	**12,187**	**56,191**

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Adapting technologies

Bales of 500 kg

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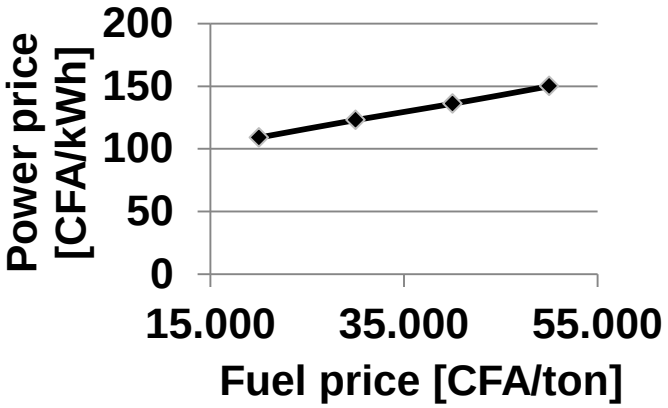
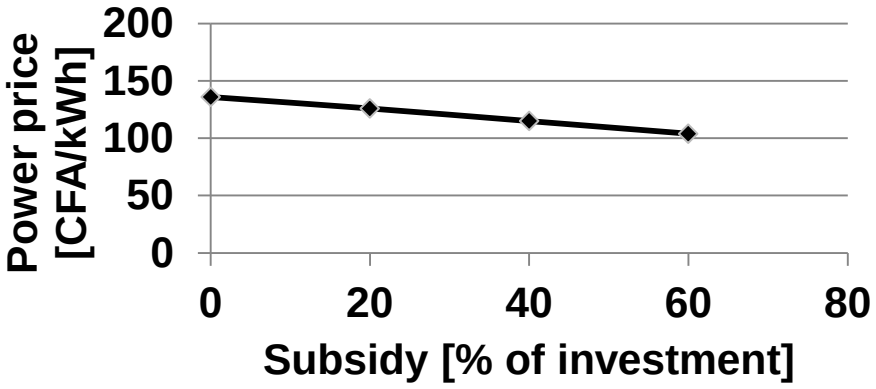
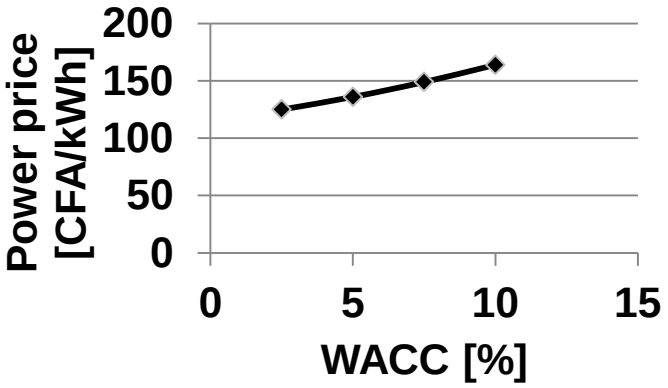
Adapting technologies

Economic feasibility

- **Size**: 5 MW_electrical
- **Fuel**: Rice straw (80%) and rice hulls (20%)
- **Technology**: Grate fired boiler, steam turbine, air cooled condenser
- **Efficiency**: 24,6 % at full load. 20 % as yearly average.
- **Operation**: Base load (6.400 h/year)







Lessons learned

Opportunities

- Economic feasible compared to diesel generation
- Nearby sugar factory possessing knowhow on cogeneration
- Local job creation
- Use of national resources
- Reduction of greenhouse gas emissions
- Energy security, reducing dependency on imported diesel

Challenges

- Who should Built, Own and Operate ?
- Difficult access to finance ?
- Uncertainty on future sales prices
  - Power purchase agreements, - only one of its kind
  - No standard feed in tariff
- Uncertainty on price and delivery of feed stock
  - Long term contracts with small holders on price and delivery ?
- Limited developer interest
  - Limited national market for this type of plant
  - Demonstration only ?
- Political stability

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Conclusion

Opportunities

- High and relative stable oil prises increasingly makes biomass cogeneration economic feasible
- Technologies are mature, and can be adapted and diffused in Africa
- Resources are available, although most often in competition with other use

Measures

- Long term interventions
- Stable enabling framework for investment (political stability)
  - Standard power purchase agreements
  - Feed in tariffs
- North - South and increasingly South – South cooperation
- Access to finance
- Awareness rising
- Training for technical skills to maintain and operate the installations

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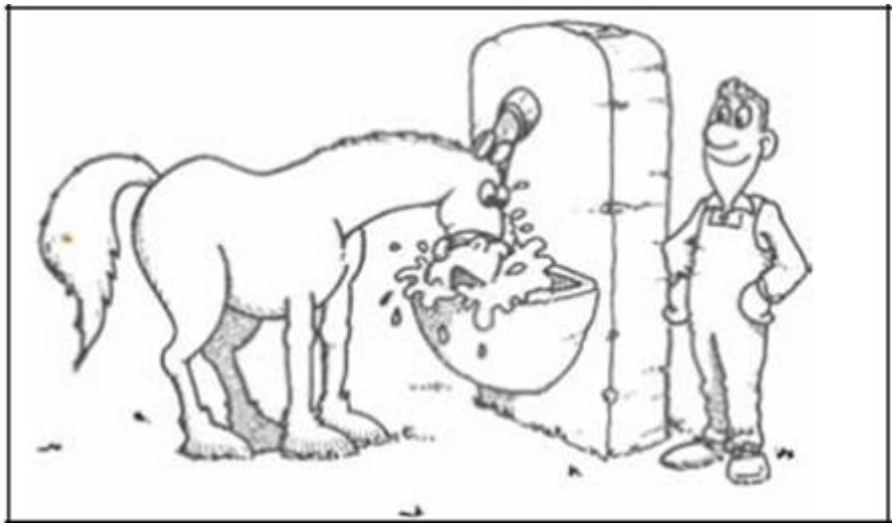
Be patient – diffusion of technologies takes time !



Thanks for your attention