

Environmental, economic and social dynamics of bioenergy production

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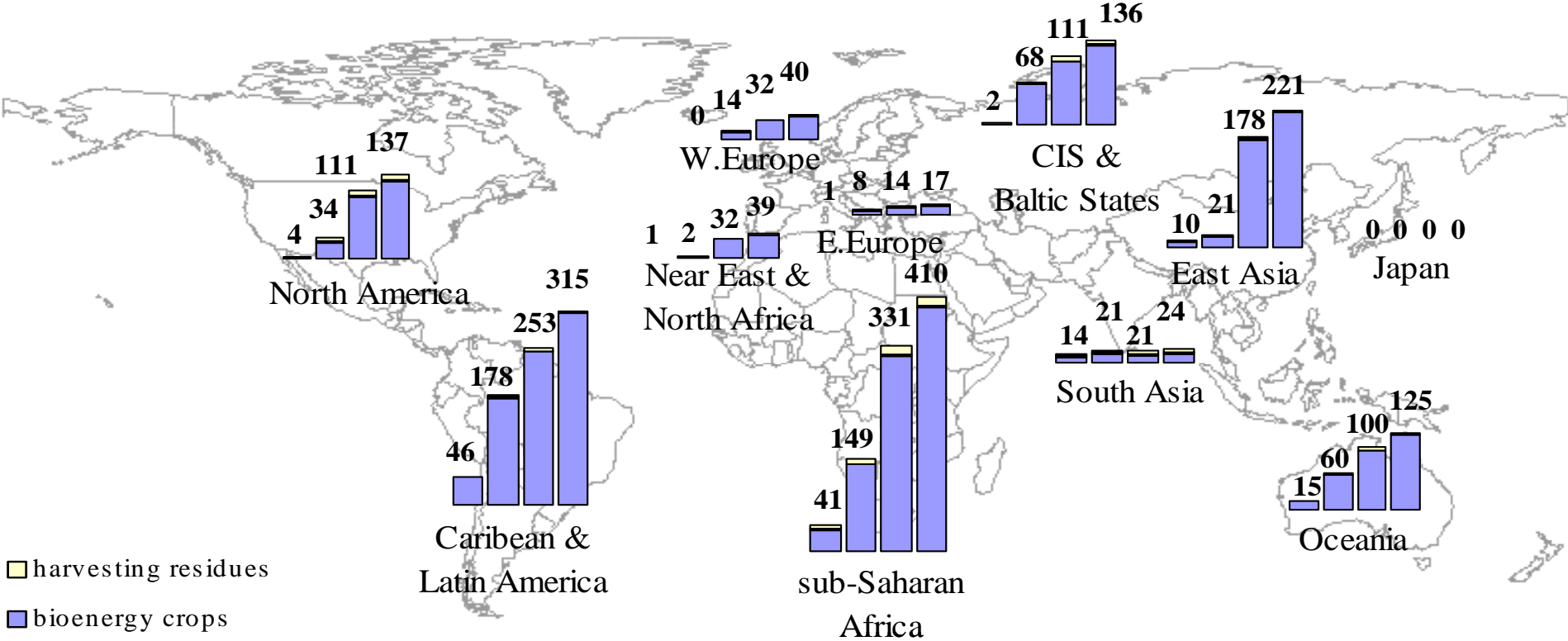
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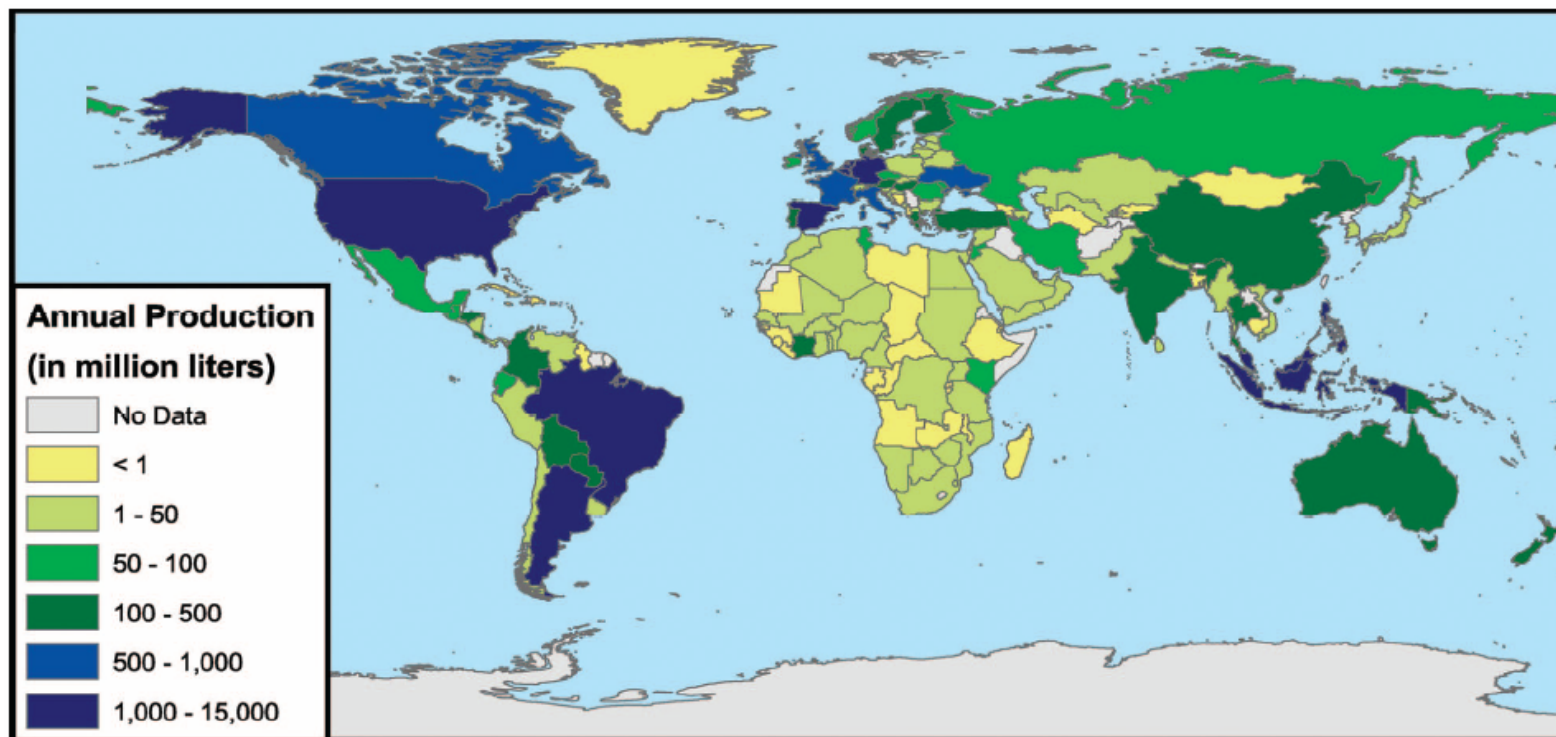


Bio-energy production potential in 2050 for different scenarios



Smeets E, Faaij A, Lewandowski I (2004) A quickscan of global bio-energy potentials to 2050: Analysis of the regional availability of biomass resources for export in relation to underlying factors. Copernicus Institute, Utrecht University, NWS-E-2004-109.

Global biodiesel potential from existing lipid exports

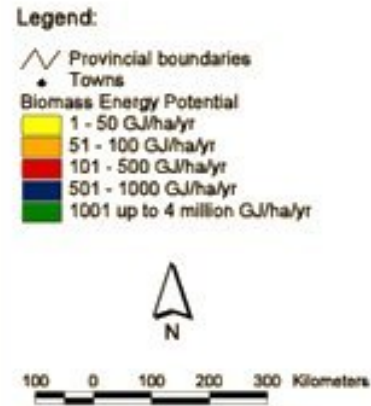
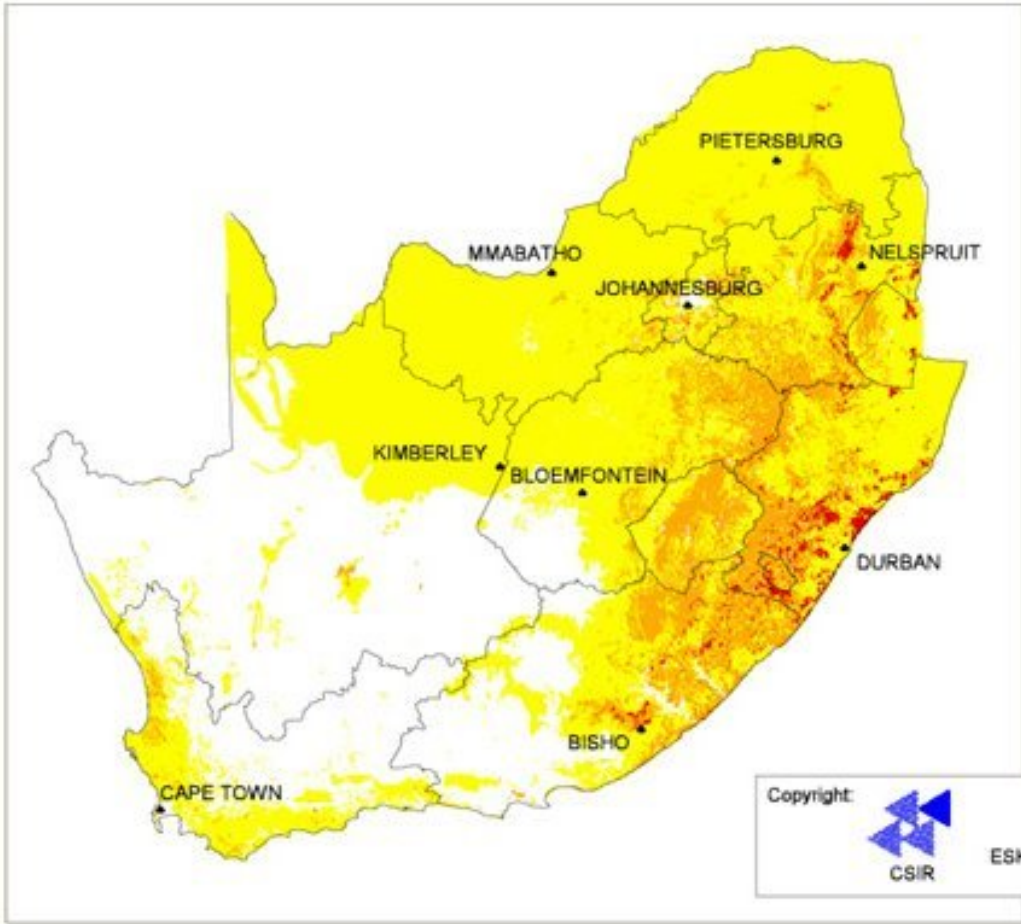


Country (2003)	Production Cost (\$/lt.)	Potential Biodiesel Volume (lts.)	Total Export Profits (\$)	% of Diesel Imports	% of Diesel Demand	Change in GDP/capita	Drop in Unemp.	Jobs Created	Tons CO2 Reduced
South Africa	\$ 0.59	5,937,301	\$ 1,705,804	1%	0%	0.00039%	0.00006%	7	1,168

Johnston M, Holloway T (2007) A global comparison of national biodiesel production potentials. *Environmental Science & Technology*, 41 (23), 7967 – 7973.

Country details: <http://pubs.acs.org>

Muller J (ed) (1999) South African renewable energy resource database. Report No. ENV-P-C 98161, Environmentek, Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa.

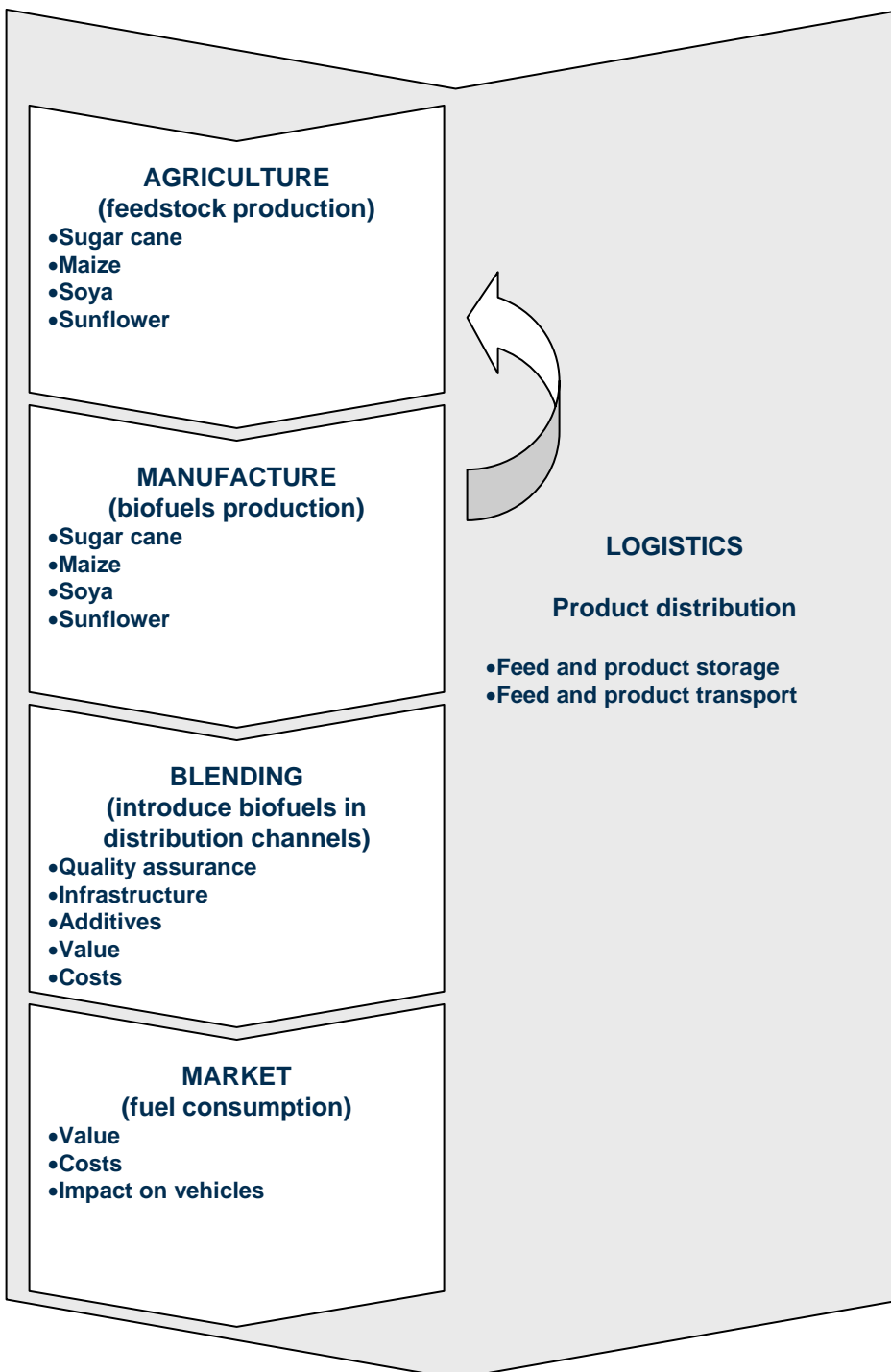


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CSIR ESKOM CORPORATE TECHNOLOGY MINERALS AND ENERGY

Biomass energy could theoretically provide approximately 1.26 EJ, or 50%, of the total South African national energy demand by the turn of the century



The strategy aims to achieve biofuels average market penetration of 2% of liquid road transport fuels, i.e. petrol & diesel by 2013

National Biofuels Task Team (NBTT) (2006)
National biofuels study: An investigation into the feasibility of establishing a biofuels industry in the Republic of South Africa.
Available from:
<http://www.dme.gov.za/energy/documents.stm>

Utilising surplus agricultural capacity & assuming the oil price remains above US\$65

How viability is the South African biofuels industrial strategy in terms of environmental, social and economic conditions of sustainability?

- **Environmental uncertainties**
 - Greenhouse gas (GHG) emissions?
 - Water quantity and quality?
 - Biodiversity?
- **Social uncertainties**
 - Poverty alleviation and social justice?
 - Capacity development?
 - Infrastructure and rural development?
- **Economic uncertainties**
 - The available land for growing energy crops?
 - The expected yields of the energy crops?
 - The costs of production?
 - The oil price and ZAR/US\$ exchange rate?
 - The price of crops?

Brent AC, Fortuin H, Wise R, Molapo M (2008). The viability of the South African biofuels industrial strategy. Working paper, RBSD, NRE, Pretoria.

Environmental uncertainties

- could potentially encourage undesirable land use & land management practices, particularly where bioenergy crops compete with food crops for agricultural land
 - GHGs = mostly N₂O), CO₂ & CH₄ = “well to tank” fossil fuel emission lower vs. biofuels (but higher “tank to wheel” & per km driven than biofuels)
 - **Implications of expanded bioenergy crop cultivation** = intensive monoculture & fertilizer use for high bioenergy yields will increase nitrogen emissions?
 - **water catchment management areas in South Africa are stressed and over-allocated** = competition with existing crops for rain-fed & irrigated water, & for cooling & other processes associated with biofuel conversion plants?
 - Expansion of cropland could encroach on wetlands, riparian areas & other areas of high **biodiversity** importance.
 - Etc, etc, etc, etc

Social uncertainties

- biofuels support improvement of accessibility to reliable & affordable energy services & alleviating & eradicating poverty, & ensuring sustainable development
 - legacy of **marginalisation of the poor in land distribution** & other assets & inequity in accessing basic services
 - may not be practical for SA to achieve its RE target by 2013 because of magnitude of socio-economic realities faced by millions of the poor across the country.
 - high uncertainty whether biofuels industrial strategy would benefit 2nd economy in rural areas through job creation & poverty alleviation
 - drafting of biofuels industrial strategy with **little engagement with 2nd economy in rural areas** – “poor” have knowledge & better understanding of own environment
 - Is biofuels industrial strategy **aligned with other infrastructure needs** in rural areas?
 - **land ownership in rural areas** – the role of traditional leadership?
 - Etc, etc, etc, etc

Economic uncertainties

- Potential economic (not financial) costs & benefits associated need to be valued & accounted to make tradeoffs b/n competing criteria & range of possible scenarios
 - Estimates of land to be used based on **biophysical characteristics** of the lands, i.e. soil type, soil quality, location, topography, etc.
 - What about **opportunity costs** of the land & associated risks of converting to energy crops (in the case of arable land)?
 - losses of these benefits need to be considered in evaluating economic viability of each and every biofuel processing plant
 - biofuels target will be through use of surplus production, approx 3m-5m tonnes p.a. in 2001-06 = assumes trend will continue
 - energy-crop productivity (and profitability) extremely sensitive to **rainfall variability**
 - maize harvest for 2006/2007 season down by 66% on the previous year's harvest, even with additional 17.2% of land planted to maize.

Research categorised in six areas

Life cycle analyses

Strategic assessments

Farming practices

Economic incentives

Adaptive management

Technology management

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Impact assessment and costing methodologies need to be developed to better evaluate the implications of the bioenergy value chain

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Methodologies need to be refined to improve the understanding of the ecological and socio-economic consequences of bioenergy scenarios at a regional level

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Bioenergy feedstock production must be enhanced to suit the environmental, socio-economic and cultural contexts in different regions of South Africa, and specifically in rural areas

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The potential of methods such as taxes and subsidies must be investigated in the South African context in a comprehensive manner

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A framework must be developed to instil adaptive learning and capacity building in communities that undertake distributed, co-production of bioenergy feedstock

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Models, normally applicable to the traditional organisational context, must be refined for the development, transfer and adoption of biofuels-related technologies in rural communities

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**Sustainability
Science**



**Concentrate on the design of
(technological) systems to
produce more social good
with less environmental harm**

Kates RW (2000) Sustainability science.
World Academies Conference: Transition to
Sustainability in the 21st Century, Tokyo.

Bioenergy Systems Sustainability Assessment and Management

