A CDM PERSPECTIVE ON COGENERATION IN SOUTH AFRICA

Alistair McMaster
PURE CARBON AFRICA

Co-Generation in South Africa

pure
carbon services

ESKOM definitions and classes of Cogeneration projects:

	Type 1	Type 2	Type 3
Definition	Projects utilizing process energy which would otherwise be underutilized or wasted.	Primary fuel based generation projects which produce, as part of their core design, other usable energy in addition to electricity.	Renewable fuel based projects, where the renewable fuel source is both (i) a primary source of energy used for generation and (ii) a co-product of an industrial process

Source: Eskom 2007

Examples and current initiatives

pure
carbon services

- Type 1:
  - Projects utilizing waste heat from an industrial process as the primary energy source to generate electricity – Waste Heat Recovery Systems ("WHRS"); or
  - Projects utilizing waste or unused fuel, of a non-renewable nature, produced as a direct output of an underlying industrial process, as the primary energy source to generate electricity. e.g. projects burning waste flue gas to generate electricity

Examples and current initiatives

pure
carbon services

- Type 2
  - Primarily Combined Heat and Power ("CHP") projects where in addition to electricity the project produces consumable heat e.g. projects producing process steam or district heating type projects.

Examples and current initiatives

pure
carbon services

- Type 3
  - Projects utilizing fibrous waste as the primary energy source to generate electricity e.g. bagasse from the sugar industry, or forestry waste from the paper and pulp industry
  - E.G. Tongaat Hulett - Felixton, Amatikulu and Maidstone Mills, producing 9MW.

Examples and current initiatives

pure
carbon services

- Type 3
  - Project utilizing solid renewable waste as the primary energy source to generate electricity

Current National Initiatives

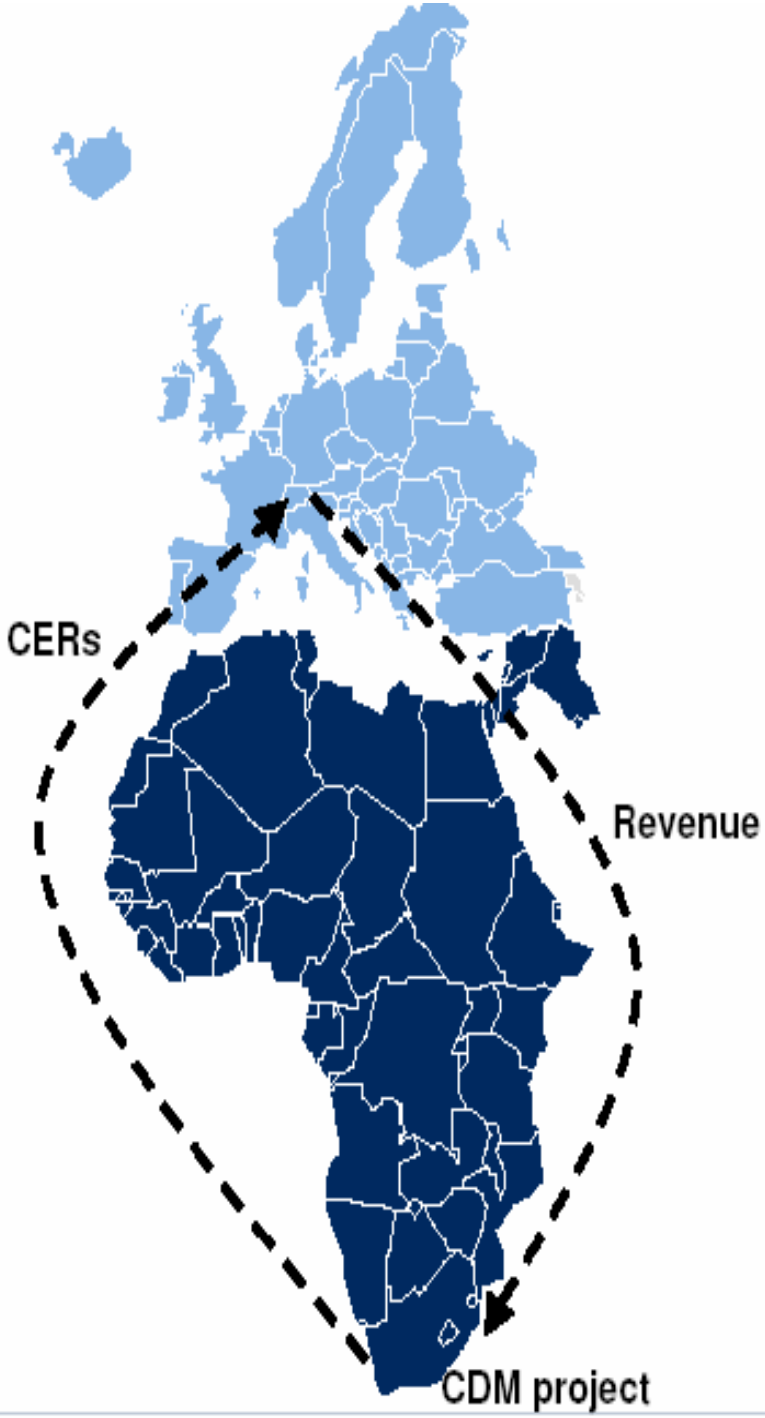
pure
carbon services

- ESKOM Pilot National Cogeneration Programme (PNCP) – suspended;
- Next Phase Cogeneration Programme – delayed until the commercial process for the PNCP has been concluded;
- REFIT PHASE II – generally excludes cogeneration.

COGENERATION & THE CLEAN DEVELOPMENT MECHANISM

pure
carbon services

The Clean Development Mechanism (CDM) is a GHG emission reduction trading scheme that is designed to improve the viability of projects, including cogeneration projects.



Carbon Trading is the Economic Mechanism for reducing GHG

pure
carbon services

Kyoto Protocol: Annex 1 countries have committed to limiting their GHG emissions in the2008–2012 period to a specified percentage of 1990 emissions

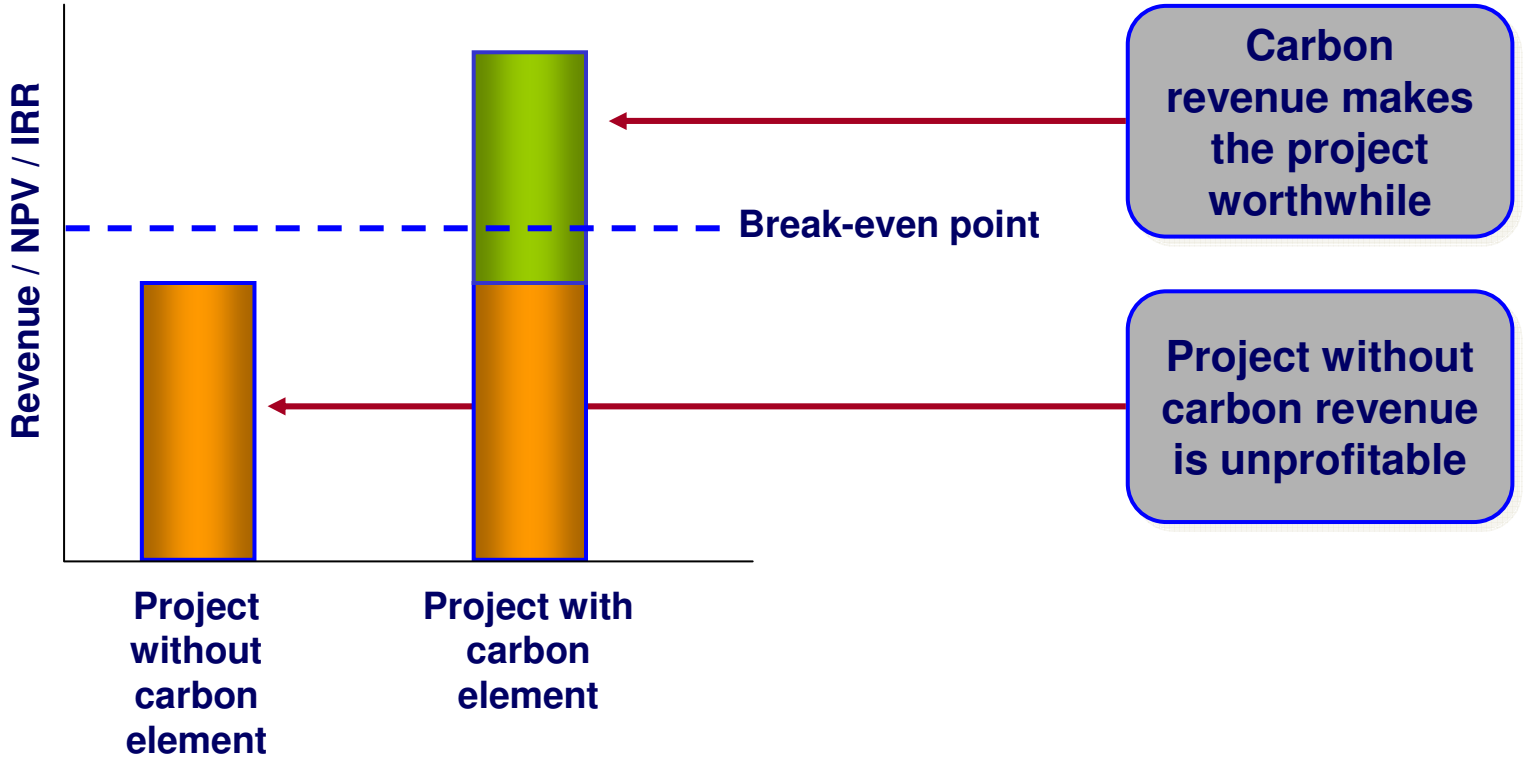
CDM ('Clean Development Mechanism') is an arrangement allowing industrialised countries to invest in emission reduction projects in developing countries as an alternative to more costly emission reductions at home.

CDM credits are called '**CERs**' and can be used to meet a country's cap

SA is signatory as a developing country

HOW DO CERs HELP PROJECTS?

CERs can fund between 10 to 40 % of project cost.



Carbon Credits are not some vast revenue stream, but rather they *can* be the cherry on top.

CDM Project Eligibility Criteria

pure
carbon services

1. Additionality (from the start)
    1. Financial
    2. Technological
    3. Common Practice
2. Sustainable Development
3. Methodology compliance
    1. Can a baseline be calculated?
    2. Is there a methodology that is acceptable to the EB?
    3. Can the departure from the baseline be measured and monitored.
4. The project must be auditable
5. You CANNOT claim CERs as an afterthought

CDM Methodologies and Cogeneration (Large)

pure
carbon services

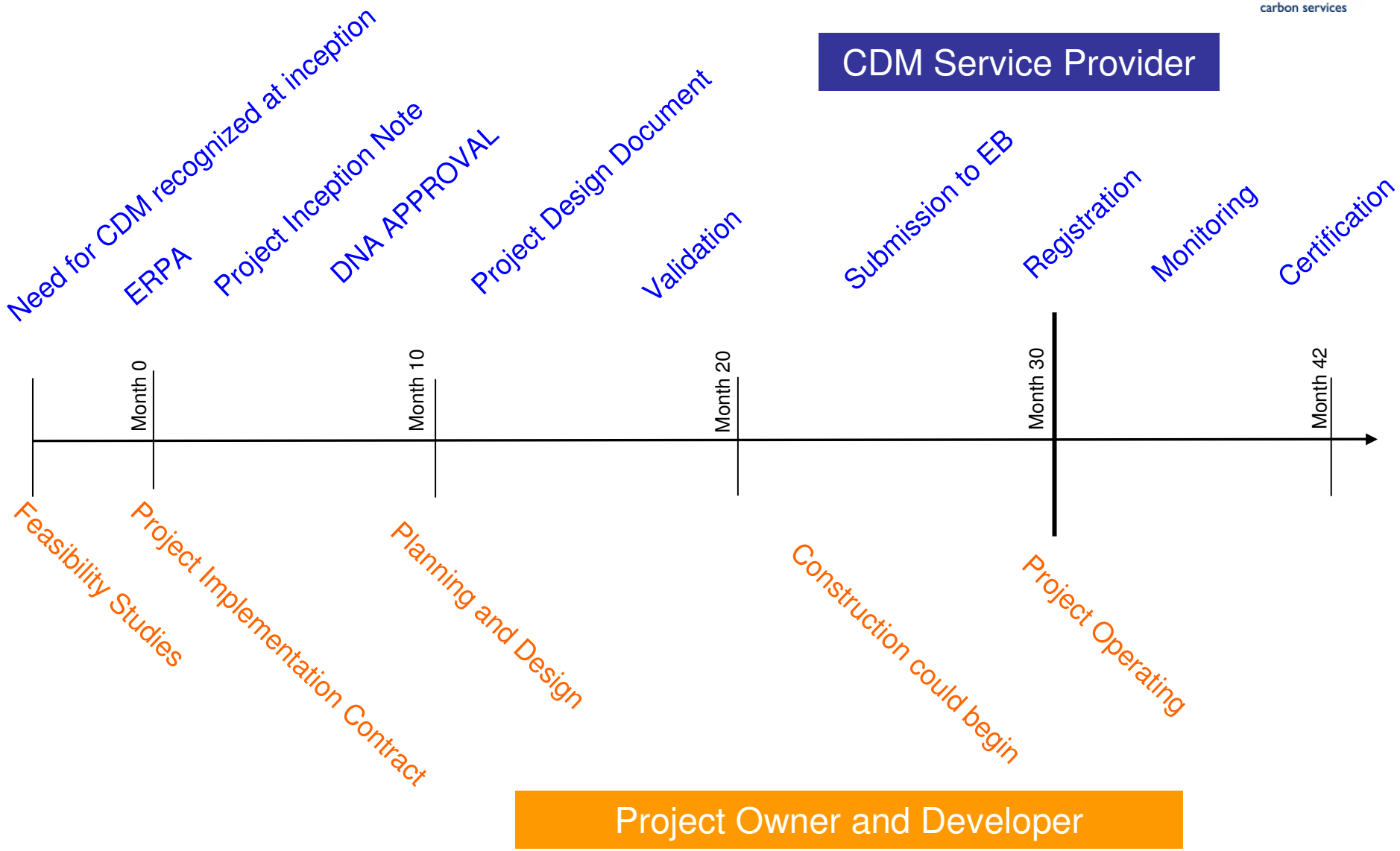
Type	Methodology Name	#
Biomass	Grid-connected electricity from biomass residues	276
Coal Bed Mine CH4	Coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat/or destruction by flaring	74
EE	Waste gas recovery and utilization for power generation at cement plant	32
EE	Recovery and utilization of waste gas in refinery facilities	4
EE (Supply Side)	Conversion from single cycle to combined cycle power generation	13
EE (Supply Side)	Natural gas-based package cogeneration	40
Landfill	Landfill gas project activities	206

CDM Methodologies and Cogeneration (Small)

pure
carbon services

Type	Methodology Name	#
RE (Type 1)	A. Electricity generation by the user	31
RE (Type 1)	C. Thermal energy production with or without electricity	345
RE (Type 1)	D. Renewable electricity generation for a grid	1585
EE (Type 2)	B. Supply side energy efficiency improvements - generation	23

The CDM Project Timeline



IS CDM MAKING A DIFFERENCE?

CDM International Status (as at 01/2010)

pure
carbon services

Status of CDM projects	Number
At validation	**2602**
Request for registration	58
Request for review	70
Correction requested	71
Under review	37
Total in the process of registration	**236**
Withdrawn	45
Rejected by EB	137
Rejected by DOEs	683
Registered, no issuance of CERs	1362
Registered. CER issued	623
Total registered	**1985**
Total number of projects (incl. rejected & withdrawn)	5688

CDM projects in the pipeline	All CDM projects in Pipeline		CDM project with CERs issued		
Type (rejected projects excluded)	Projects	1000 CERs	Projects	Issued kCERs	Issuance success
Hydro	1332	141866	127	14792	93%
Wind	830	75501	126	16150	83%
Biomass energy	656	42421	122	14915	87%
Methane avoidance	552	25902	55	5639	49%
EE own generation	455	58854	43	14008	81%
Landfill gas	279	42388	42	8349	35%
EE industry	136	4140	24	1112	82%
Fossil fuel switch	107	42212	20	3275	83%
N2O	69	49637	17	76065	125%
Coal bed/mine methane	68	39134	6	1886	49%
EE supply side	65	23298	6	389	78%
Reforestation	44	4231			
Solar	41	827	1	1	18%
Cement	31	6024	7	1203	69%
EE households	26	1102			
Fugitive	26	12126	2	4600	114%
HFCs	22	81715	17	200490	106%
EE service	18	229	1	4	61%
Geothermal	15	3440	4	654	37%
Transport	15	1836	2	201	42%
PFCs and SF6	14	4021			
Energy distribution	13	5219			
Afforestation	5	183			
CO2 capture	3	29	1	48	123%
Tidal	1	315			
Agriculture	0	0			
Total	4823	666651	623	363782	97.7%

STATUS OF CDM IN AFRICA

pure
carbon services

Africa	Number	kCER2012	
South Africa	30	19863	23.3%
Egypt	13	17161	20.1%
Uganda	11	1287	1.5%
Morocco	9	2582	3.0%
Kenya	14	2914	3.4%
Nigeria	7	27647	32.5%
Tanzania	5	2062	2.4%
Congo DR	4	794	0.9%
Mali	2	281	0.3%
Tunisia	3	4131	4.8%
Ivory Coast	3	1560	1.8%
Senegal	2	402	0.5%
Mozambique	1	111	0.1%
Madagascar	1	210	0.2%
Zambia	1	448	0.5%
Ethiopia	1	179	0.2%
Swaziland	1	252	0.3%
Rwanda	3	401	0.5%
Cameroon	2	556	0.7%
Liberia	1	215	0.3%
Cape Verde	1	340	0.4%
Ghana	1	1553	1.8%
Mauritius	1	231	0.3%
Equatorial Guinea	0	0	0.0%
Total	117	85182	100.0%

Source: UNEP Risoe Centre 2010

CDM in Africa

pure
carbon services

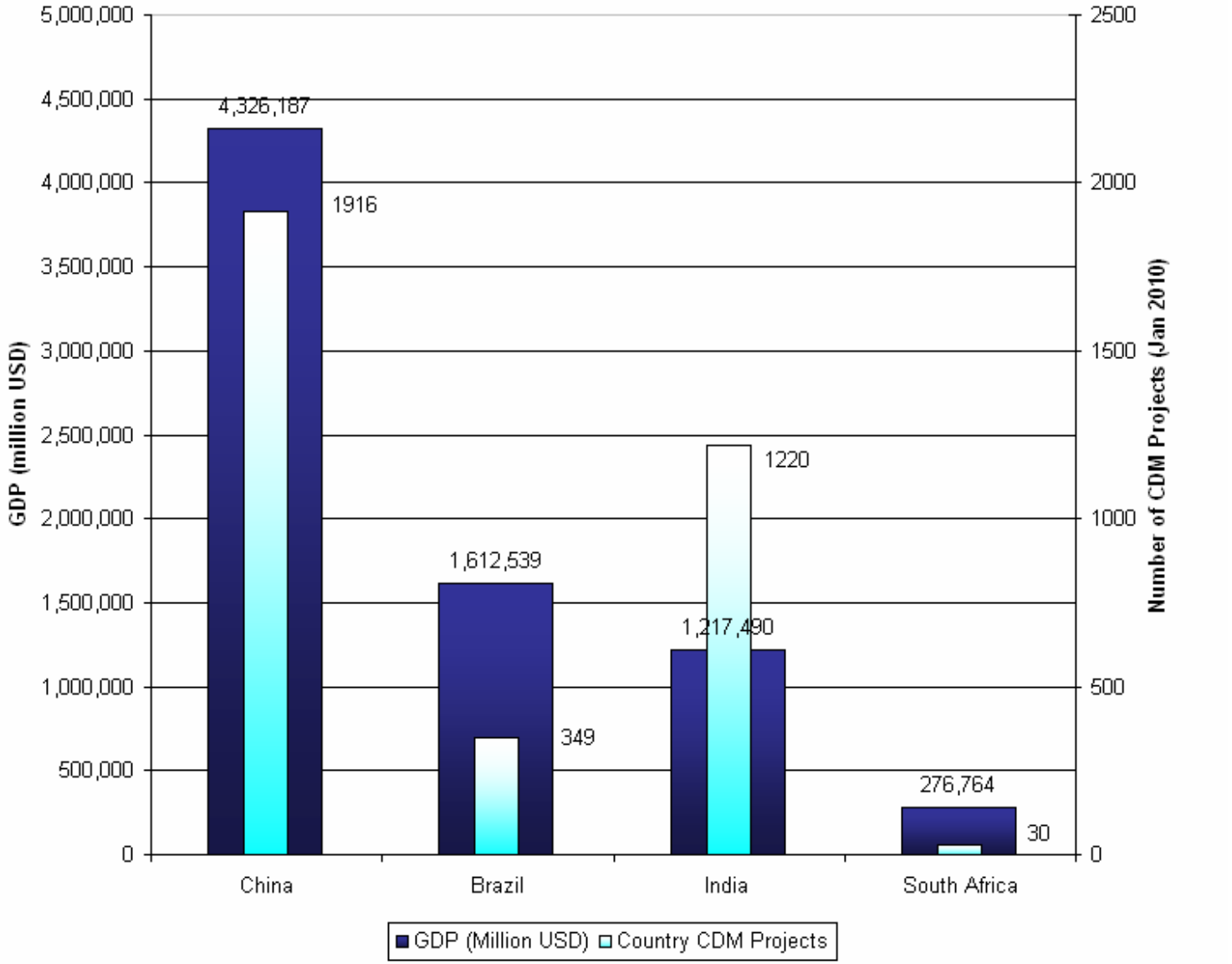
Africa	Number		kCER2012
Afforestation	2	1.7%	0.3%
Agriculture	0	0.0%	0.0%
Biomass energy	17	14.5%	6.8%
Cement	2	1.7%	6.7%
CO2 capture	0	0.0%	0.0%
Coal bed/mine methane	0	0.0%	0.0%
Energy distribution	0	0.0%	0.0%
EE households	4	3.4%	0.8%
EE industry	2	1.7%	0.6%
EE OwnGeneration	3	2.6%	0.8%
EE service	0	0.0%	0.0%
EE supply side	1	0.9%	0.1%
Fossil fuel switch	9	7.7%	5.7%
Fugitive	4	3.4%	23.7%
Geothermal	2	1.7%	1.5%
HFCs	0	0.0%	0.0%
Hydro	11	9.4%	5.0%
Landfill gas	22	18.8%	18.0%
Methane avoidance	4	3.4%	0.6%
N2O	5	4.3%	19.3%
PFCs and SF6	0	0.0%	0.0%
Reforestation	17	14.5%	3.7%
Solar	4	3.4%	0.7%
Tidal	0	0.0%	0.0%
Transport	0	0.0%	0.0%
Wind	8	6.8%	5.9%
Total	117	100%	100%

Source: UNEP Risoe Centre 2010

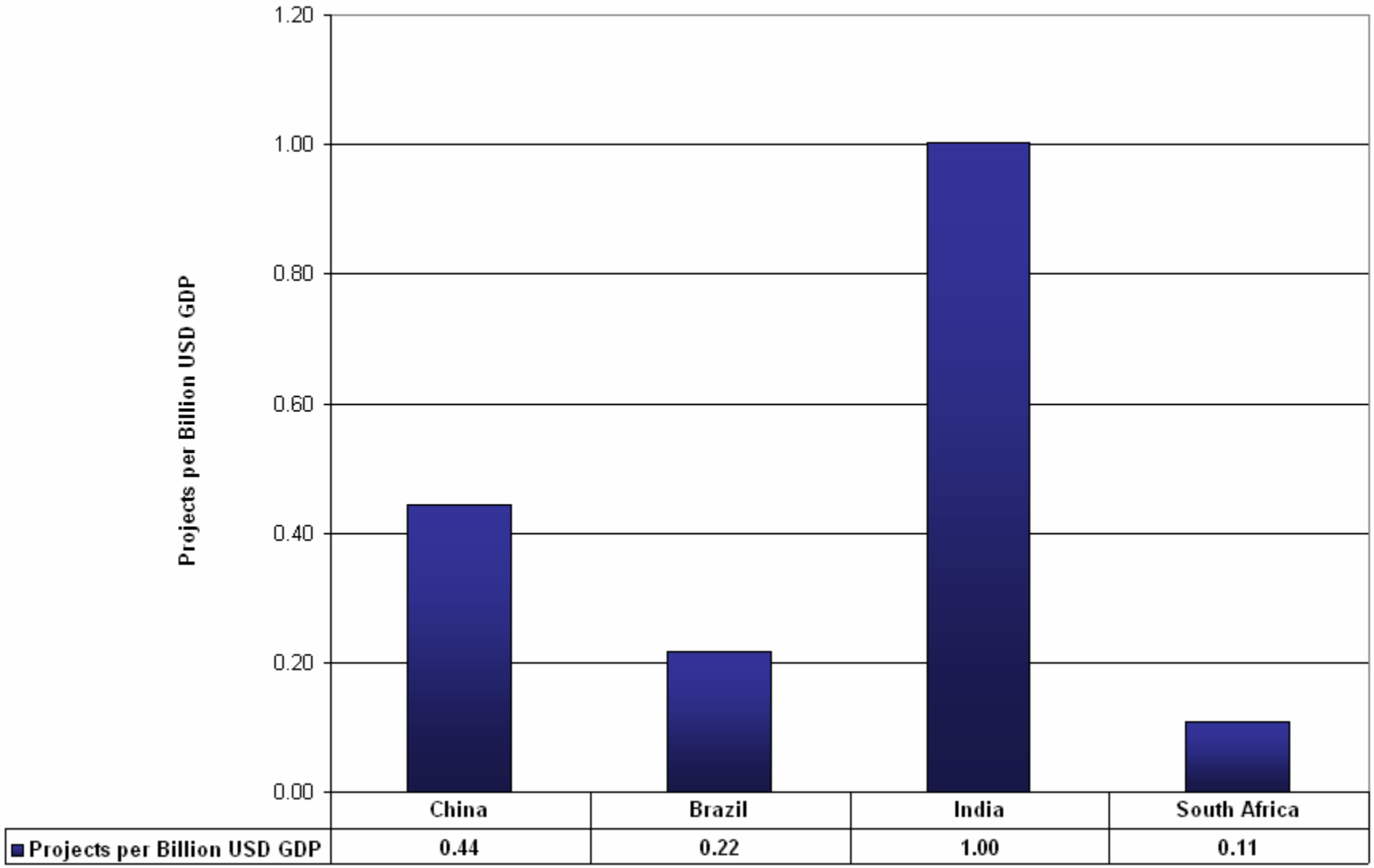
Title	Type	Sub-type	1st period $ktCO_2e/yr$	kCERs	Issuance success
Kuyasa low-cost urban housing energy upgrade project, Khayelitsha	EE households	Lighting & Insulation & Solar	6.6		
Rosslyn Brewery Fuel-Switching Project	Fossil fuel switch	Coal to natural gas	101		
Lawley Fuel Switch Project	Fossil fuel switch	Coal to natural gas	19	35	92%
Durban Landfill-gas-to-electricity project – Mariannhill and La Mercy Landfills.	Landfill gas	Landfill power	69		
Bethlehem Hydroelectric project	Hydro	Run of river	34		
PetroSA biogas to energy	Methane avoidance	Waste water	30	33	109%
Tugela Mill Fuel Switching Project	Biomass energy	Forest residues: other	56		
Omnia Fertilizer Limited Nitrous Oxide (N2O) Reduction Project	N2O	Nitric acid	473	505	115%
Durban Landfill-Gas project Bisasar Road	Landfill gas	Landfill power	343		
Mondi Richards Bay Biomass Project	Biomass energy	Forest residues: other	185		
Sasol Nitrous Oxide Abatement Project	N2O	Nitric acid	960	260	76%
Transalloys Manganese Alloy Smelter Energy Efficiency Project	EE industry	Non-ferrous metals	55	223	133%
Project for the catalytic reduction of N2O emissions with a secondary catalyst inside the ammonia reactor of the No. 9 nitric acid plant at African Explosives Ltd ("AEL")	N2O	Nitric acid	117		
EnviroServ Chloorkop Landfill Gas Recovery Project.	Landfill gas	Landfill flaring	188	83	130%
N2O abatement project at nitric acid plant No. 11 at African Explosives Ltd. (AEL), South Africa	N2O	Nitric acid	265		
Kanhym Farm manure to energy project	Methane avoidance	Manure	33		
Alton Landfill Gas to Energy Project	Landfill gas	Landfill power	26		

Title	Type	Sub-type	1st period $ktCO_2e/yr$
The Capture and Utilisation of Methane at the Gold Fields' owned Beatrix Mine	Fugitive	Non-hydrocarbon mining	283
Ekurhuleni Landfill Gas Recovery Project	Landfill gas	Landfill flaring	282
Fuel switch project on the Gluten 20 dryer of Tongaat Hulett Starch Pty (Ltd) Germiston Mill	Fossil fuel switch	Coal to natural gas	8
Humphries Boerdery (Edms) Bpk, piggery methane capture and electrical generation	Methane avoidance	Manure	11
Karbochem Combined Heat and Power Project	Fossil fuel switch	New natural gas plant	234
Clanwilliam Hydro Electric Power Scheme	Hydro	Existing dam	11
Boskor Renewable Electricity Plant (BREP)	Biomass energy	Forest residues: sawmill waste	14
Southern Cape Cleaner Energy Project	Biomass energy	Forest residues: other	63
New England Landfill Gas to Energy Project	Landfill gas	Landfill power	54
Omnia Steam Turbine Project	EE own generation	Chemicals heat	18
Kloof #3 Ice Chiller project	EE industry	Mining	54
BioTherm Hernic Ferrochrome Cogeneration Project	EE own generation	Iron & steel heat	186
Buffalo City Landfill Gas to Electricity Project	Landfill gas	Landfill power	34

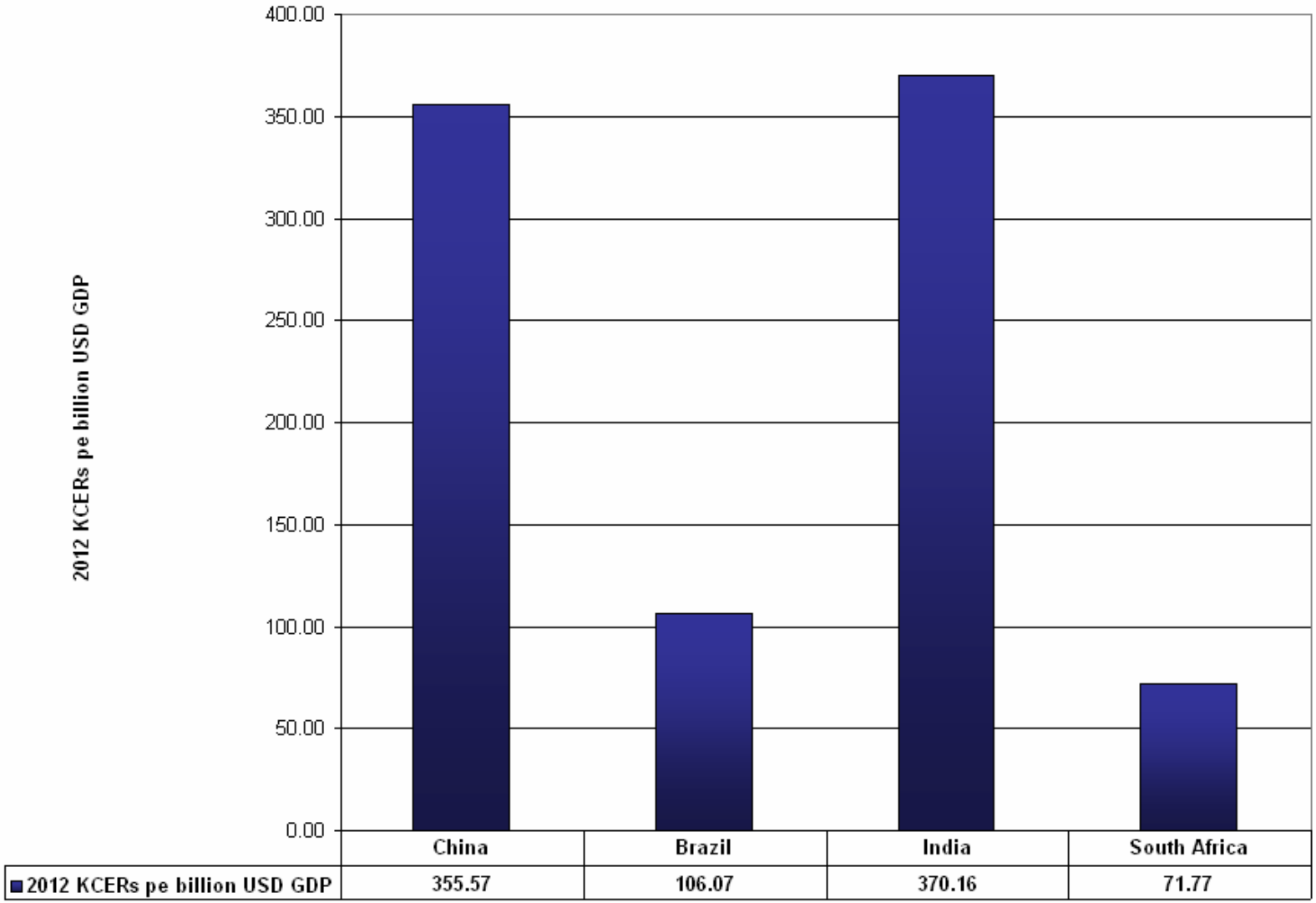
Comparative CDM performance: South Africa



CDM Projects per Billion US$ GDP



2012 KCERs per billion US$ GDP



Why so few cogeneration based CDM projects in South Africa?

Poor enabling environment in South Africa

pure
carbon services

- Technology Issues
- Financial Issues
- Institutional Issues
- Regulatory Issues
- EIAs
- Rigorous CDM Process
- Apart from renewable solid biomass, cogeneration has been excluded from REFIT I and II

Some Technology Issues

pure
carbon services

- No CC gas/steam turbines manufactured in South Africa (?).
- To date most IC gas engines are imported, but:
  - Are expensive given current electricity prices
  - May not be appropriate for local conditions; and
  - After sales service and support can be an issue.
- Locally produced hardware has yet to reach maturity, but promising future (also expensive).
- Limited supporting technology (flaring systems, continuous monitoring systems, remote field stations) and few integrated modules.

Locally manufactured technology: CAE

pure carbon services

Demonstration Project Piggery – Limpopo

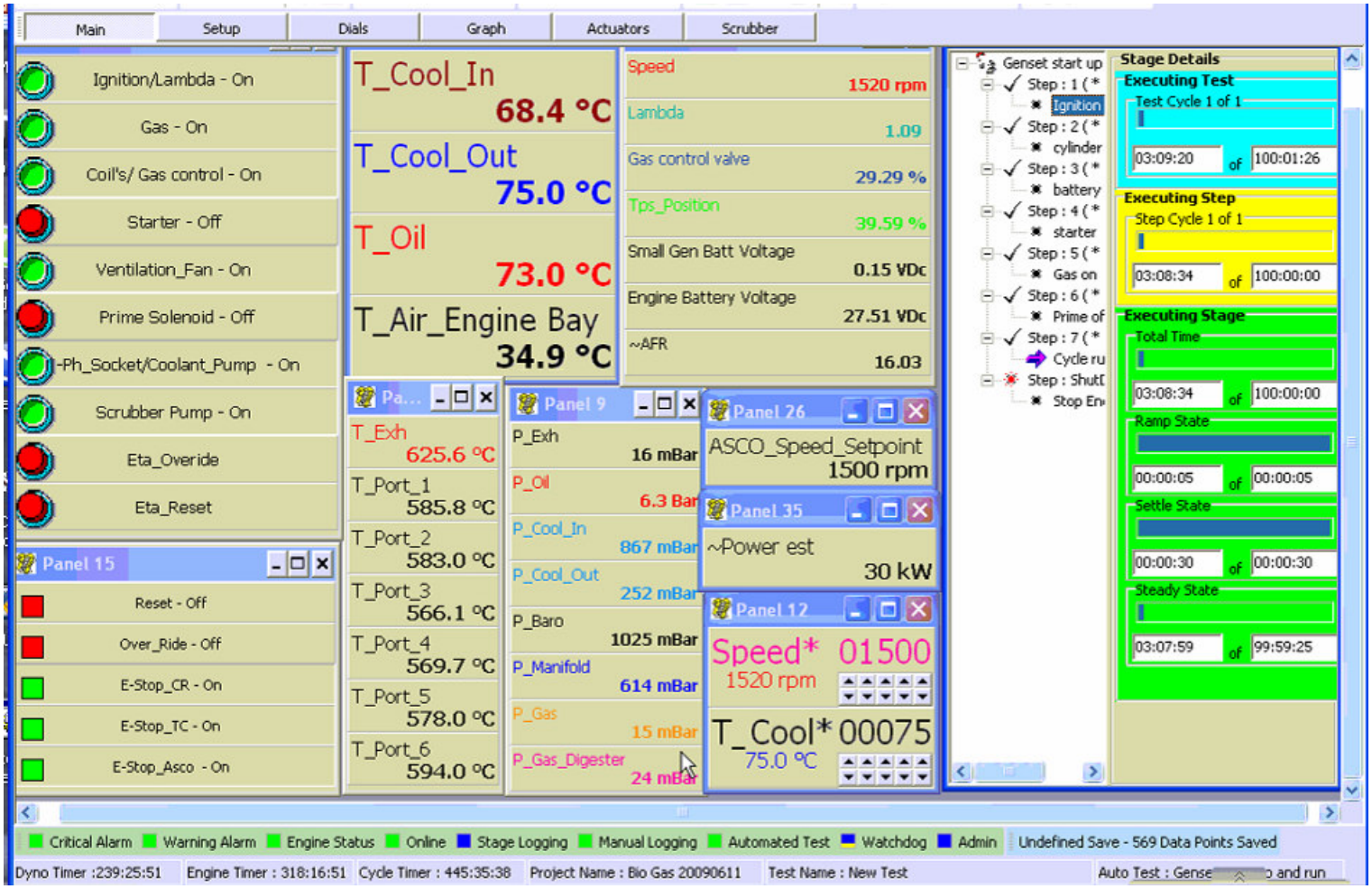
- **Continuous operation**
- **Remote monitoring & control**
- **Potential of up to 500 kW**

Locally manufactured technology: CAE

pure
carbon services

Remote Monitoring and Control

Emergency alarm automatic shut down; 24/7 monitor and remote control



Locally manufactured technology: CAE

pure
carbon services

Demonstration Project Piggery

Locally manufactured technology: EECO Fuels

pure
carbon services

Biomass Gasification for Cogeneration

Melani Biomass Gasification Project, UFHIT

pure
carbon services

- **First conceptualized among Eskom R&D, Eskom Development Foundation and UFHIT in 2000;**
- **System installed in 2007 by Carbo Consult (Pty) Ltd**
- **Situated at a sawmill in the Tyume River Valley, Eastern Cape**
- **Sawmill currently incinerates waste wood.**

System Specifications and Details

pure
carbon services

Current Status

- No grid connection;
- Waiting for delivery of a package bakery and grain mill to be driven by gasification system;
- kWh cost of running the plant and recovering investment far exceeds the R1.18 REFIT II guide for biomass RE (although this project would not be eligible in first place)

General Lessons Learned: Financing

pure
carbon services

- Public Finance
  - Highly bureaucratic and plenty of red tape;
  - Staff often have limited capacity to assess projects;
  - Problem complicated by high staff turnover, which often means that applications go back to square 1;
  - Each application must go through tiers of committees;
  - Decision by the agency can take up to two years.
- Private Finance:
  - More easily accessed, but high cost of borrowing.

General Lessons Learned: Institutional

pure
carbon services

- Issues around Power Purchase Agreements;
- No codes and standards for grid tie-in and transmission/wheeling agreements. Very poor enabling environment;
- Regulatory environment for Independent Power Producers is still in infancy; NERSA appears to be feeling its way;
- To date, Eskom has been both player and referee (Renewable Energy Purchasing Agency (REPA) housed in Eskom); and
- Electricity in South Africa has traditionally been cheap, while REFIT still to be rolled out.
- All eyes on Independent System Operator (ISO)

NERSA Licensing Requirements – a laborious process

pure
carbon services

- NERSA permits IPPs to sell power directly to entities willing to buy renewable energy outside REFIT, provided that a generation license has been granted…
  - EIA – Record of Decision.
  - Power Purchase Agreement.
  - All other commercial agreements:
    - Fuel Supply Agreement (FSA);
    - Transmission Connection Agreement (TCA); and
    - Transmission Use of System Agreement (TUOSA).
  - Confirmation of inclusion in IRP/Ministerial approval for plant.
  - Financing arrangements.
  - Business Plan.

Environmental Authorisation

- National Environmental Management Act (1998).
- National Environmental Management: Air Quality Act (2004).
- National Environmental Management: Waste Management Act (2008).

Rigours of the CDM Process

pure
carbon services

- To date CDM has been a complex process which is difficult to navigate, and involves significant financial risk.
- 40% of applications are rejected after large amounts of money have been spent.
- Issuance is often not successful.
- Uncertainty about post 2012 means high financial risk.

National Energy Response Team Co-generation and Market Workgroup.

pure
carbon services

- Enabling Environment Programme -
  - Develop feed-in tariffs for cogeneration (COFIT)
  - Facilitate appropriate power purchase agreements (PPA) for buyers and sellers
  - Assess grid access conditions
  - Facilitate the finalization of cost recovery mechanism rules
  - Facilitate the creation of an Independent System Operator (ISO)

Cleared Alien Invasives as Biomass Sources

pure
carbon services

- Total condensed invaded area in EC: 438,387 Ha (Versveld *et al,* 1998);
- Biomass value @ +/- 50 tons Ha = 21,919,350 tons;
- Roughly equal to 10,959,675MWh electricity;
- Heavy infestations in Kei, Kubusi, Mthatha, Mzimvubu, Mzimtlava, Kaneka, Bira, Keiskama;
- Strong opportunity for decentralised, rural off-grid renewable energy hubs with LED and job-creation benefits.
- Possibilities of CDM PoA

PURE Carbon Africa (Pty) Ltd

E-Mail: mcmaster@purecarbon.de
Mobile: 072 813 0063
Tel: 043 737 4887

Web: www.purecarbon.de

PURE Carbon Group

Adresse: Mohrenstraße 34
D-10117 Berlin

E-Mail: office@purecarbon.de

Tel: 0049 (0) 17366 95662
Fax: 0049 (0) 30212 33886

Web: www.purecarbon.de