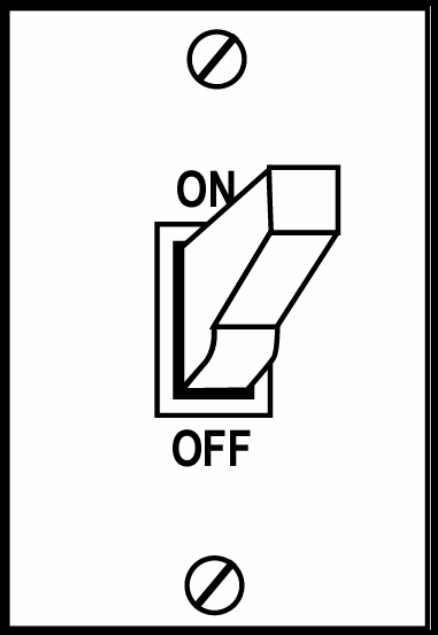

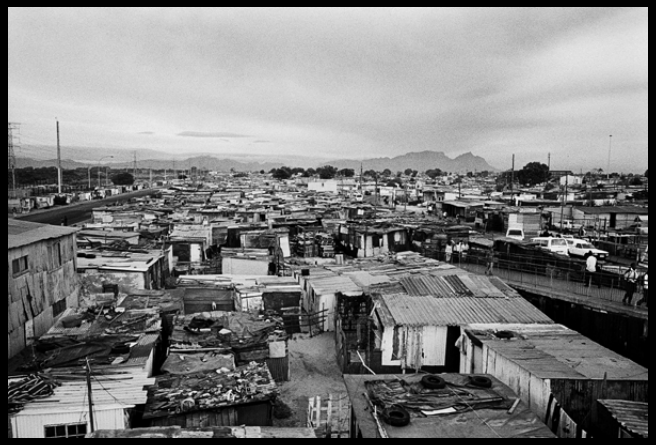

Potentials and Barriers Facing Demand-side Energy Efficiency Projects in Low-income Households under the Clean Development Mechanism, and the Way Forward for Programmatic CDM

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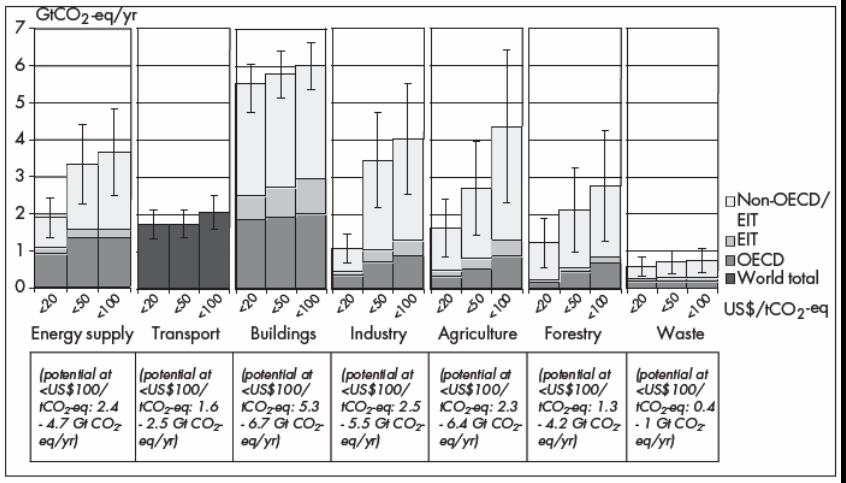
Large Potential for End-Use Energy Efficiency (EE) to Mitigate Carbon

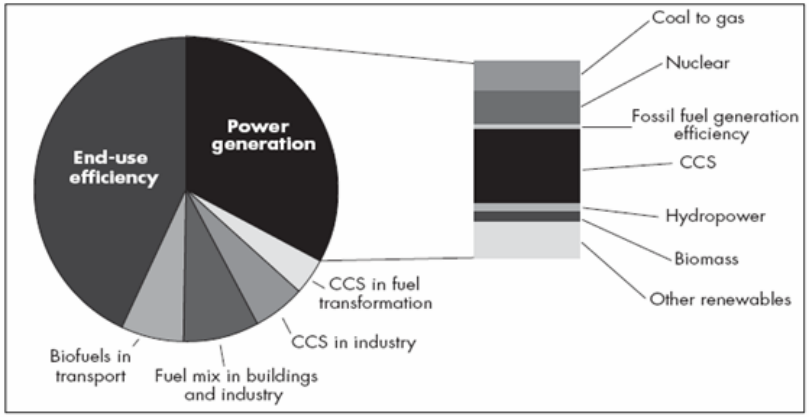
Improved end-use (demand side) EE is the most important contributor to potential reduced emissions

Figure 2: GHG Mitigation Measures – 2030



Source: IPCC 4th Assessment Report, WG.III, 2007.

Figure 1.1: Potential GHG Emission Reduction by Technology Areas – Scenario through 2050[2]



Source: IEA Energy Technology Perspectives 2006.

Possible Benefits of Household EE For Sustainable Development

- Reduced energy costs for residents
- Growth of electricity infrastructure with clean technology
- Improvement in local air quality
- Increased jobs on site

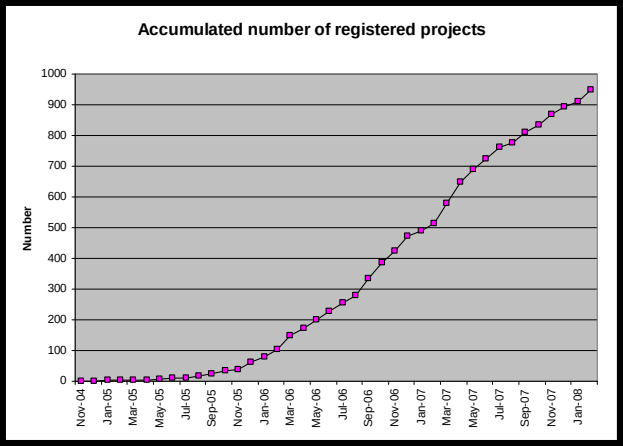
– Jane Ellis of the OECD

Clean Development Mechanism

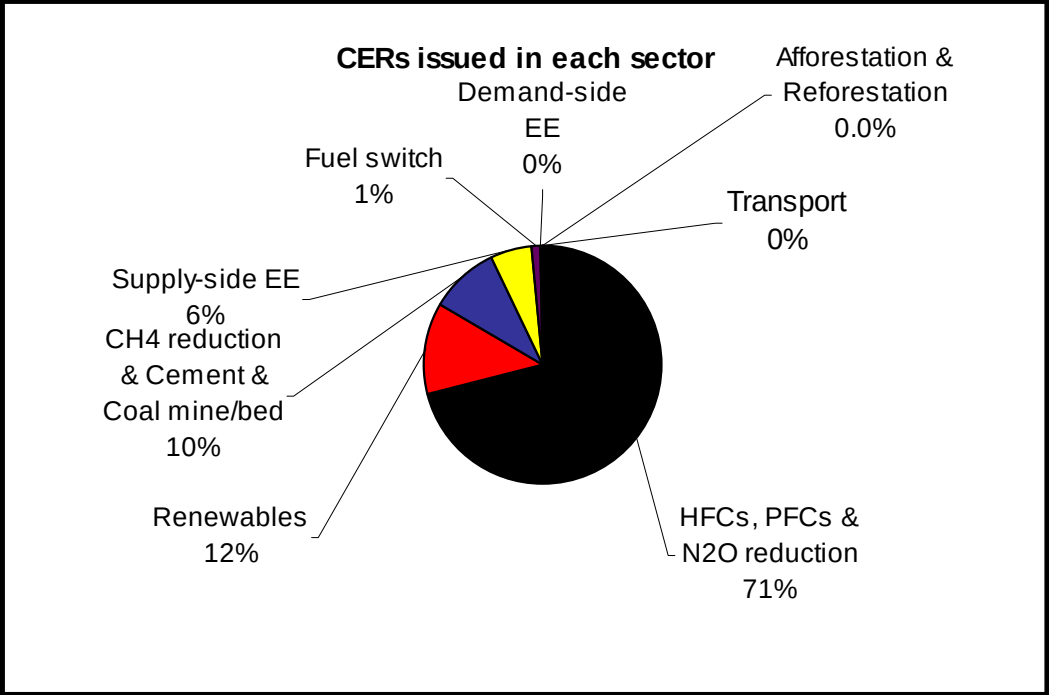
"The purpose of the clean development mechanism shall be to assist Parties not included in Annex I in achieving ***sustainable development*** and in contributing to the ***ultimate objective of the Convention***, and to assist Parties included in Annex I in achieving compliance with their quantified emission limitation and reduction commitments under Article 3." -UNFCCC, Article 12.2.,1997

- Current estimate worth of CDM pipeline = US $25 billion
- Large Market for Energy Efficiency
- $60 billion CER Market for Household Energy Efficiency

Its Growing ➔



The Dilemma: an Untapped Potential



Household and industry combined do not account for even 0.01% of the total CERs estimated within the CDM pipeline.

Household EE projects account for less than 0.3% of the projects in the CDM pipeline; while industry EE projects account for approximately 4.4%.

	EE Household	EE Industry
Number of projects	8	136
CERs	1226	28662

Research Question

- What are the barriers causing household energy efficiency projects to be such a small percentage of the CDM portfolio

- …and what then is the next step for household EE under the CDM to fix this dilemma

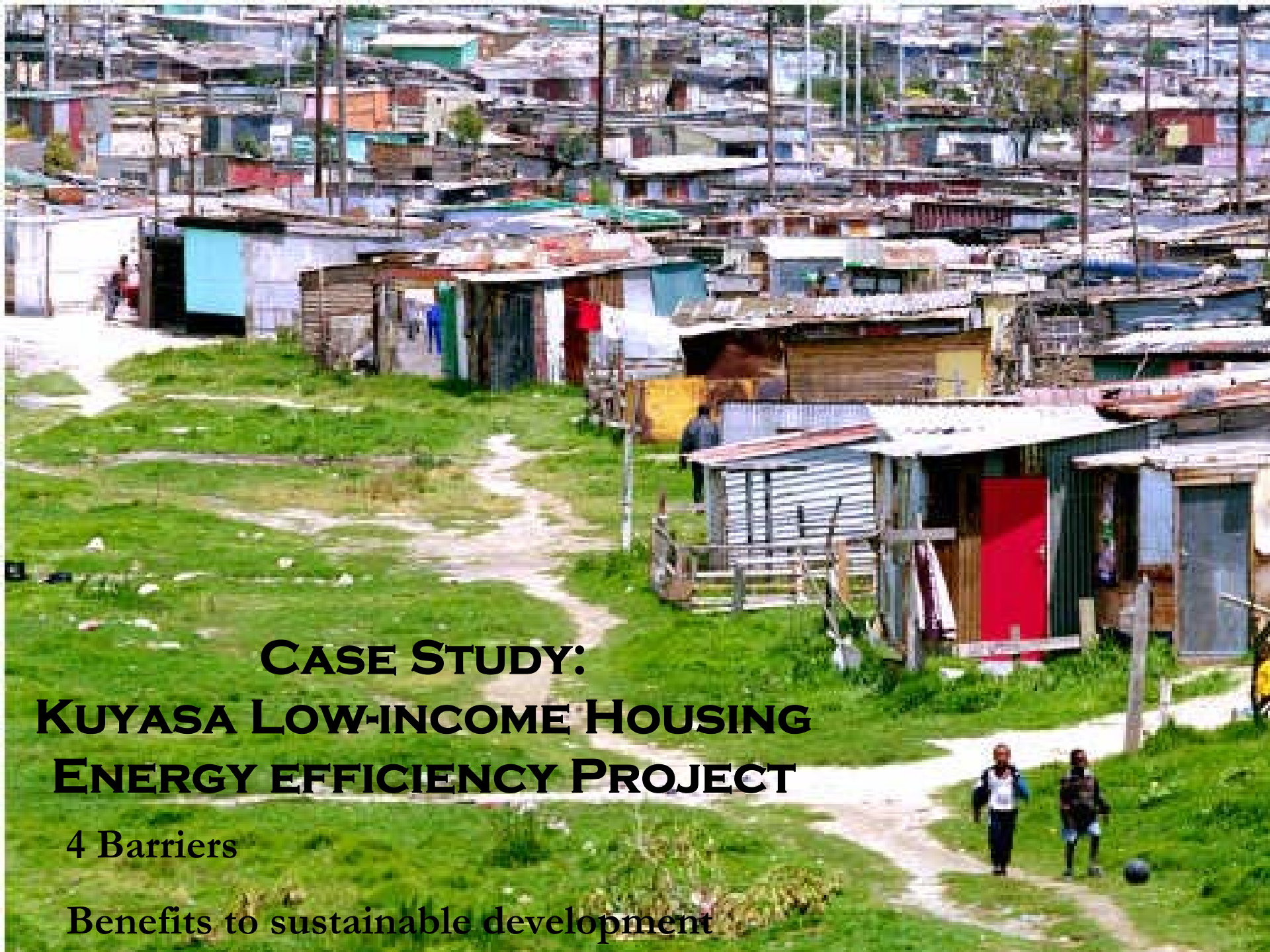
Research Methods

- Published literature and UN reports,
- Project design documents (PDD)
- Interviews
- Financial analysis

1) In-depth case study on the Kuyasa Gold Standard Project

2) Analysis of the 8 Existing Projects in the pipeline

- *Kuyasa Project, South Africa*
  - CFLs, Solar water heaters, ceilings
- *Salvador, Brazil*
  - CFL distribution and refrigerator replacement
- *Visakhapatnam, and Yamunanagar & Sonipat (India)* (2 projects)
  - CFL distribution CDM Project
- *Moldova* (2 projects)
  - Biomass Heating in Rural Communities Project
- *Kupang, Indonesia.*
  - Biomass cook stove replacement
- *Ghana.*
  - CFL distribution

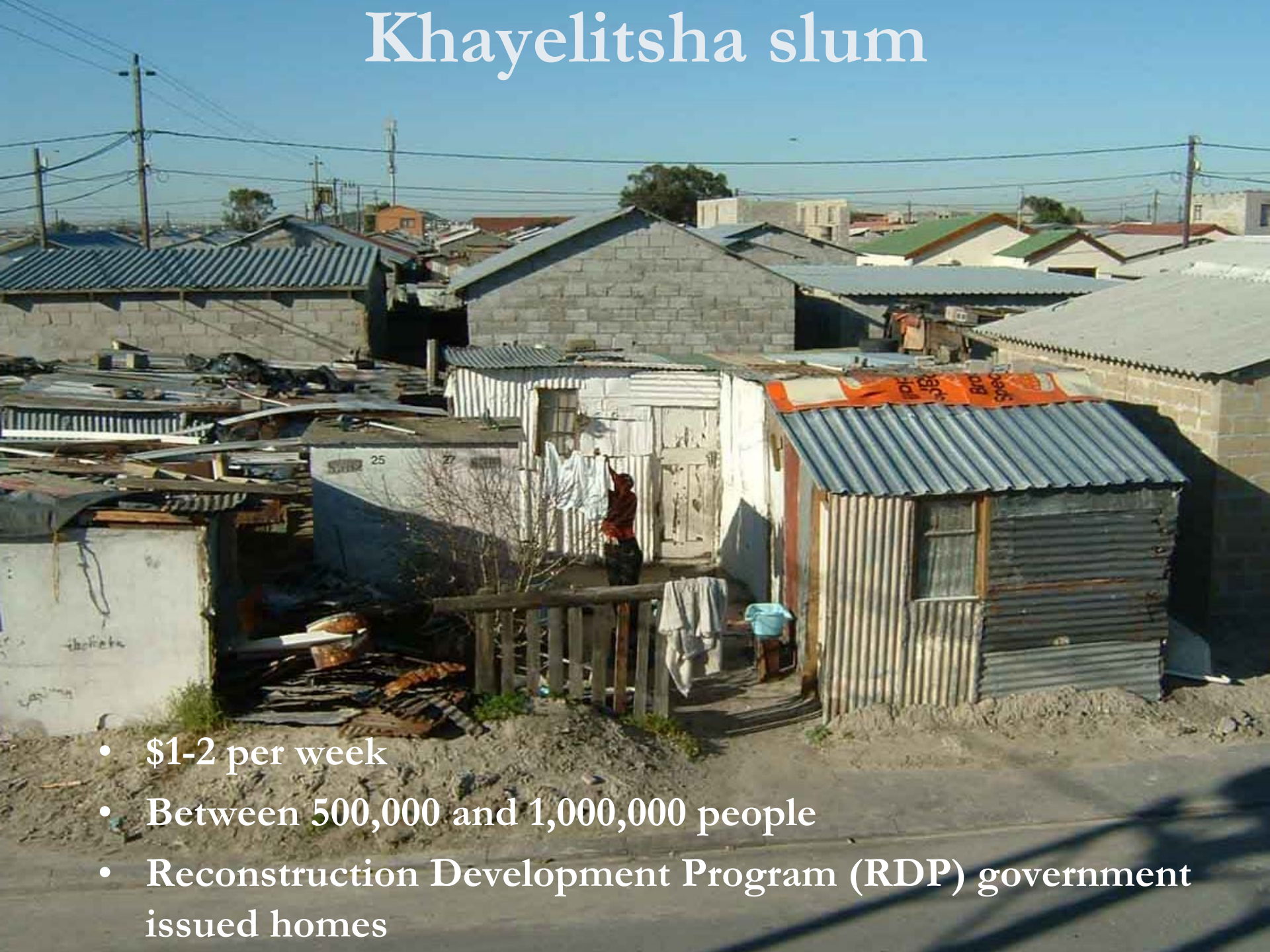


Case Study:
Kuyasa Low-income Housing Energy efficiency Project

4 Barriers

Benefits to sustainable development

Khayelitsha slum



- $1-2 per week
- Between 500,000 and 1,000,000 people
- Reconstruction Development Program (RDP) government issued homes

Kuyasa Energy Efficiency Project

- NGO, SouthSouthNorth, installs Solar hot water heaters, insulated ceilings, and CFL light bulbs in 2309 low-income homes in the Kuyasa neighborhood
- 2.85 tCO2e per household per year ; 21 years reduce 138,180 tCO2e total
- Won the Gold Standard Award
- Won Carbon's Best CDM Project at the Carbon Market Insights Conference, Amsterdam 2004
- Vienna-based Renewable Energy and Energy Efficiency Partnership called it a "model project for national replication"

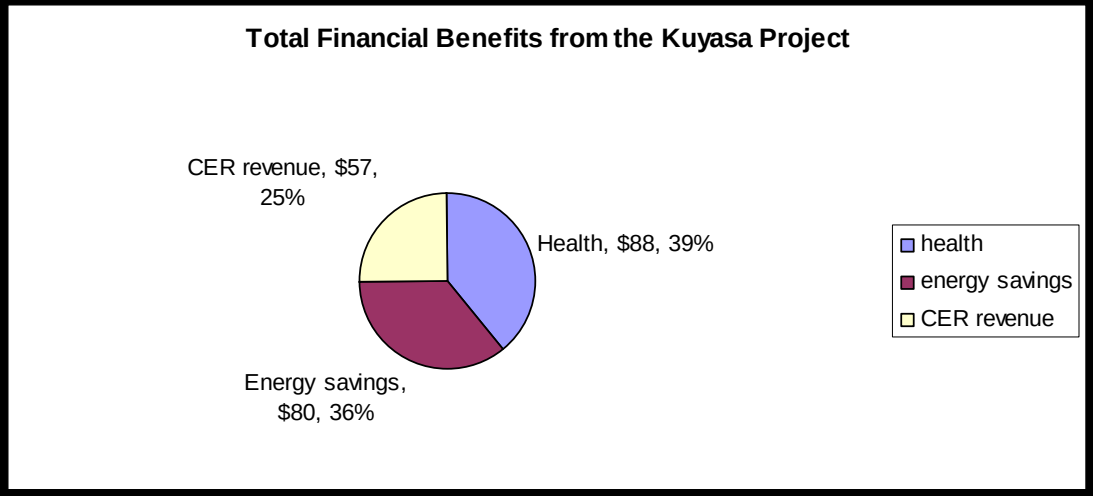
Sustainable Development, but a "Split-incentive Barrier"

Table 2.2: Financial benefits for residents

Cost per home for project developer	$771
Revenue for residents	
From electricity	$80
From Health	$88
Total per year	$168
Total over 21 years	$3,528

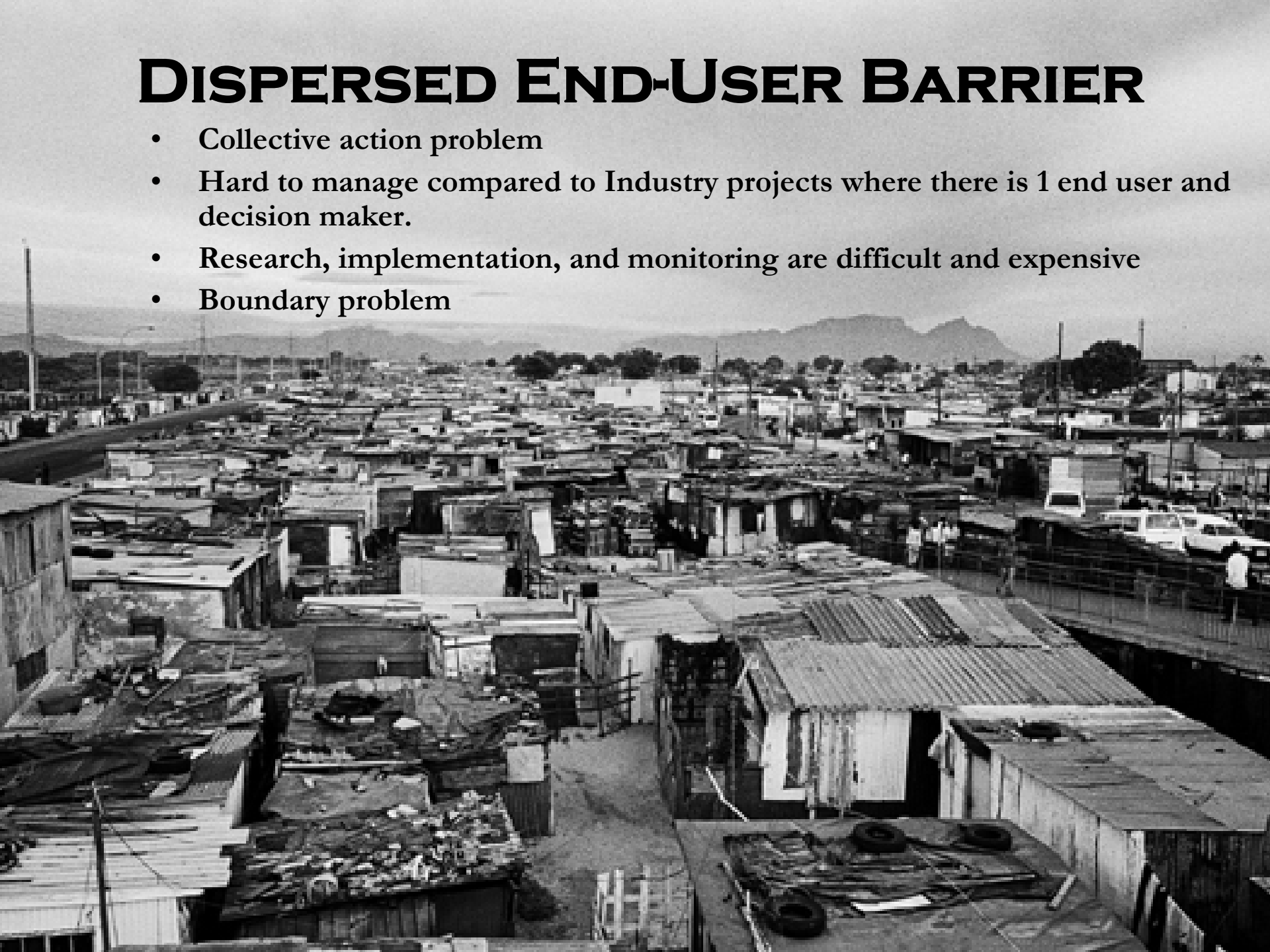
Net Profit from CER sales over project lifespan

Upfront Cost	
Per house	$771
Number of houses	2,309
Total	$1,780,239
Revenue	
Emissions reduction per household (CO2/hh/year)	2.85
Credit Price	$20
Revenue per household	$57
Number of households	2,309
Revenue per year	$131,613
Revenue over project lifespan (21 years)	$2,763,873
Net Profit	$983,634
Payback period	14
NPV of Revenue at 8% discount rate	$1,423,809
Net Profit at 8% discount rate	-$356,430



Dispersed End-User Barrier

- **Collective action problem**
- **Hard to manage compared to Industry projects where there is 1 end user and decision maker.**
- **Research, implementation, and monitoring are difficult and expensive**
- **Boundary problem**



Suppressed Demand

- When total energy expenditure goes down…consumption goes up.
- Net emissions are then difficult to anticipate without a pilot study
- Does not affect fraudulence, CERs are still awarded based upon the monitoring, but is essential for financial modeling
- CFLs are not affected by Suppressed Demand

Monitoring Barriers

- Dispersed end-user barrier
- Immature methodologies
  - 9 methodologies for all Demand-side EE
  - Kuyasa displays complexity;
- Prohibiting of Performance Based Monitoring
  - Each intervention must be monitored separately
  - The Pao de Acucar project in Brazil

Analysis of Existing Projects

Table 4.1: Comparison of Household EE projects conducted under the CDM

	Percent of emissions reduced from original baseline	Emissions reductions (tCO2/hh/year)
Refrigerators (Brazil)	55.4%	0.03
CFL (Brazil)	75.0%	0.013
CFL (Kuyasa)	77.6%	0.228
CFL (India)	75.0%	0.112
CFL (Ghana)	74.1%	0.055
Cook stove (Indonesia)	100.0%	1.49
Ceilings (Kuyasa)	19.4%	1.33
SHW (Kuyasa)	100.0%	1.29
Boiler improvement (Moldova)	43%	44.7

- Percent saved from baseline in comparison to total reductions
- Percent saved from CFL light bulbs is similar in many different nations because it is electricity based instead of fuel based.
- Most fit to be scaled and uniform across differing demographics

Financial Viability

Table 4.6: Project Comparison of Cost per CER Earned

Project	Total credits	Total Cost	Total price spent per credit
Coelba	14914	$9,400,000	$630.28
Kuyasa	138180	$1,780,239	$12.88
Ghana	11307	$355,422	$31.43
Visakhapatnam	488499	$4,229,337	$8.66
Yamunanagar & Sonipat	485395	$4,286,171	$8.83
Kupang 1	446250	n/a	n/a
Moldova	178884	$19,020,000	$106.33

- Kuyasa and the India CFL projects are the only financially sustainable projects in the face of the split-incentive barrier when CER price is approximately US $20

Scaling-Up

Table 4.5: Comparison of Visakhapatnam and Ghana CFL distribution projects

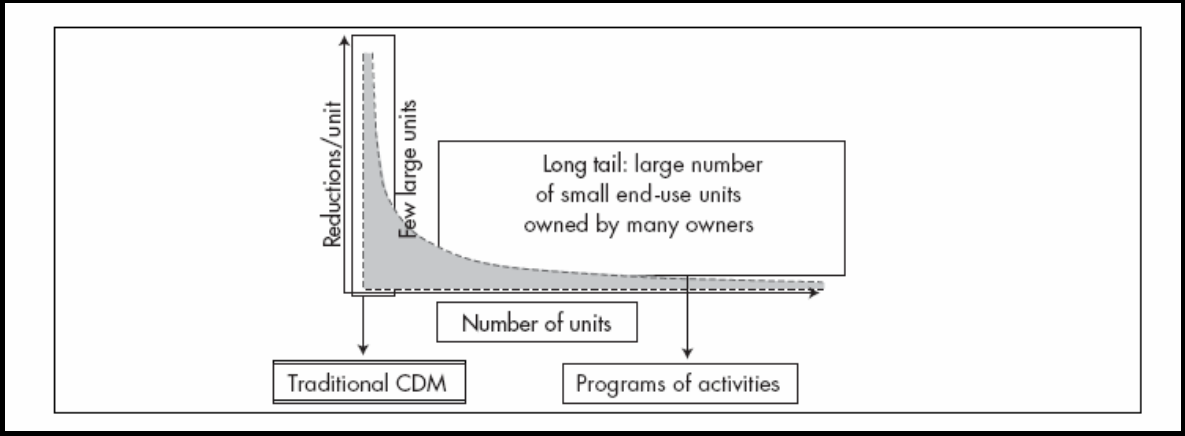
	Visakhapatnam	Ghana
Total price	$4,229,337	$355,422
CERs	488499	11307
Number of CFLs	870,000	45000
Cost per CFL	$4.86	$7.90
CERs per CFL	0.56	0.25
Dollars in CERs per CFL	$11.23	$5.03
Net Profit per CFL	$6.37	-$2.87
Net Profit for Project	$5,540,643	-$129,282

- Projects are more financially viable if scaled to a larger demographic
- Approximately half of the "difference" is from scaling-up, the other is from the fuel source.

Programmatic CDM

- Approved July 2007
- Open-ended group vs. a Closed group
- Includes "long-tail" emissions reductions
- Only 1 project currently in the pipeline
- Currently only 1 technology allowed

"Long-Tail" emissions reductions – Hinostroza et al.



Comparison of traditional and programmatic CDM

Traditional CDM projects: Visakhapatnam, and Yamunanagar & Sonipat (India)

Benefits

1) **Multiple CPAs can be included under 1 PoA, allowing supply to meet market demand, also reduces operational costs**
2) **Open-ended group instead of a closed-group reduces capital costs for baseline research.**
3) **Open-ended group participation creates higher cooperation with community.**

Problems

- **Volume of GHG reduction not required to be known at registration – thus cannot be used for initial financial modeling.**

What have we learned? And what are the solutions for the pCDM?

- Dispersed end users
  - pCDM open-ended group allows for a decrease in capital costs
  - The open-ended group creates easier access the dispersed end-users
  - The program system will inspire more community cooperation during the monitoring phase
- Monitoring
  - Monitoring is essential. For now, use technologies that are simplest to monitor
  - Performance based monitoring is superior but not allowed, also not currently applicable to pCDM
- Suppressed demand
  - Essential to calculate in all household EE projects.
  - CFL's not affected
- Split-demand
  - Scaling –up increases revenue
  - Combination of PDDs under the PoA allows small-scale to meet full market demand and reduces transaction costs
  - Open-ended group leads to minimized capital costs
  - Minimize costs, maximize revenue.
    - Means: More people, more efficiently.

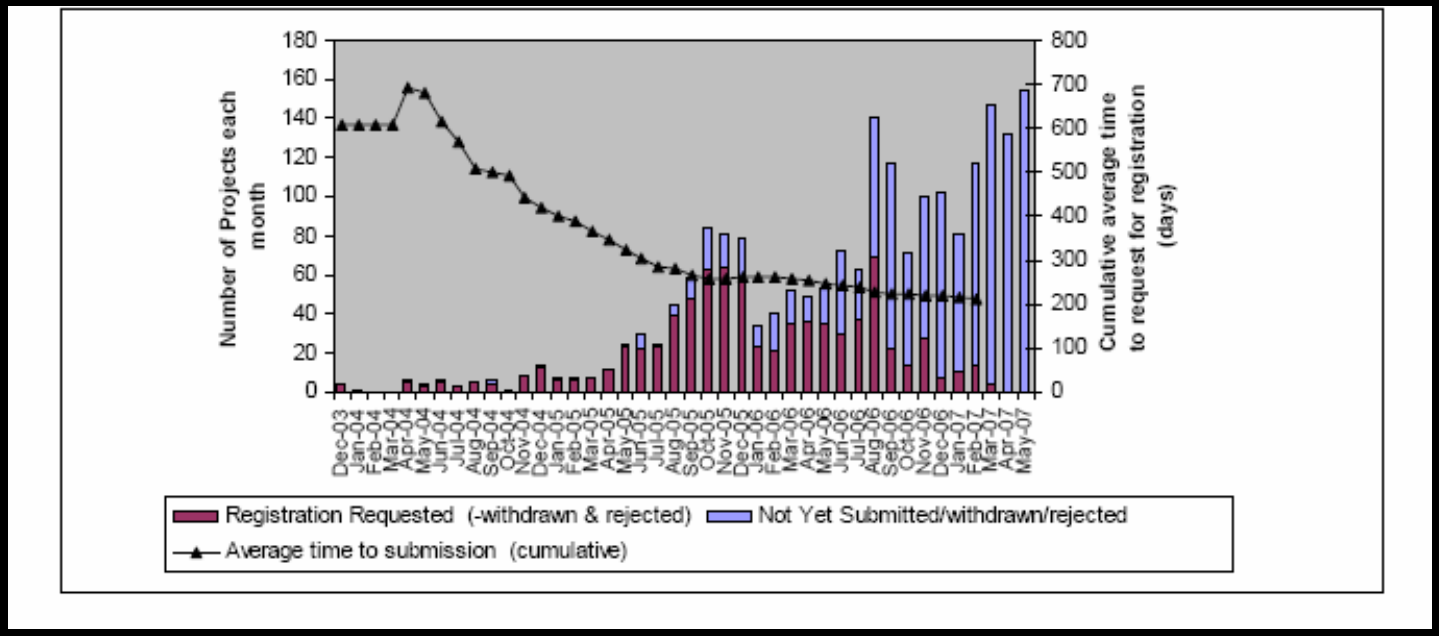
What have we established?

- There is a large market for household EE CDM projects
- Scaling up to reach a larger demographic helps to overpass the split-incentive barrier
- The open-ended group system of the pCDM is meant to help manage the dispersed end-user barrier.
- CFL distribution projects are the most financially viable without supplement funding.

What does this mean for the future of the pCDM?

It takes time

Time needed to request for registration



Recommendations

Known:

- pCDM is very new
- Will take a number of years to "work out the kinks"

Therefore, first -- attempt the projects with the least amount of variables so as to advance the pCDM system.

CFL distribution is the best "next step" for household EE projects in the pCDM because it has the highest chance of success.

Reasons

- Simple technology
- Most attempted projects in CDM this far
- Tested in a number of differing regions and demographics
- Easiest form of replacement and usage. Do not need a construction crew.
- Significantly easier to monitor compared to heating space and/or water because of its uniform supply.
- minimally affected by suppressed demand.
- can be expanded over large regions through the pCDM system.
- More financially viable when scaled to large demographics.

Conclusion

- CFL distribution is the next best step for the success of household EE projects in the newly formed pCDM
- Long-term goals are still to have full building retrofits and interventions that have more health and sustainable development benefits.
- At this time, the pCDM system must be "ironed out" with the easiest, most likely to succeed projects so that more complicated projects can be attempted in the future.