



**BIOFUELS FROM NON-EDIBLE  
SOURCES  
- RESEARCH ACTIVITIES AT KNUST**

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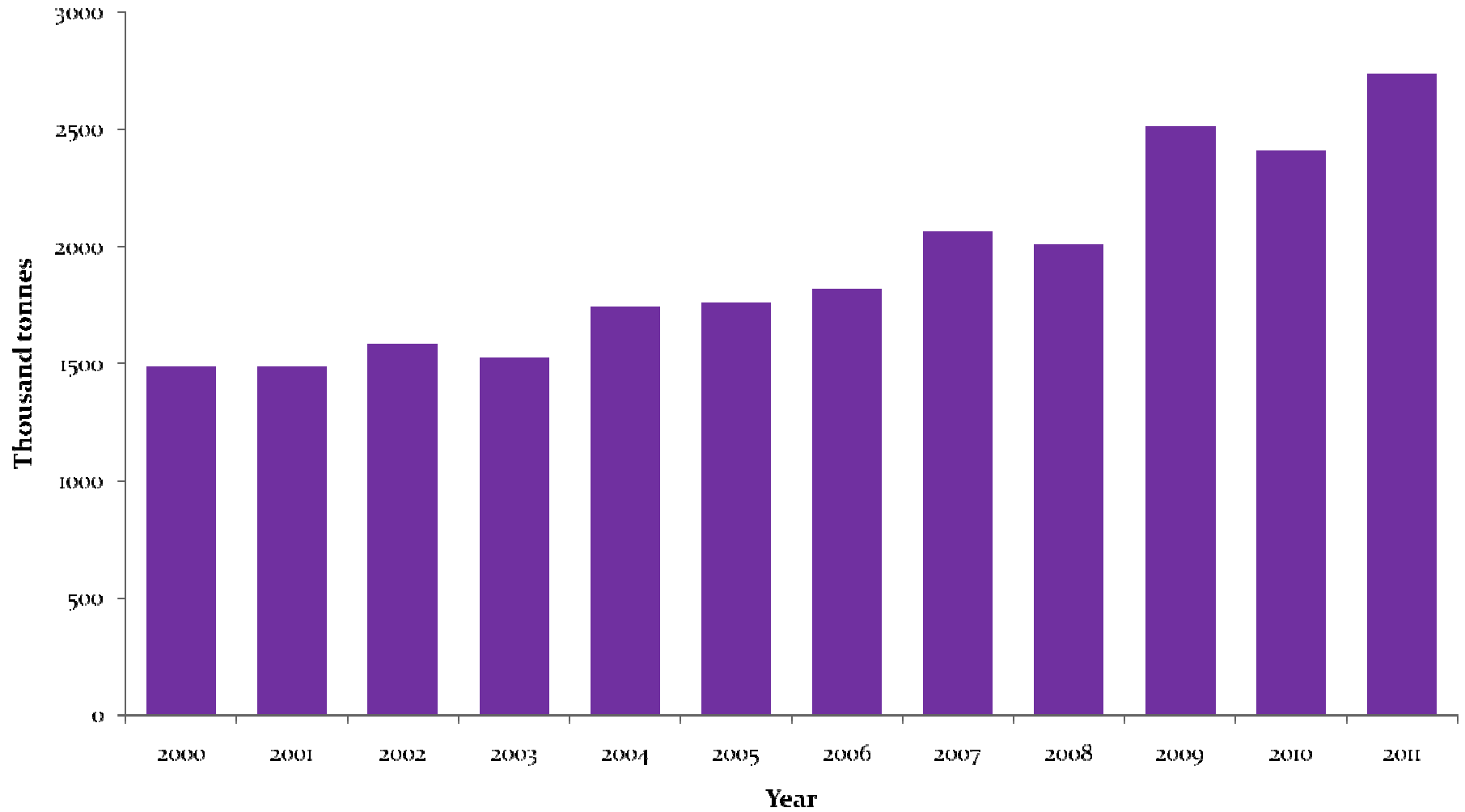
# GHANA'S PRIMARY ENERGY MIX

Product	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
	In ktoe											
Oil	2,157	2,401	2,595	2,561	2,616	2,602	3,097	3,326	3,087	2,826	3,283	3,767
Natural Gas	0	0	0	0	0	0	0	0	0	5	395	772
Hydro	568	568	433	334	454	484	483	321	533	591	602	650
Woodfuels	4,406	4,785	4,967	5,148	5,231	5,313	5,478	5,610	5,808	5,907	6,039	6,138
<b>Total</b>	<b>7,131</b>	<b>7,754</b>	<b>7,994</b>	<b>8,043</b>	<b>8,300</b>	<b>8,399</b>	<b>9,058</b>	<b>9,257</b>	<b>9,428</b>	<b>9,329</b>	<b>10,318</b>	<b>11,328</b>
	Shares (%)											
Oil	30.2	31.0	32.5	31.8	31.5	31.0	34.2	35.9	32.7	30.3	31.8	33.3
Natural Gas	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	3.8	6.8
Hydro	8.0	7.3	5.4	4.2	5.5	5.8	5.3	3.5	5.7	6.3	5.8	5.7
Woodfuels	61.8	61.7	62.1	64.0	63.0	63.2	60.5	60.6	61.6	63.3	58.6	54.2
<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>	<b>100</b>

- Fossil fuels and Biomass (burnt inefficiently) dominates the mix

Courtesy: Kemausuor et al (2013)

# PETROLEUM CONSUMPTION IN GHANA



Courtesy: Kemausuor et al (2013)

# RENEWABLE ENERGY LAW AND DRAFT BIOENERGY STRATEGY

Ghana's RE law requires that as from 2020, 10% of the total installed electricity generation capacity must come from renewable energy



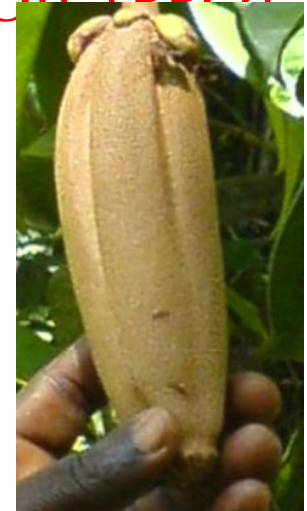
The draft bioenergy strategy also requires the use of 10% biofuels in transport fuel mix by 2020 and 20% by 2030

Courtesy: Kemausuor et al (2013)

# 1. NON-EDIBLE BIODIESEL FEEDSTOCKS

## Plant Sources

- **STRAIGHT VEGETABLE OIL (SVO) / PURE PLANT OIL (PPO).**
  - Jatropha Oil
  - Castor Oil
  - Allan Blackia
- **ESTERIFICATION/TRANSESTERIFICATION:**
  - Jatropha Oil
  - Waste Vegetable Oils



## Other Sources:

- **Faecal Sludge to Biodiesel – Pilot Stage Facility**
  - Columbia University - Waste Enterprises –KNUST Collaboration
  - Bill & Melinda Gates Funding of US\$1.5 Million

# BIODIESEL FEEDSTOCK (CONT'D)

## B. Waste Vegetable Oils (WVO)

- **Potential Assessment – Energy Commission Sponsored**

1. Survey

2. Transesterification of Various Samples (Conventional catalysts)

Sample ID	%FFA	% Yield (Crude Biodiesel)	% Yield (Refined Biodiesel)
Accra Sample	1.08	99.41	97.46
Frytol Oil (Chicken, Fish)	0.97	98.43	94.22
Viking Oil (Potato, Wedges)	1.01	98.00	87.75
Gino (Yam, Potato, Plantain)	1.04	100.00	91.67
Lele (Plantain)	1.46	100.00	95.50
Coconut Oil (Fish)	1.62	100.00	98.70
OKOil (Doughnuts)	0.87	90.00	87.50
Palm Kernel oil	3.53	93.00	88.00
Ghana Sample	1.13	99.44	88.89

*Independent Private Company at the Implementation Stage in Accra*

3. Biodiesel Production using Unsupported Potassium Carbonate

## 2. BIOMASS

1. 2GBIONRG (KNUST – DTU Collaboration) and
2. Biomass Gasification Project – ECREEE Funding (KITE-KNUST-UPC)

### Expected Outputs:

1. Assessment of Integrated feasibility of electricity service based on local biomass gasification mini grids in 5 MFP communities
2. Analyse and recommend affordable financial mechanisms for decentralised energy infrastructure set-up and pro-poor business promotion in the target communities.
3. Prepare a detailed pre-investment implementation plan for a selection of communities with a higher feasibility and business promotion prospects.
4. Assessment of the climate change mitigation potential using biomass feedstock for energy generation as an alternative to diesel (fossil fuel)
5. Networking and knowledge transfer to key decision-makers

## 3. BIOGAS

- Technology implementation at domestic level is appreciating
- Private Companies are the business drivers
- Massive potentials yet to be fully harnessed
  - Over 240 digesters with total capacity of about 3,680 m<sup>3</sup> installed
  - Size range = 4 – 800 m<sup>3</sup> (*Biggest @ GGBL, Kumasi using UASB*)

### Studies Carried out:

1. Technical Evaluation of Existing Biogas Plants
2. Feasibilities Studies on Institutional Biogas
3. Evaluation of the Guinness Biogas Plant at Kaasi

- **Institutional Scale Feedstocks:**

- Abattoir Waste (District & Regional)
- Sorted Market Waste (Central & Satellites)
- Cassava Peels (from Gari Processing Waste)
- Industrial Organic Waste (e.g. Cocoa Processing Waste)





# BIOGAS (CONT'D)

## Ghana-UNIDO-Korea Project:

**“Supporting green industrial development in Ghana: Biogas technology and business for sustainable growth”**

- **Overall Objective:**

To increase access to energy in Ghana by promoting industrial-scale biogas technologies for electricity and thermal applications in Ghana through integrated technology transfer approach

- **Outputs/Activities:**

3 Technical components namely:

1. *Piloting, and business and enterprise development support*
2. *Resource mapping and conducting industry-led research on biogas technology [TEC-KNUST, KoPoly & IIR (CSIR)]*
3. *Awareness Raising and Policy Recommendations/Strategy*

# 3. WASTE-TO-ENERGY RESEARCH

- **Biomass Assessment / Resource Mapping**
  - KNUST-DTU Collaboration (2GBIONRG)
  - Biomass Gasification Project
  - GIS-based Mapping Project (**Signing Document**)

## *Agricultural Waste –*

- 1. Plantain & Banana Stalk for Biodiesel production
- 2. Palm Kernel Shells & Palm Fibre – Syngas Analysis
- 3. Corn Cobs – Pyrolysis (for Syngas & Biochar) & Trigenation
- 4. Corn Stovers – Pyrolysis for Biochar

## ● *Industrial Waste –*

- KNUST – IIR (CSIR) – Slow Pyrolysis for Bio-Oil & Biochar Production
- KNUST – RPI Collaboration – Pyrolysis & BioSolar Pyrolysis



# CONCLUSIONS

- KNUST is a hub of research into energy research with a strong traction in Biofuels (First and Second Generation) technology development and deployment.
- TEC-KNUST and its fellows in particular are actively involved in:
  - laboratory-scale research
  - Pilot-scale activities
  - Feasibility studies of various technologies
  - Energy Access facilitation
  - Policy analysis and recommendations
- Has a strong local and international collaborations in realizing its vision and mission.



**THANK YOU**