Panel 4: Stimulating tools towards the development and deployment of bioenergy – CDM and JI

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Bioenergy Needs in Developing Countries

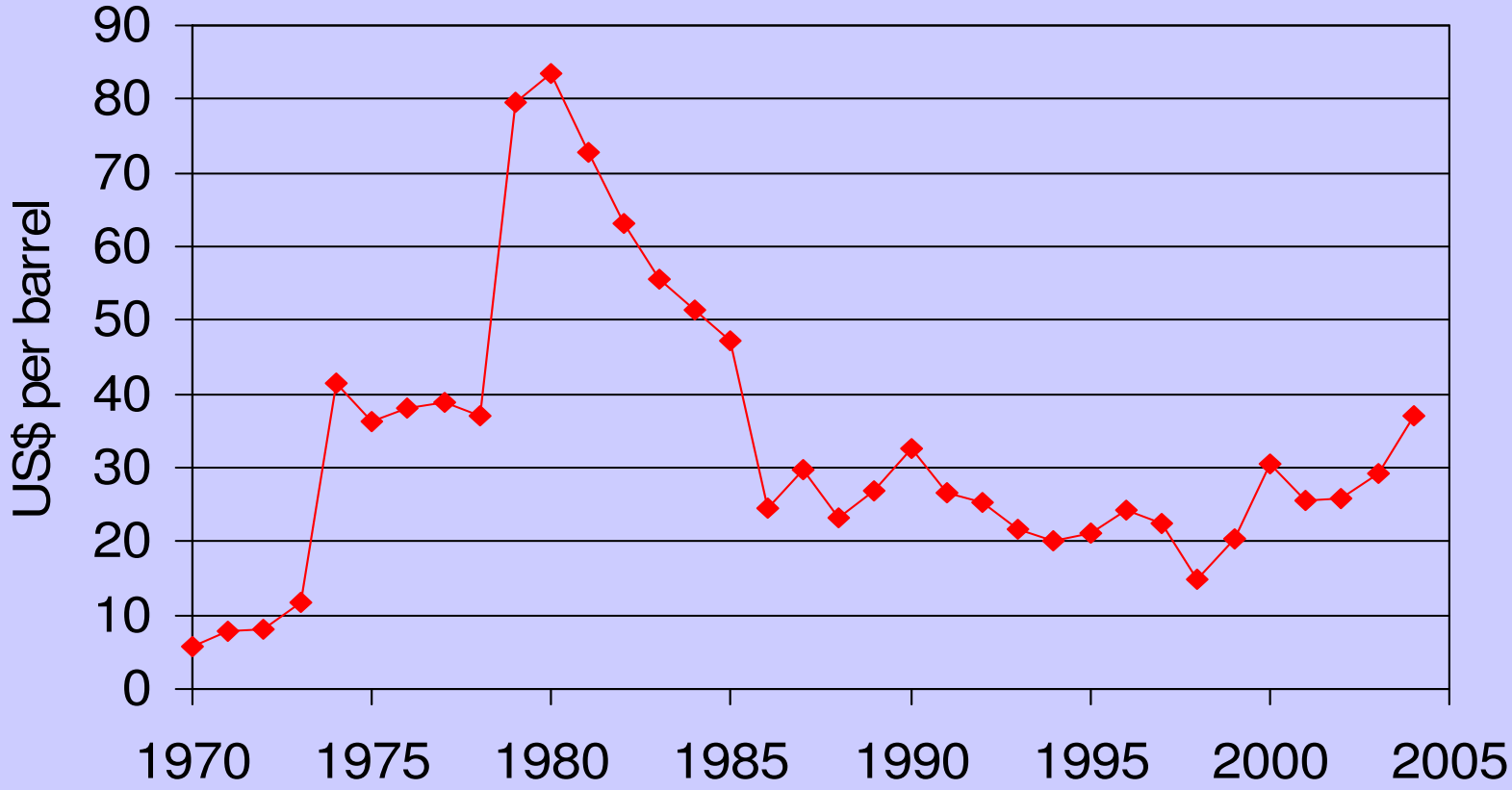
- Access to modern fuels for cooking, lighting, productive uses, and information/entertainment
- Competing needs for biomass: food, fuel, and fodder
- Reduce unsustainable and non-renewable biomass use
- Willingness to pay for electricity and fossil fuels high, replacement for biomass fuels low
- Simple, dependable, and serviceable technology
- Low capital intensity (given financing constraints)
- Financially viable without large government subsidies
- Market oriented

Carbon Market Drivers

- **The Kyoto Protocol - 1997**
  - **Status: came into force on February 16, 2005**
  - Total Demand for GHG Reductions (ratifying countries): ~5 to 5.5 billion TCO2e by 2012
  - Half to be met in OECD countries themselves
    - 2,500 million TCO2e by "flexibility mechanisms" (clean development mechanism, joint implementation and international emissions trading)
  - **1 to 1.5 billon TCO2e through CDM and JI (project based emission reductions) by 2012**
    - Less than 300 million TCO2 contracted (mostly in CDM) to date
    - At least $10 billion of emission reductions involving more than $50 billion of project investment before 2010
  - **About 6.5 billion TCO2e of 'hot air'**

- **The European Trading System**
  - Designed as an entity-based domestic cap and trade emissions allowance programme that started operation on January 1, 2005
  - **Allowances allocation** in accordance with a national allocation plan
  - EU Directives: biofuels for heat; transport (5.75% by 2010)

Historical crude oil price (2004 US$)



Climate Change – A Development Issue

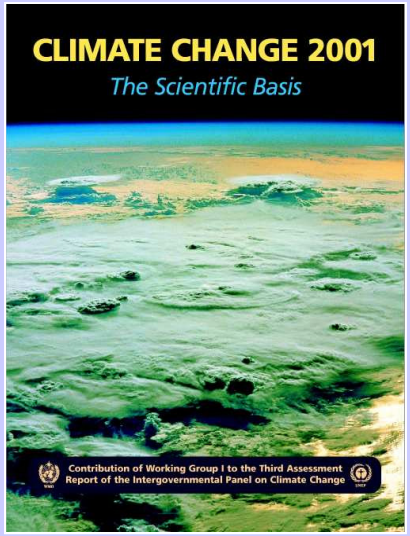
Climate variability and human-induced climate change threaten poverty alleviation and the sustainable economic development of developing countries

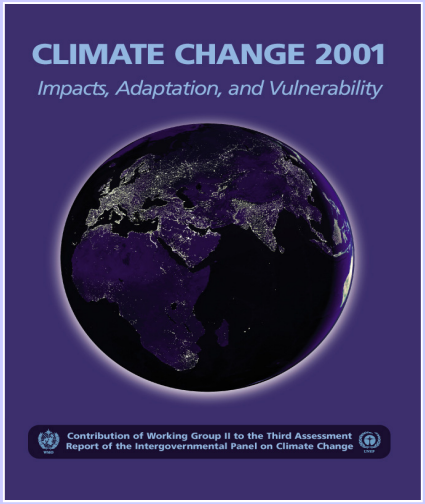
The Earth's climate is changing due to human activities and is likely to increase climate variability and the frequency of extreme weather events

Climate change is projected to adversely affect water quantity and quality, agricultural production, human health, human settlements and biodiversity and ecological systems in most developing countries

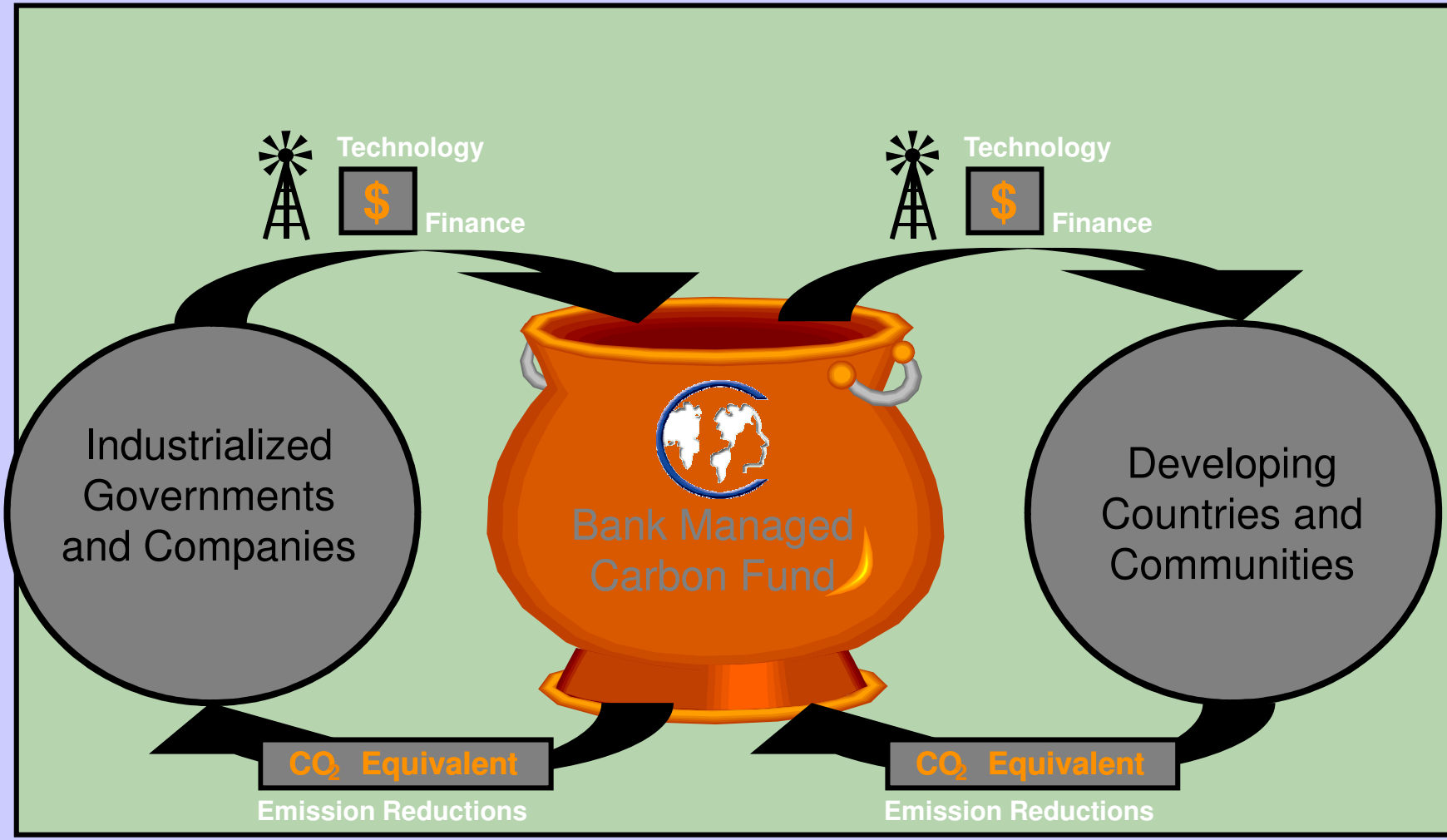
Many sectors in developing countries are already vulnerable to current climate variability.

Potential climate change impacts are more important to developing countries than mitigation

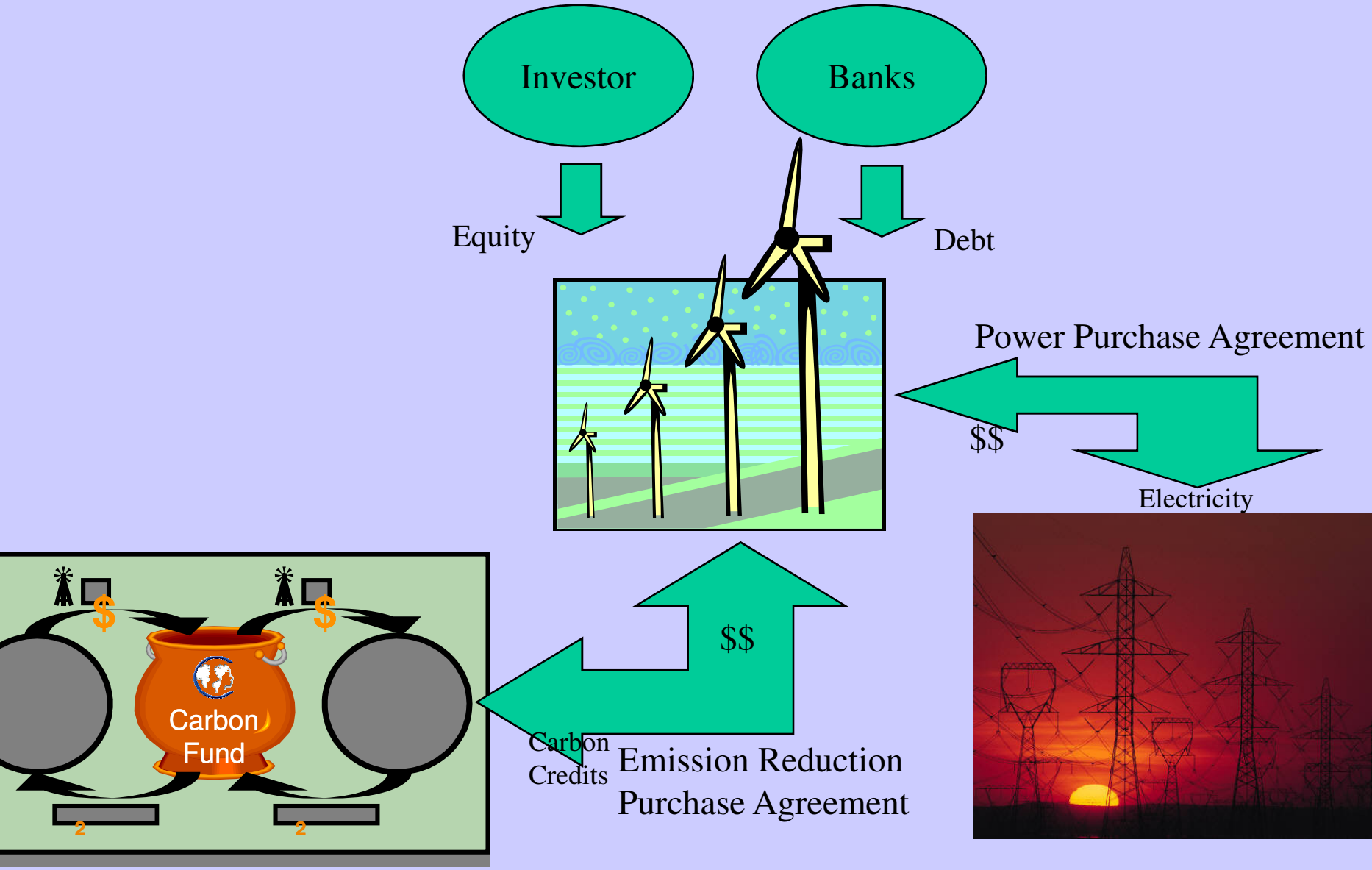




How Carbon Funds Work



Nature of Carbon Financing Contract



World Bank Carbon Finance Products

Total funds under management (Jan. 31, 2005): $865 million

Prototype Carbon Fund.

- $180 million;
- Multi-shareholder (17 private and 6 government/ public sector)

Community Development Carbon Fund

- First tranche closed on January 15, 2005 at $128.6 million;
- Multi-shareholder: 15 private sector, 10 government/ public sector

BioCarbon Fund

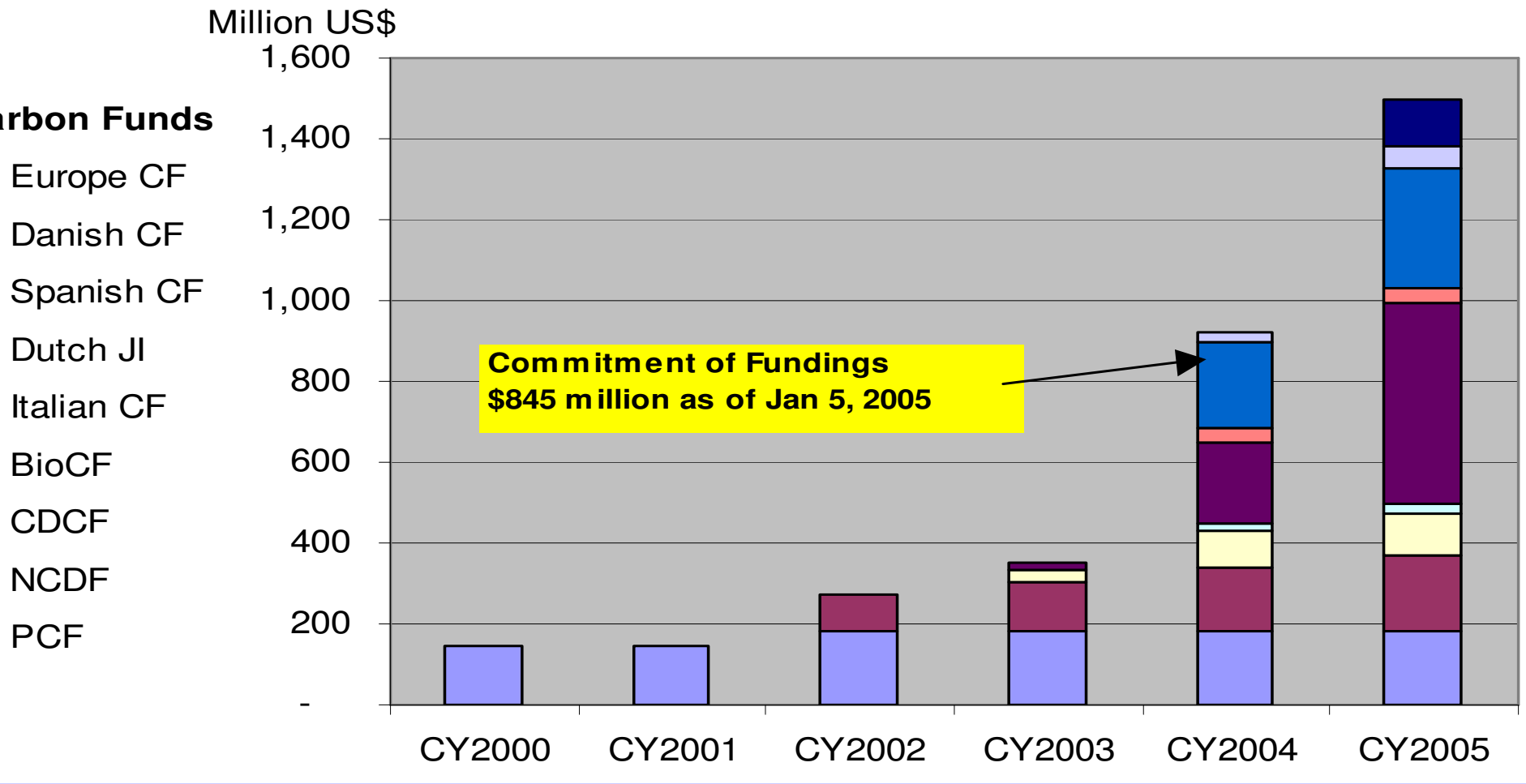
- Currently $51.3 million; multi-shareholder
- Expected to close for subscription by end of June 2005

Netherlands Funds (€ 180 million)

- € 132 million ($170 million) for CDM
- € 55 million ($70 million) for JI jointly with IFC

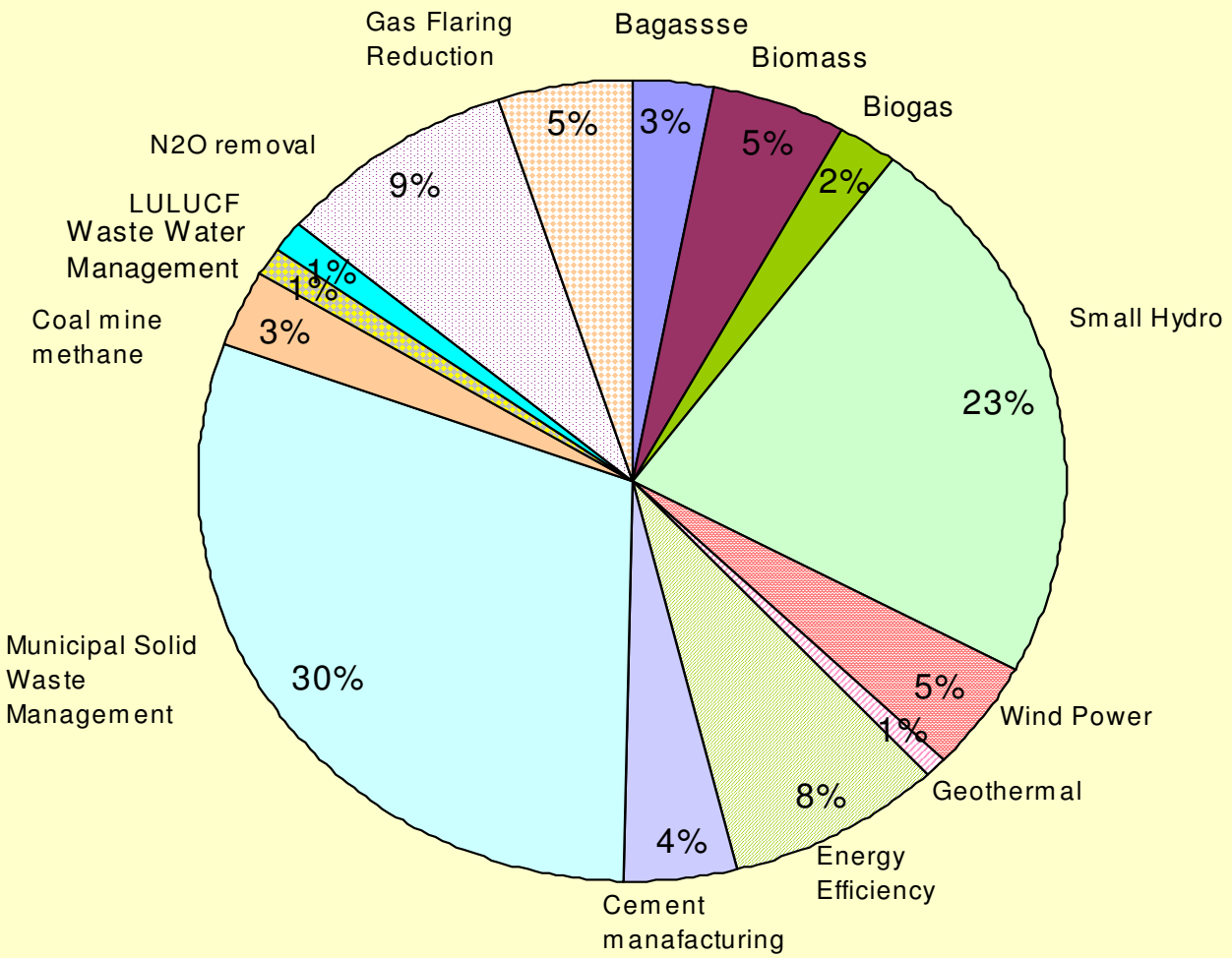
- Current level: $65 million from Italian Government
- Expected to exceed $200 million; Italian Multi-shareholder

Evolution of World Bank Carbon



80% of funds are from governments (non-ODA)

TECHNOLOGICAL DISTRIBUTION OF ACTIVE PIPELINE PROJECTS
(Total Approx. US$544 million with indicative purchase of 134 Million tons of CO2e for 106 projects as of Nov 2004)



Italian Carbon Fund: Main Characteristics

- ICF is a Trust Fund established at the request of the Italian Environment Ministry and administered by the World Bank
- Operative March 2004. Initial capital = $15M. Replenishment = $60M by February 2004. Total capitalization at mid-2005 = $75M.
- This amount may grow considerably over next two-three years
- Cost of ERs to Participants <$6/$tCO_2e$. First ERs expected 2005-2006
- Open to the participation of Italian private and public entities
- All Participants will receive a share of ERs *pro rata* to their contribution
- Minimum participation is $1M, payable in one tranche or in annual tranches over fund life (10-12 years)

www.carbonfinance.org

www.italiancarbonfund.org

Italian Carbon Fund

PCF Carbon Prices

Uganda small hydro (5&1.5 MW) remote area	$3.00
Chile: 25 MW hydro run-of-river	$3.50 [+option]
Brazil sustainable charcoal replacing coal/coke	$3.50
Poland District Heating Fuel Switch – Coal to Geothermal and Biomass	$3.50
C. America small wind/hydro	$3.50
Romania Afforestation	$3.60 [+option]
Colombia wind farm	$3.50 + 0.5
South Africa Durban waste management	$3.75 + 0.2
Czech small-scale energy efficiency	$4.00

Lessons from PCF: Benefits of Carbon Finance

- High quality cash flow reduces risk
- Increased cash flow boosts returns:

Technology	**ΔIRR (%)**
Energy Efficiency - District Heating	~2
Renewables	1 – 2 ½
Gas Flare Reduction	2-4
Biomass, MSW -- "methane kick"	>5

Contribution to project IRRs at $3/tCO2e

CDM Biomass Methodologies

- Reduce biomass burning through energy use (AM0004)
- Seasonal biomass use (AM0007)
- Biomass for grid connected electricity (AM0015)

- Biodiesel - India (not approved – NM0069)
  - LCA emissions (production, harvesting, processing)
  - Need to monitor consumption (baseline, leakage)
  - Domestic use: indirect benefits of reducing fossil fuel production, "shelf-life," additionality if exported
- Bioethanol – Thailand (changes req'd – NM0082)
  - LCA – assumes Brazilian estimates
  - Domestic use – verified by DNA
  - No enforceable mandate to use bioethanol
  - Other: % of blended fuels, non-transport

Bioethanol: Brazil is low-cost producer

- Center-South region of Brazil is by far the most efficient producing area for biofuel
  - Ethanol from sugarcane
  - Plentiful land
  - Excellent climate and soil
  - Good infrastructure
  - Functioning capital market
- Economic cost of ethanol production about US$0.20-0.25 per liter, or US$0.30-0.38 per liter of gasoline equivalent.
  - Makes ethanol competitive at today's oil prices

Biodiesel

- Rapeseed, soybeans
- At least US$0.50 per liter for production, and often higher
- Estimate of cost of biodiesel production from Jatropha US$0.40 (high byproduct prices)–0.50 per liter.
- Biodiesel much less competitive than bioethanol at this time

LCA - Bioethanol

Change in Lifecycle Greenhouse Gas Emissions per Kilometer Traveled by Replacing Gasoline with Ethanol in Conventional Spark Ignition Vehicles

Feedstock	*Location*	*Change*		*Source*
Wheat	UK	-47%		Armstrong and others 2002
Sugar beet	North France	-35%[a]	-56%[b]	Armstrong and others 2002
Maize, E90	USA, 2015	10%		Delucchi 2003
Maize, E10	USA	-1%		Wang and others 1999
Maize, E85	USA	-14%[c]	-19%[c]	Wang and others 1999
Cellulose, E85	USA, 2005	-68%[c]	-102%[c]	Wang and others 1999
Sugar, E85	Australia	-51%[d]	-24%[d]	Beer and others 2001
Woodwaste, E85	Australia	-81%		Beer and others 2001
Sugarcane, E10	Australia	1%[d]	3%[d]	Beer and others 2001

Note: Percentage changes are for neat ethanol unless indicated otherwise.

[a] Average

[b] Best case

[c] A range given in the study report

[d] Different assumptions about credits for by-products

LCA - Biodiesel

Change in Lifecycle Greenhouse Gas Emissions per Kilometer Traveled by Replacing Diesel with Biodiesel in Conventional Compression Ignition Vehicles

Feedstock	*Location*	*Change*	*Source*
Rapeseed	Germany	-21%	Armstrong and others 2002
Rapeseed[a]	Netherlands	-38%	Novem 2003
Soybeans[a]	Netherlands	-53%	Novem 2003
Soybeans[a]	USA	-78%	Sheehan and others 1998
Soybeans, 2015	USA	173%	Delucchi 2003
Tallow	Australia	-55%	Beer and others 2001
Waste cooking oil	Australia	-92%	Beer and others 2001
Canola	Australia	-54%	Beer and others 2001
Soybean	Australia	-65%	Beer and others 2001

[a] Only CO_2 emissions are considered.

Global carbon market and biofuels

- Assuming maximum of $15-20/t CO_2-eq over the coming decade
- Assume 100% GHG offset (20-80% likely)
- $0.01–0.05 per liter of biofuel
- Tax reduction for hydrous ethanol in Brazil is currently $0.18 per liter
- Tax reduction for biodiesel in Germany €0.47 per liter

Summary

- Bioenergy is a reality in developing countries and modern biomass energy should not be equated with liquid biofuels for transport
- Modern biomass can help reduce environmental impacts (IAP) and includes improved stoves, biogas, ….
- There is great potential for developing countries to make better use of existing biomass resources with existing technologies and prices, including solid, gaseous and liquid fuels.
- CDM can help make these investments more attractive. Work is needed to further develop biomass methodologies, including on life-cycle GHG emissions analysis.
- Liquid biofuels programs (historically from crops) must be aware of the potential impact on agriculture – freer trade and the reduction of OECD agricultural subsidies are needed in and of themselves and could benefit biofuels programs
- There is significant long-term potential for bioenergy using new feedstocks and technologies – research programs should be promoted in OECD countries and a handful of the largest developing countries