

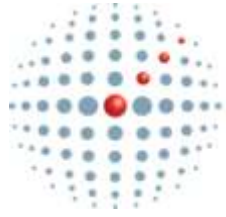
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# **Woody Biomass as a Modern & Sustainable Energy Source**

**By Mike Bess for Camco Clean Energy Tanzania**

**Developing Biomass Energy in Tanzania Conference, Dar es Salaam Hyatt Regency Hotel**

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# **Woody Biomass as a Modern & Sustainable Energy Source**



# Summary

- History of Woody Biomass Energy
- Growth of Charcoal as a Modern Fuel
- Charcoal Sustainability
- Biomass Energy Strategies (BEST) in Africa
- Best practices in Biomass Energy in Africa: Rwanda, Kenya, Niger & Ghana
- Increasing Role of Biomass Energy in Europe and North America
- Lessons Learned and Best Practices in Successful Biomass Energy



# History of Woody Biomass Energy

- Fuel wood used for millennia throughout the world
- Charcoal comes into use several millennia ago for industrial (metal-working) reasons
- In Europe, household energy shifted briefly from fuel wood to charcoal, but, quickly, shifted to coal, coal-derived gas (“town gas”) and then natural gas from the early-19th Century to early-20<sup>th</sup>
- Shortly after the Industrial Revolution in Europe, North America, Japan, charcoal ceases to be a significant non-industrial fuel source
- In Sub-Saharan Africa (SSA), Latin America and many areas of Asia and the Middle East, charcoal becomes increasingly important as an ***urban fuel*** – despite attempts to shift to kerosene, LPG & electricity for heat & cooking.



# History of Woody Biomass Energy (2)

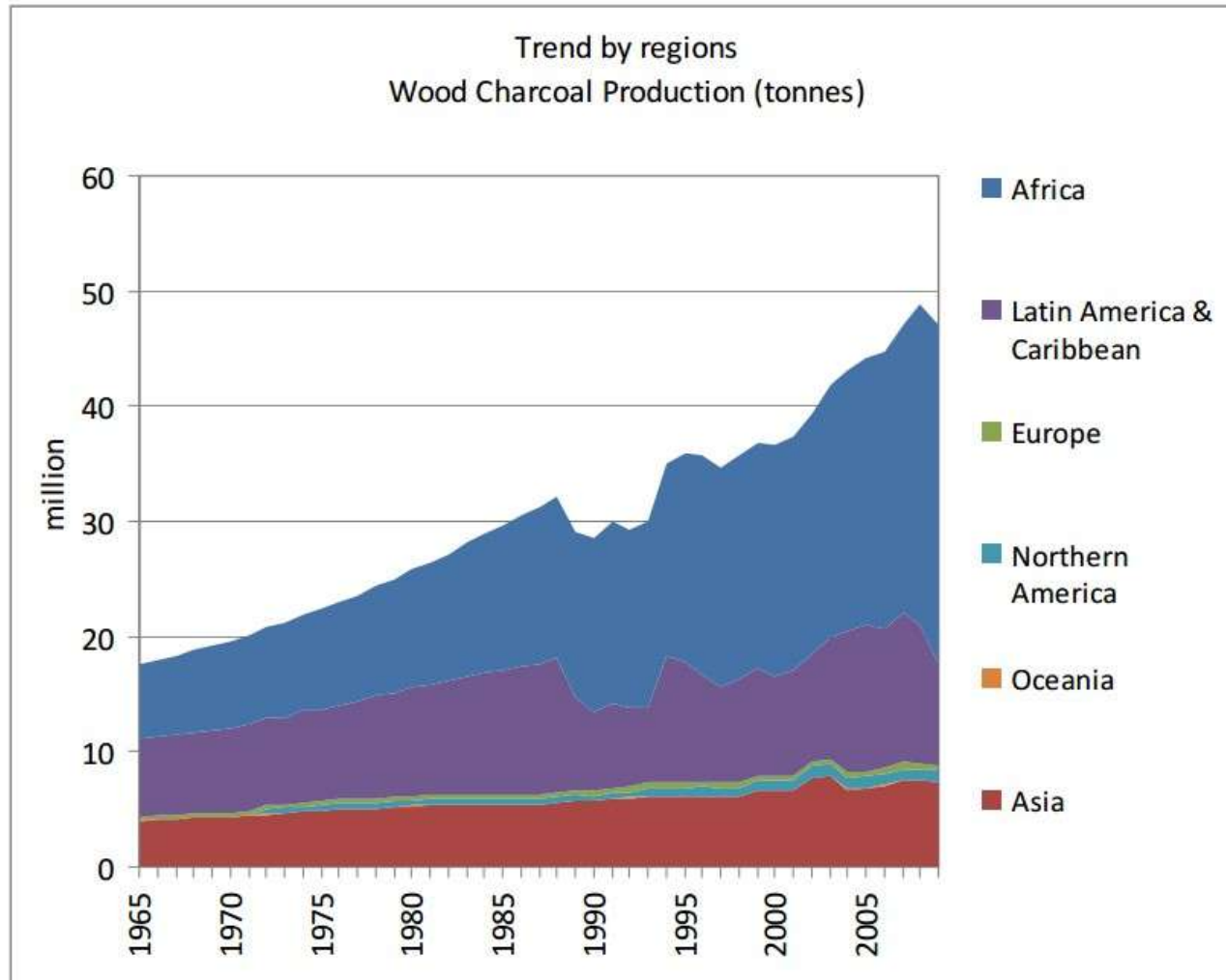
- Woody biomass accounts for nearly 25% of all world primary energy consumption: Demand is increasing in both developing & developed countries.
- The EU, USA, China, Canada and Brazil have increased their woody biomass use for households, industry, others by over 3.5% per annum (in relative terms, more in absolute terms) since 2000.
- In Europe & North America, wood energy is used, proportionately, by more wealthy households, than poor households (with exceptions in Eastern & Southern Europe, some depressed areas of the USA);
- Woody biomass is commercial, a traded commodity, with demand driven by:
  - “greenness” – wood’s “renewable” energy character;
  - Desire to stimulate rural development & rural livelihoods;
  - Interest in increasing energy self-sufficiency & security;
  - Concerns about climate change & desire to reduce greenhouse gas emissions



# Growth of Charcoal as a “Modern” Fuel

- This transforms the biomass energy sector in these countries – with biomass energy becoming increasingly more commercial.
- In Africa, in particular, charcoal use grows dramatically post-WWII with **rapid urbanization**
- While still accounting for a smaller amount & portion relative to fuel wood, charcoal’s absolute demand & portion of Sub-Saharan Africa (SSA) household energy is growing dramatically with urbanization (Figure 1)
- Charcoal is almost universally a “commercial commodity” – it is as “modern” as natural gas in almost all respects, particularly its commercial aspect
- It has a far more significant impact on rural livelihoods because it becomes one of the most important rural “cash crops” – effectively, transforming many rural subsistence economies into cash economies
- While charcoal, and commercial fuel wood, never took on this widespread commercial aspect in Europe, Japan & North America, it does in Latin America, Africa and, to a lesser extent, in Asia

# Figure 1: World Growth of Charcoal Production: 1985-2005

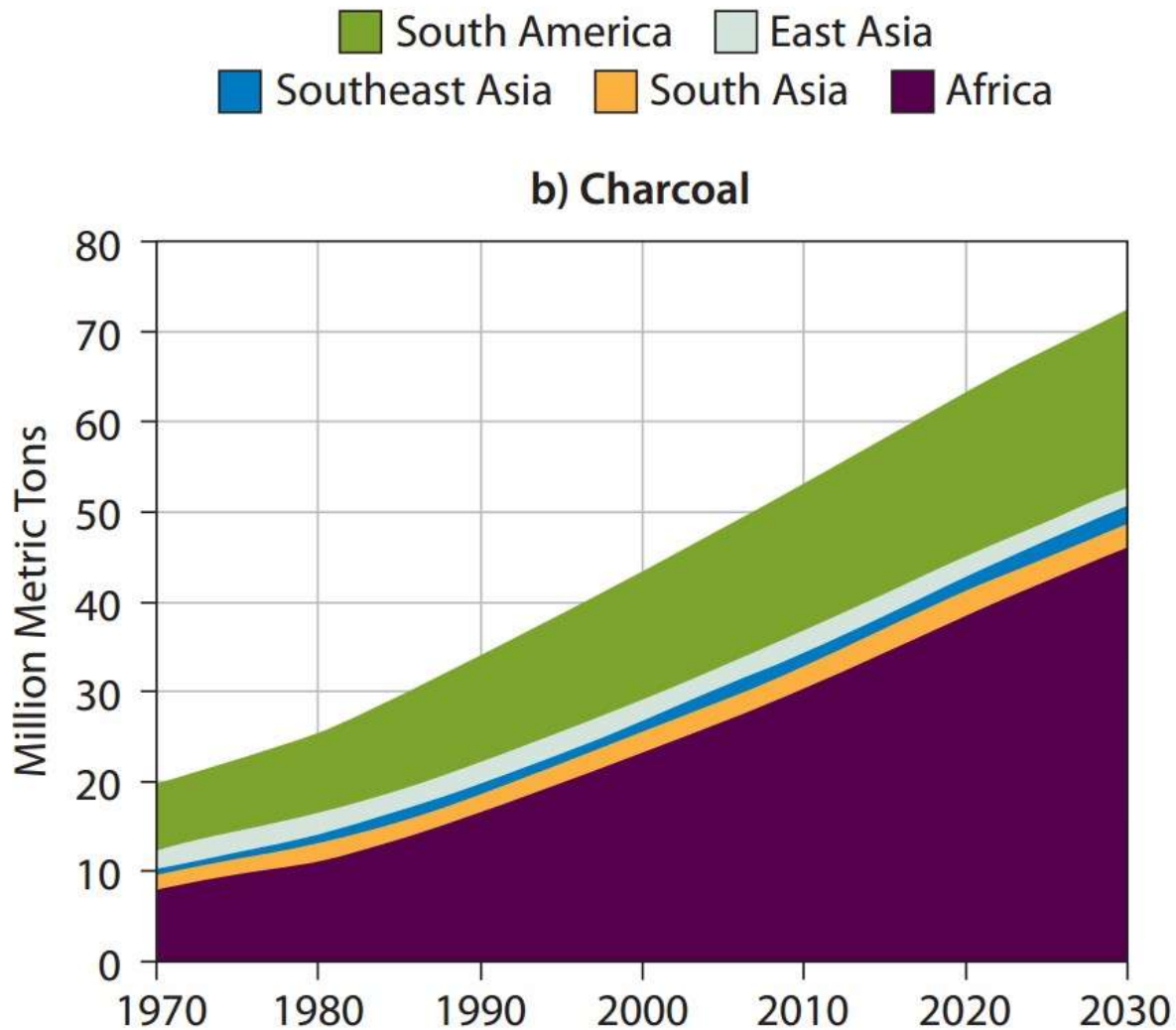


Source FAOstat



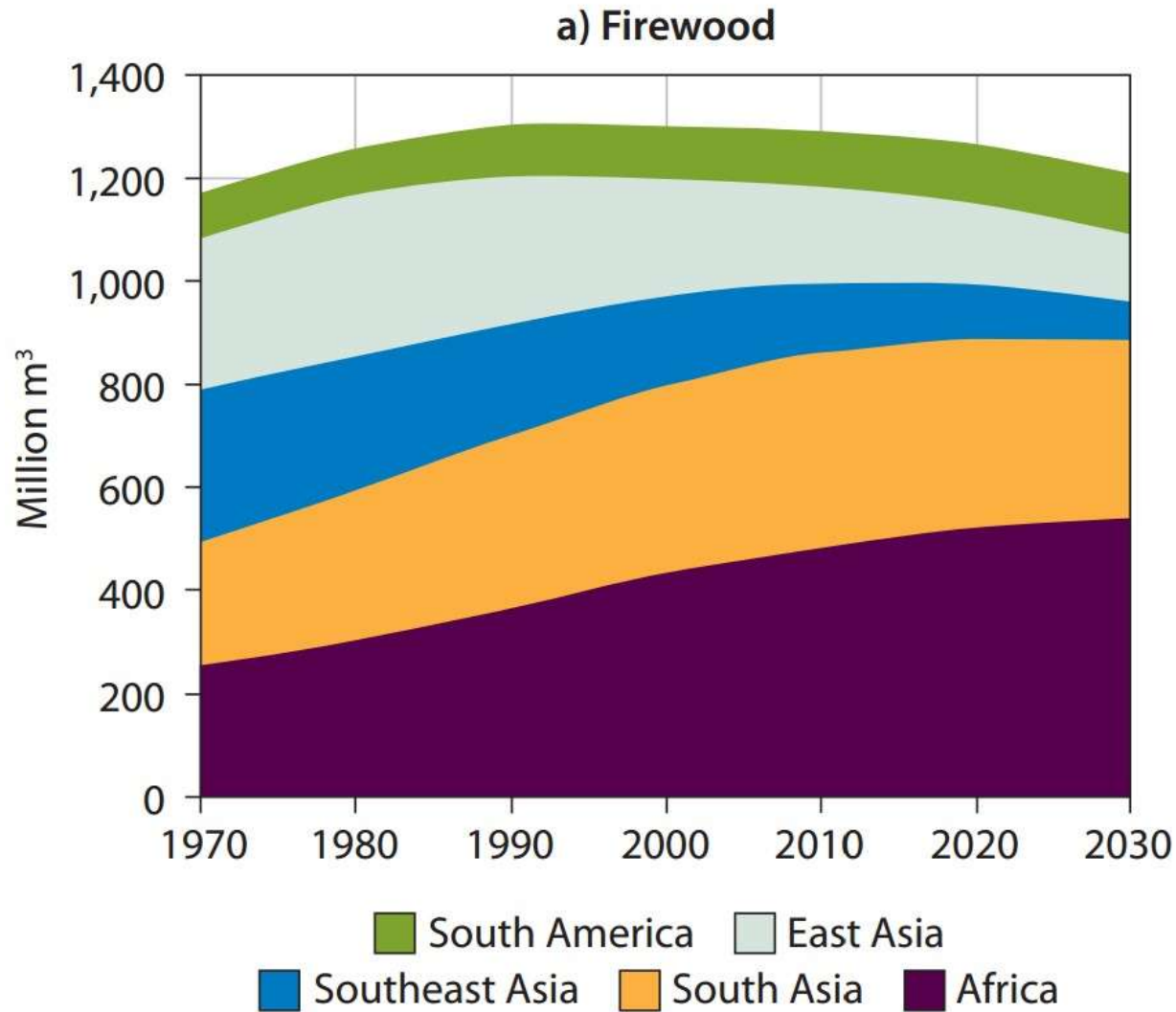


# Figure 2: Growth of Charcoal Production in Developing Countries: 1970-2030





# Figure 3: Growth of Firewood Production in Developing Countries: 1970-2030



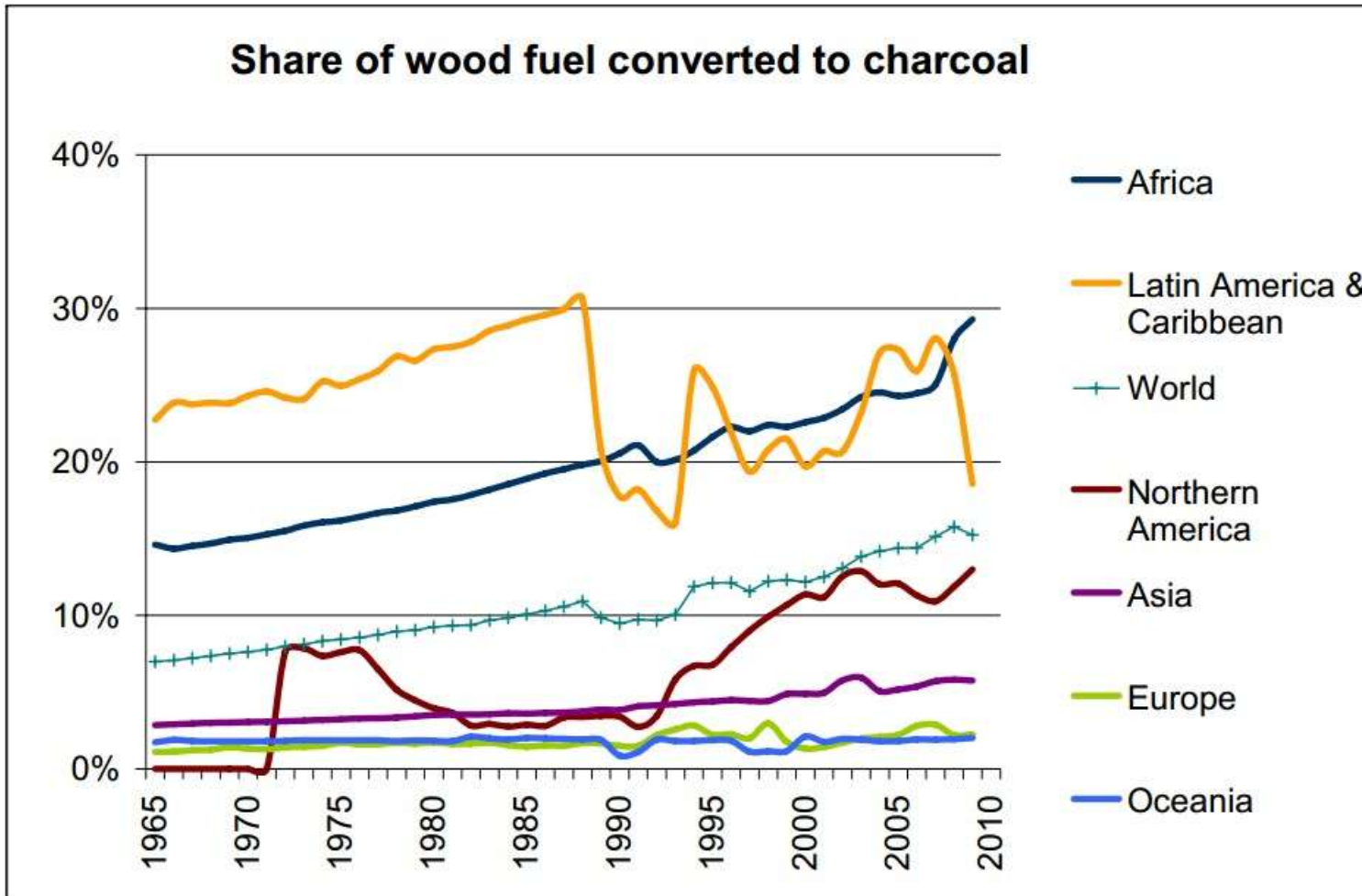


# Charcoal Sustainability: Africa

- In SSA, demand for energy with increased urbanisation, until the 1970 “oil shocks”, is met largely by kerosene (lesser extent LPG);
- Then, with ten-fold increase in price of oil, massive balance of payments problems in developing countries to pay for petroleum products, things change.
- This, accompanied by dramatic increases in urbanisation, demand for biomass, particularly charcoal demand increases significantly
- Tanzania’s urban population increases from less than 3 million in 1970 (i.e. less than 15% of the population) to over 12 million (over 30% of total population) today.
- This is closely mirrored, if not exceeded, in other SSA countries, including Ethiopia, Kenya, Ghana, Uganda, Rwanda, etc.
- Rural practices, from means of producing charcoal, to control of resources, do not match the rapid transformation of charcoal to major commercial crop.

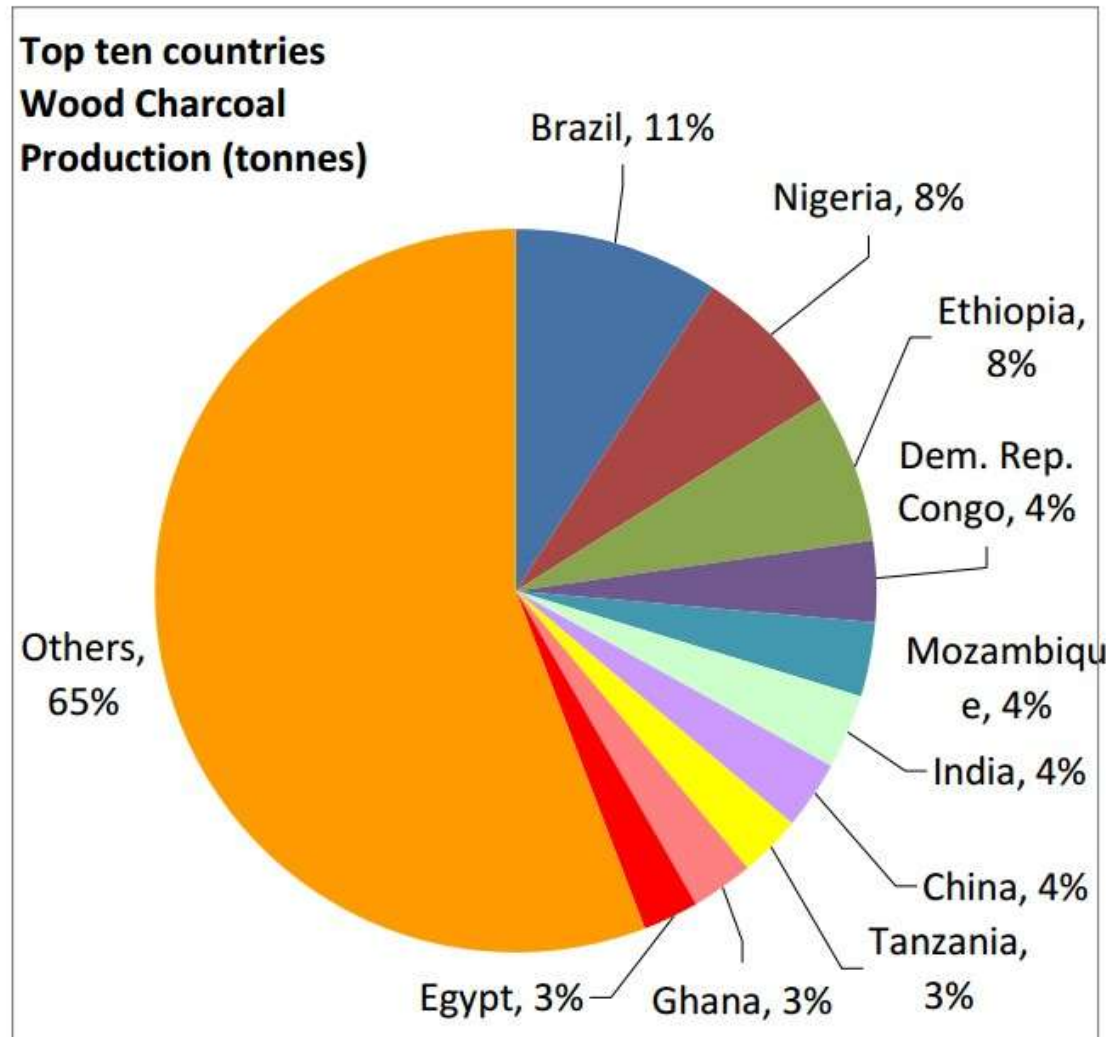


**Figure 4: Africa Shows Steady Rise in Charcoal Production (% Wood Fuel Converted to Charcoal): 1985 – 2010 (IIED, FAO)**





# Figure 5: World's Top Ten Charcoal Producers: 2010 (FAO) (Note: Tanzania & 5 other SSAs in top 10 internationally)





# Increasing Interest in “Solutions” to Biomass Energy from 1970s – Origin of “BEST”

- From the “oil shocks” and “Sahelian Crisis” in SSA in the 1970s, many studies, assessments, plans and projects designed & implemented in many countries – including Tanzania from the 1980s.
- Out of these comes the European Energy Initiative Policy Dialogue Facility (EUEI PDF) approach to working with governments & stakeholders through development of “Biomass Energy Strategies – BESTs” in:
  - Malawi (2003)
  - Mozambique (2005)
  - Botswana (2009)
  - Rwanda (2009)
  - Tanzania (2012-13)
  - Ethiopia (2012-13)
  - Sierra Leone Woody Biomass Household Cooking Action Plan (2013)



# BEST Objectives and Desired Outputs

In all the SSA countries where BEST has been implemented, the targeted objectives and outcomes focus on:

- Engaging all key stakeholders in government, politicians & policy makers, private sector, NGOs, civil society, financial institutions, biomass energy producers & consumers “speak the same language” & work from same basic definitions & principles to develop BEST
- Putting in place a supportive policy and regulatory framework for biomass energy
- Ensuring the institutional capacity is in place & strengthened to manage the biomass energy sector effectively and to implement the Strategy
- Making sure that efficient use and processing of biomass along the value/supply chain is in place.
- Ensure rural and urban households, institutions, SMEs, other businesses adopt & use improved biomass energy efficient techniques & technologies.



# Best Practices in Biomass Energy In Africa: Rwanda

- Rwanda mirrored most of SSA until the Civil War/Genocide of 1990s
- With new government & return of most refugees, Government focused on woody biomass energy
- The Vision 2020, set out in 1998-99, specifically addressed biomass energy
- Government called upon EUEI PDF to develop BEST Rwanda in 2008 to set the stage for policies in rural development, agriculture, job creation, value-added, sustainability & energy self-sufficiency
- BEST explicitly recognised by Government as providing significant background to:
  - Economic Development and Poverty Reduction Strategy (EDPRS – up to 2018) specifically refer to BEST and address the issues around biomass energy
  - The National Forestry Policy of 2011 identifies the role wood energy plays in forestry support and management
  - National Climate Action Plan
  - Other Government policies recognise the continued, even expanded, role biomass energy can play in Rwanda's development





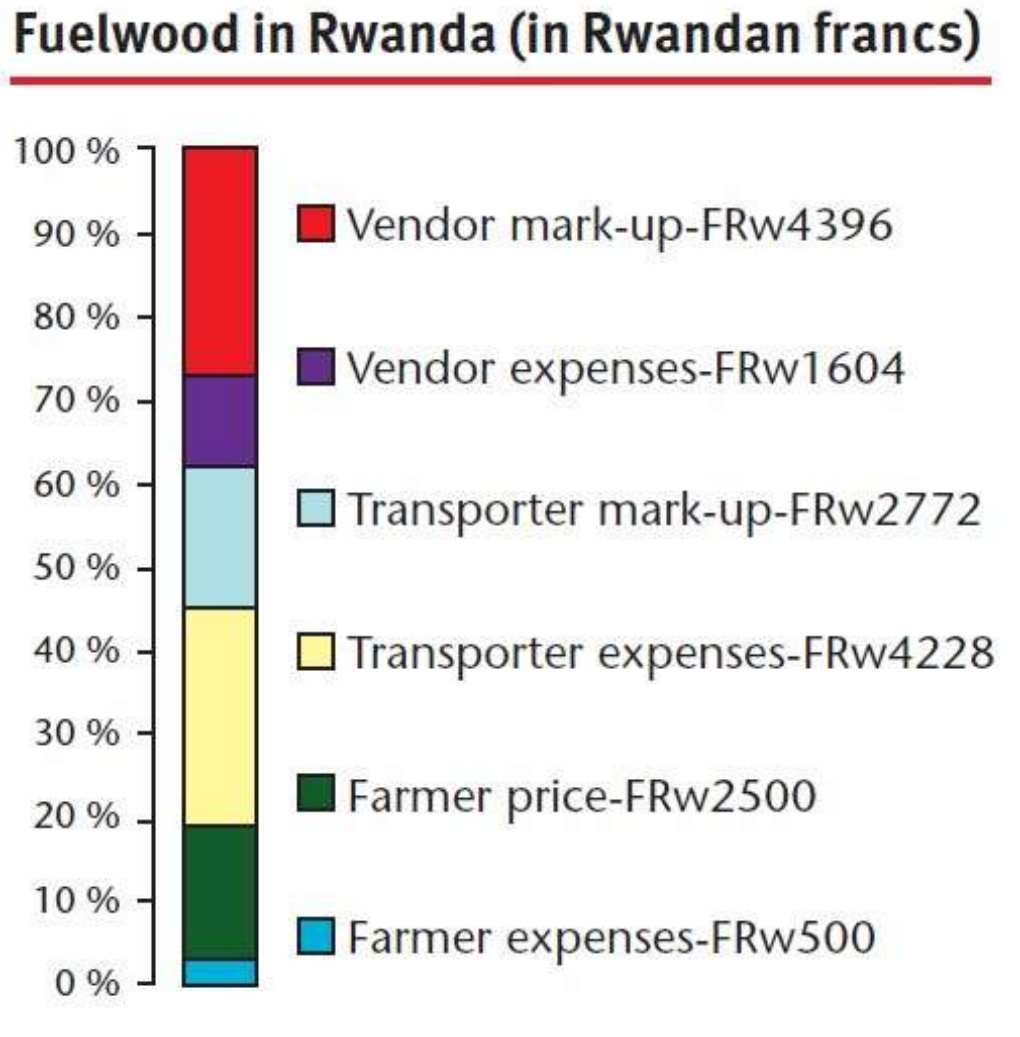
# Best Practices in Biomass Energy In Africa: Rwanda (2)

Government, both national and local, NGO and development partners recognise the following (as set out in the Rwanda BEST in 2009) stating:

- Wood energy plays a crucial role in rural, urban and national economies
- Over 5% of GDP derives from the charcoal business (the complete woodlands to urban consumer) value chain
- Commercial biomass (fuelwood and charcoal) is a one of the most important sources of rural livelihoods and provides the primary livelihood for over 20,000 rural and urban Rwandans
- This should be supported by people owning, or having specific access, to woodlands, including personal, community or larger-scale forest plantations (over 80% of all charcoal produced is produced legally on these woodlands)
- The charcoal business should be legal, run on commercial terms within the same general framework as any agricultural production.
- Charcoal should be produced with efficient techniques and technology;
- Charcoal should be consumed using efficient, affordable cookstoves.



# Figure 6: Rwanda Charcoal Price Structure (GIZ 2010)



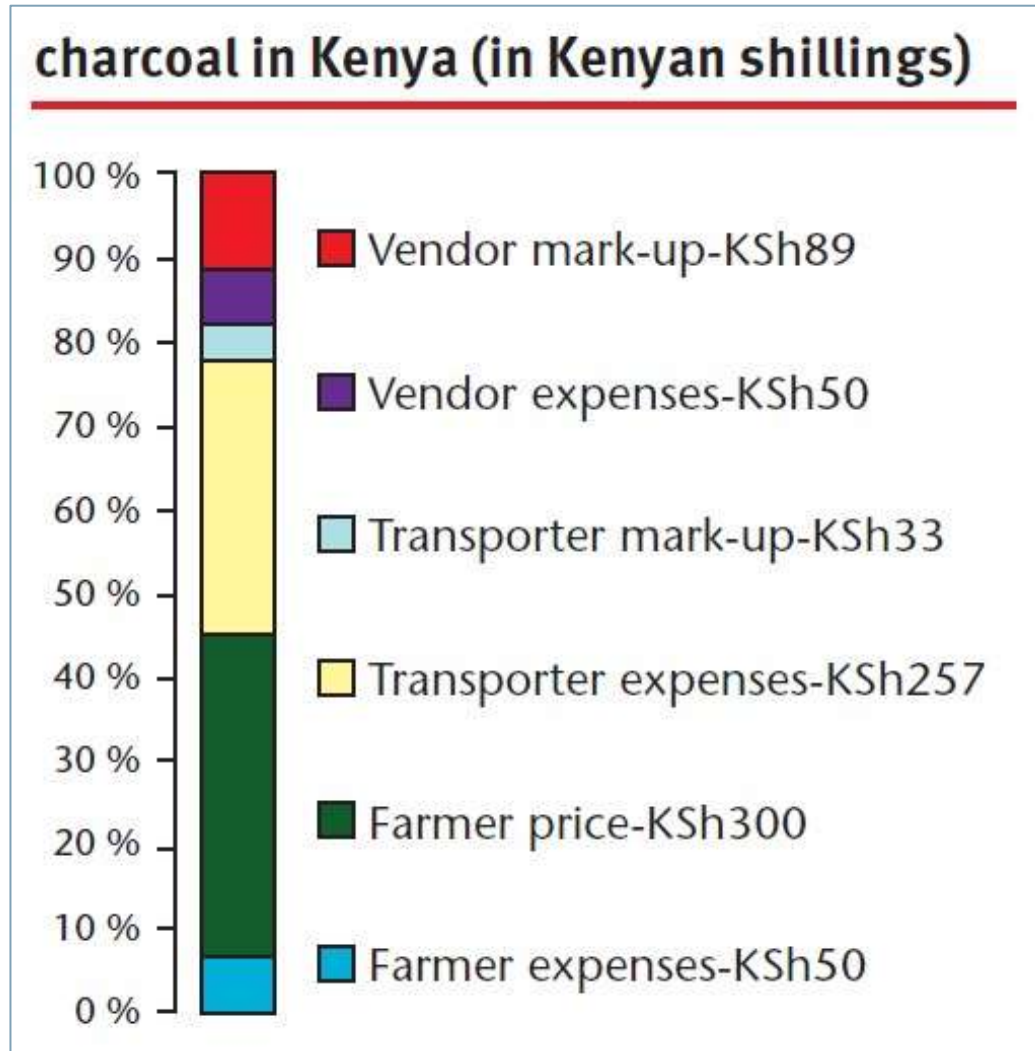


# Best Practices in Woody Biomass Energy In Africa: Kenya

- Today, over 90 percent of rural households use firewood for cooking & heating while 80 percent of urban households use charcoal as a primary source of fuel for cooking
- Charcoal was outlawed in 1978 (supposedly to stop exports to the Gulf)– drove production underground & resulted in near-elimination of sustainable charcoal
- Kenya has had a highly monetized biomass energy sector since colonial times – sustainable charcoal was produced by companies (East African Tanning, Thika Tanning) & small holders since the 1920s – charcoal worth over US\$400 mi (GIZ)
- Kenya, as host of the 1981 “UN New & Renewable Energy Conference” provided impetus, with development partner support, for major efforts in cooking efficiency (improved cookstove – ICS), in sustainable charcoal, biogas & other renewable energy activities – ICS efforts had major results.
- New Energy Policy (2004), Vision 2030 (2008), Forest Policy of 2009, plus National Energy Policy (NEP) of 2008 & the SREP (2011) put sustainable biomass energy production & consumption as high priorities.
- While non-sustainable biomass energy production is still an issue in Kenya, the value added to charcoal production, relative to other rural crops, is one of the highest in Africa (see Figure 6)

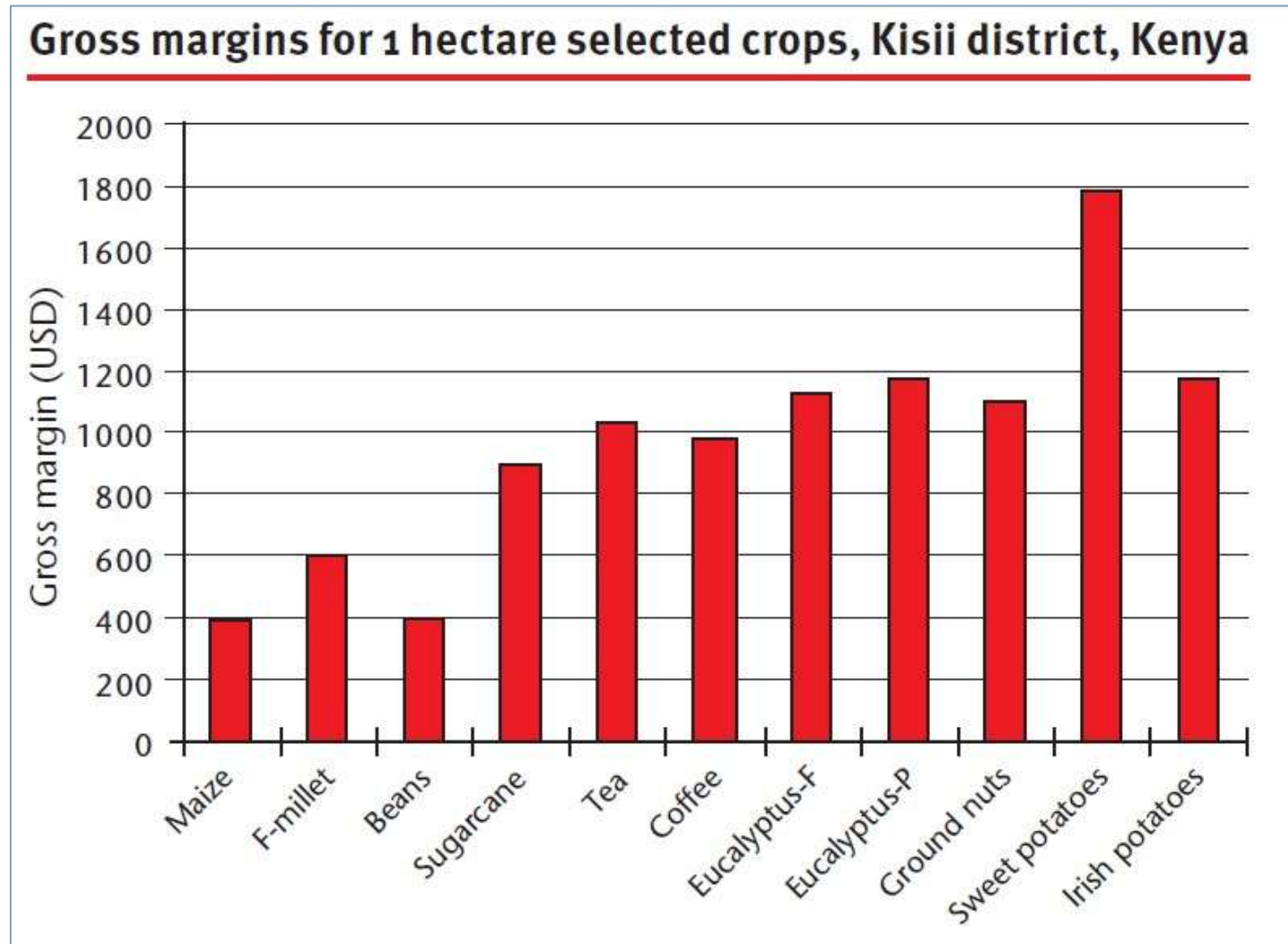


# Figure 7: Kenya Charcoal Price Structure (GIZ 2010)





## Figure 8: Value-Added of various crops in Kisii, Kenya (US\$/ha)





# Best Practices in Biomass Energy In Africa: Niger

- Niger differs from most SSAs: Most urban biomass energy supplied commercially as fuel wood. Commercial fuel wood is supplied in major quantities in all urban areas.
- The “Sahelian Crisis” of the late-1970s had a devastating effect on rural farmers & livelihoods. The Crises really raised the issue of “deforestation” due to woody biomass demand both in the Sahel, and throughout SSA.
- Major actions on improved cookstoves began in the Sahel in the late-1970s, early-1990s, but, dealt with charcoal, little on wood – which is important for Niger, Mali, Burkina Faso & many parts of urban Sahel.
- To address wood fuel sustainability, Government embarked upon innovative community & private licensing of woodlands, with technical, financial & other support, to promote “plantations” as sustainable source of urban (&, to lesser extent, rural) woody biomass energy.
- This took off &, from 1985 to 2000 nearly 1 mi ha of new woodland was planted by rural farmers, coops & local companies. Continues today with the latest “The Household Energy Strategy – a forestry policy to supply urban areas with Household energy (2012)
- This is one of the most successful approaches to both afforestation/reforestation & urban biomass energy supply, in the world.



# Best Practices in Biomass Energy In Africa: Ghana

- Ghana is one of SSA's most developed economies. Woodfuels account for over 70% of all energy consumption in Ghana. Woodlands account for over 85% of the land mass.
- Some 90% of woody biomass energy is sourced from public woodlands.
- Woody biomass energy figures prominently in the country, with over 80% of all urban households (over 1 mi) using charcoal as their primary energy source, & over 85% of Ghana's rural populations using woody biomass to meet their cooking & heating needs.
- Most rural & many urban SMEs use woody biomass for heating, boiling & cooking.
- Over 60% of all primary energy consumption is from woody biomass sources.
- Government tried to move SMEs away from woody biomass (oil processing, fish smoking, baking, etc.), but, after nearly ten years of major subsidies & foreign exchange expenditure – withdrew the support – today, over 300,000 SMEs use firewood & charcoal.
- Strategic National Energy Plan: 2006 – 2020 (Energy Commission) has long-range vision & recognizes that woody biomass will be important for years to come, focus on ICS, private & community plantations, improved charcoal production & community management. Successfully incorporated into all major Government policies (poverty, industry, agriculture, energy, water, etc.).
- **Made charcoal & commercial fuel wood “formal”, “regularized” & part of the “official**



# Return to Woody Biomass Energy: Trends in OECD Countries - The EU (1)

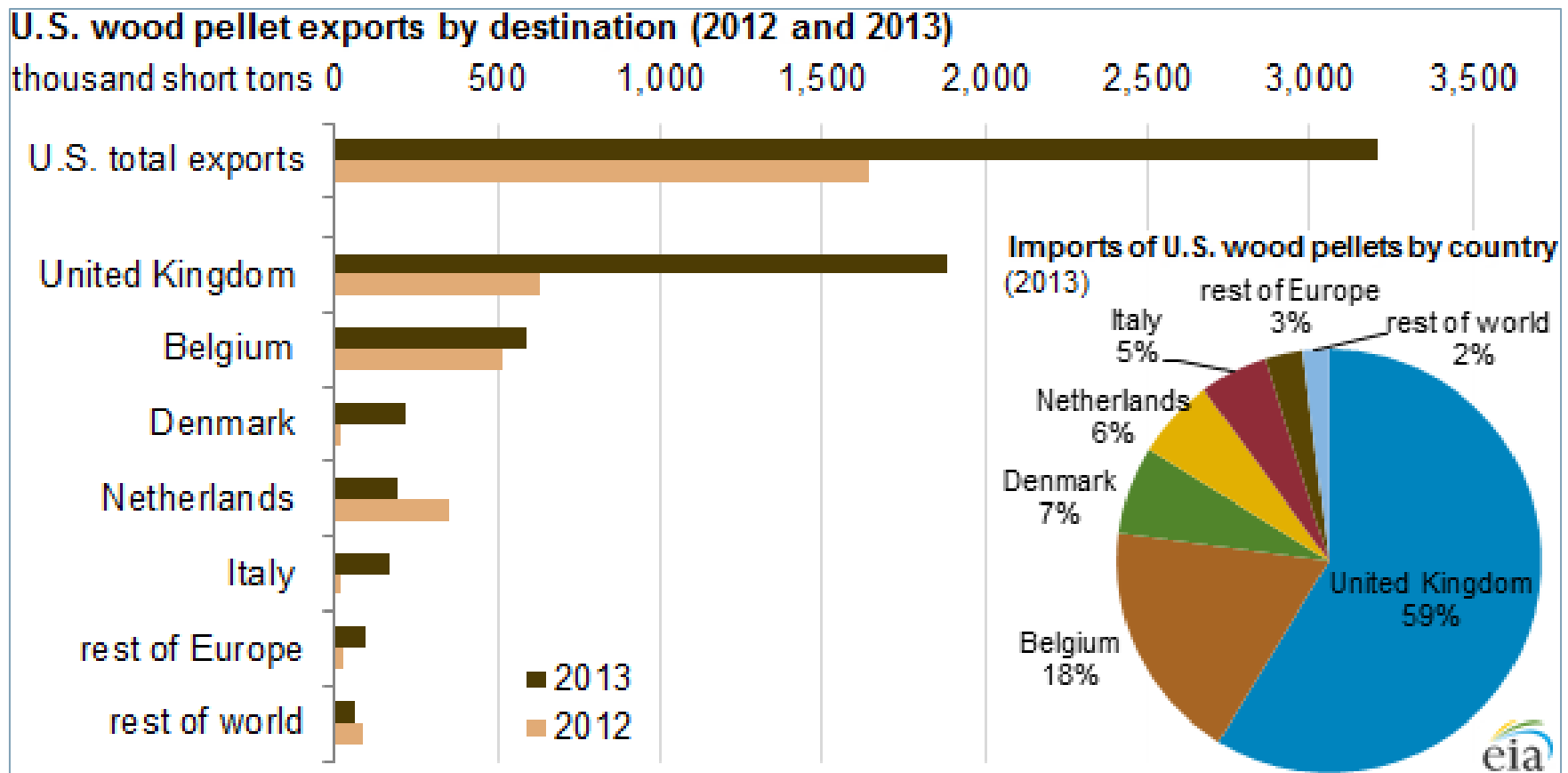
- Currently, in the EU, wood energy accounts for approximately 50% of all renewable energy produced – and this proportion is growing.
- The EU’s renewable energy target is 20% for 2020 and 30% in 2030 for all primary energy supplies – and, woody biomass is supplying over half of that now and is projected to increase.
- In eleven of the EU’s 28 Member States, wood energy accounts for over 15% of household energy consumption – in countries ranging from Germany to Estonia – and this proportion is growing, & over 25% of total rural energy consumption up from less than 15% in 1990.
- “Renewable Heat Obligations (RHOs)” are in place in the UK, The Netherlands and a number of local constituencies.
- In the UK, The Netherlands, Denmark and other EU Member States, all new household heater/boilers must be very efficient, and use either biomass, ground-source or air-source heating/cooling pumps, or top-of-the-line natural gas as fuel.





# Trends in OECD Countries: EU (2)

- Wood is being used increasingly to co-fire with coal with the intent to reduce GHG emissions in electricity & heat production. Largest non-EU source of wood for co-firing is the USA (Figure 9):





# Trends in OECD Countries: USA & Canada (1)

- Wood energy accounts for over 15% of all energy produced in the US and Canada – and this proportion is growing
- In California, Texas, Massachusetts, Connecticut, and other states in the US, and British Columbia, Ontario, Quebec, New Brunswick & Nova Scotia in Canada, similar renewable heating and cooling policies are in place – with wood energy leading the way.
- Key drivers are:
  - Support for rural development and livelihoods;
  - Job creation and technology innovation;
  - Security of energy supply; and,
  - Environment, both local (e.g., watershed management, improved land use) and climate change

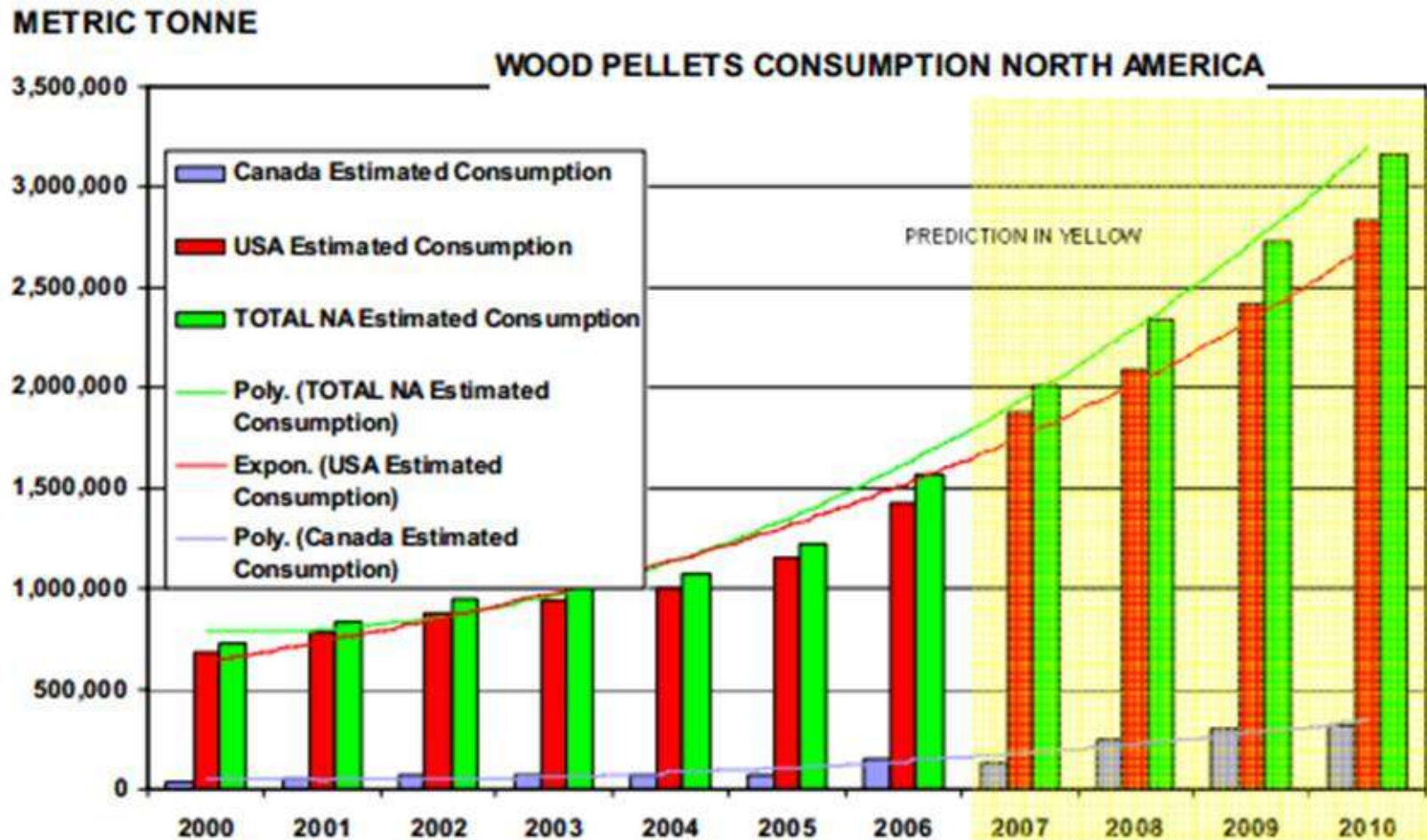


## Trends in OECD Countries: USA & Canada (2)

- As in Europe, major growth in household/domestic woody biomass use, in both rural & peri-urban/suburban areas.
- Also, in both Canada & the US, almost all provinces/states have “Renewable Portfolio Standards (RPSs)” which oblige electricity & gas suppliers to promote renewables, with biomass energy (wood, wood residues, biogas, etc.) getting highest premiums of any renewable energy sources.
- As the next chart shows, wood pellet production over the past 10 years in the USA increased nearly seven-fold to supply electricity, heating & cooling, industries, institutions and households in the USA, mainly driven by local, state & national (federal) policies.
- A number of municipalities have set up major support programmes for biomass energy & biomass energy end use efficiency investments.
- As Figure 8 shows, household consumption of wood for energy increases with income, rather than poverty. This shows the “green” premium.

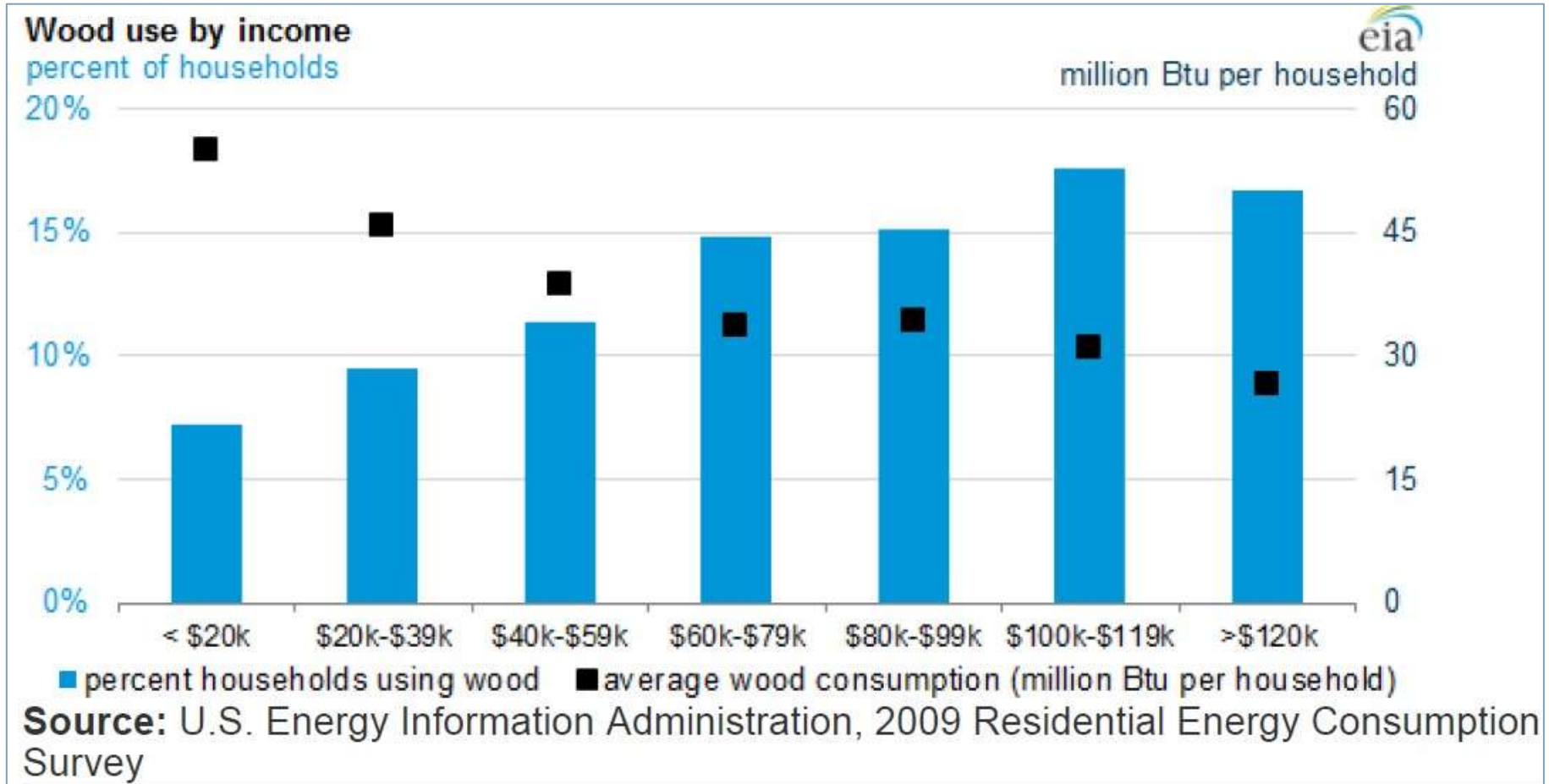


# Figure 10: Wood Pellet Consumption in the USA: 2000 to 2010)





# Figure 11: US Household Wood Energy Use by Income (2010)





# Lessons Learned and Best Practices in Successful Biomass Energy (1)

- International trends, from North America, the EU, China & Japan have seen the role of woody biomass grow substantially in the past 20 years.
- This transformation has been driven primarily by policies, which, in turn, are driven by intent to:
  - generate employment;
  - stimulate rural development;
  - Generate equitable balance between rural & urban populations;
  - stimulate technical & technological change;
  - Support industrial development & exports; and,
  - obtain more energy security

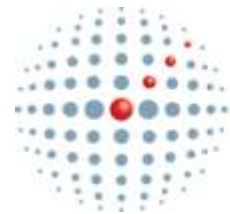


# Lessons Learned and Best Practices in Successful Biomass Energy (2)

- Success starts with well-developed policy, with a strategic vision that has been generated by a number of stakeholders;
- Success relies upon policy makers, businesses, civil society “buying into” the belief that biomass is a modern, sustainable, profitable, long-term means to deal with a variety of strategic issues.
- Success depends upon consistency, upon “buy-in” across the board – Rwanda is a classic example – the policy reduction strategy views sustainable charcoal production as a critical success factor for rural & urban poverty alleviation, as well as watershed management, soil improvement, biodiversity, increased agricultural development, etc.
- Success depends upon constant updating of assumptions, data, of information, of strategies, policies & plans.



**Asante sana!**



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