The Noflay Stove:

An Advanced, Low-Cost Clay Brick Stove

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REAP-CANADA
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Introduction

- REAP is working in the Gambian and Senegalese border area since 2004

- In West Africa:
  - Wood >90% of energy requirements
    - Deforestation
    - Soil erosion

Deforestation: Border area of Gambia/Senegal

Fuelwood Demands

- Fuelwood collection:
  – 2.3h/day by women in Wack Ngouna, Senegal

- Problems of deforestation and fuelwood collection
  → reduce fuelwood consumption
  → increase tree planting and protection

REAP Stove Experiences in West Africa Evolution

- **5000 Mayon Turbo Rice Hull / Groundnut Shell Stoves (MTS) (2004-2013)**
  - Well received but expensive ($20)
  - Lots of tending for the long cooking cycles of West Africa
- **250 Bucket Rocket Stoves (2005-2010)**
  - Well received but expensive ($15)
  - Somewhat undersized
  - Weak on longevity
- **2000 Noflay Clay Brick Stoves (2012-2013)**
  - $10
- **All these stoves were sold at a market price of $5 in rural communities**

Brick Stove Design Evolution

- **Local 24 Brick Rocket Stove (2010)**
  - Our first attempt at a low cost clay brick stove
  - Problems of excess air and no preheated air
  - Lack of clean combustion and low heat transfer
  - Walls vulnerable to being pushed out by heavy pots

Advanced Clay Stove Designs

- **Positive features of Esperanza and the Lion stoves**
  - Low excess air
  - Improved heat transfer
    - preheated and multiple entry sources for primary air

→ Best fit for Senegalese/Gambian households: Esperanza stove
  - A cultural and technological manufacturing leap
  - Expensive and material intensive to produce and transport

Objectives of Noflay Stove

Technical Issues

- Create a low cost design compared to existing metal or advanced clay stoves
- ↓ fuelwood consumption
- ↓ indoor air pollution
- Have good stove longevity

Social issues

- Have high cultural acceptance
- Promote local entrepreneurship and skill development
- Reduce drudgery on rural women

Original Noflay Prototype

- Produced September 2011 in Gambia
  - Used readily available housing bricks to prototype combustion chamber and shroud
  - Performance appeared promising
  - But using conventional bricks was a problem!

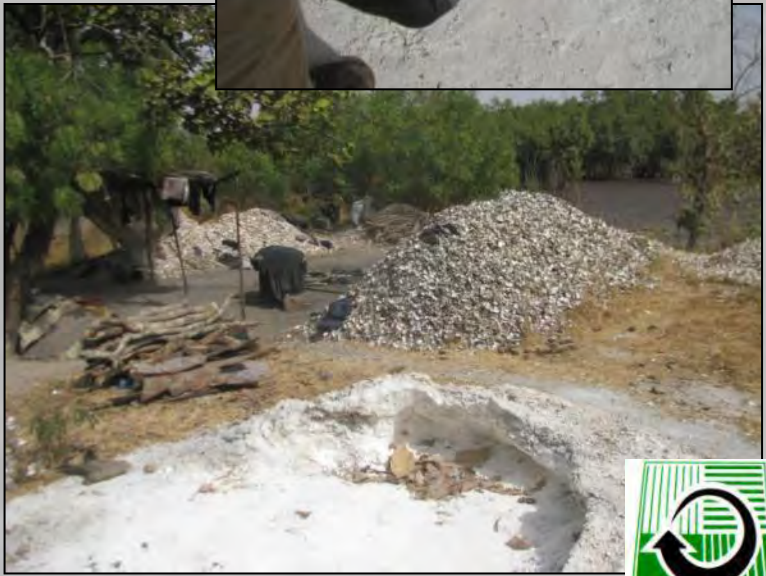
Combustion Chamber Brick Production

- The best high quality clay is sourced and the bricks are fired in a kiln

Shroud Brick Production

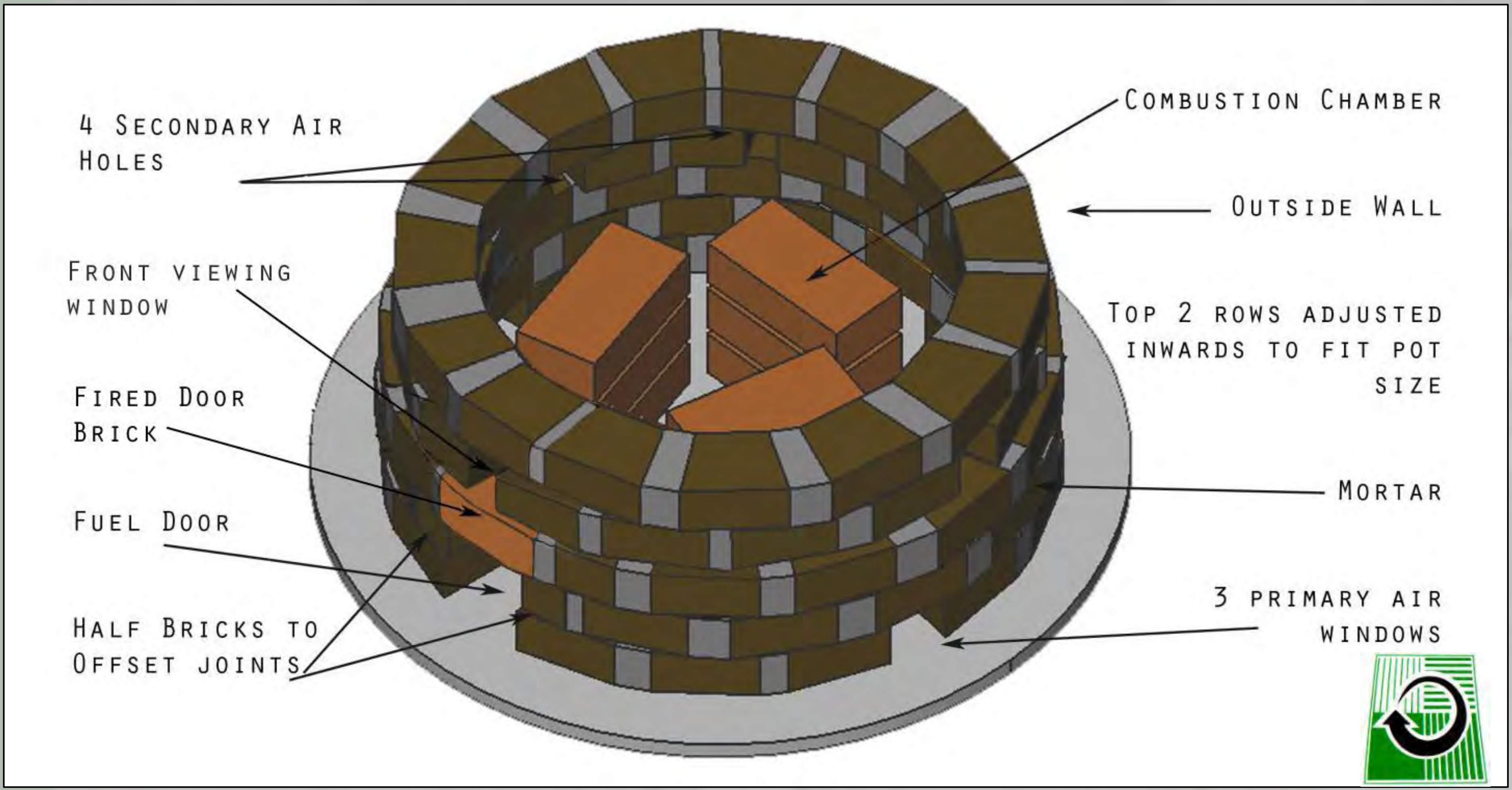
- 100% high quality clay or local clay and lime may be used





Noflay Design Evolution (Jan 2013)

- "Noflay" = 'convenience', 'easy' or 'no problem'



Element #1: Combustion chamber

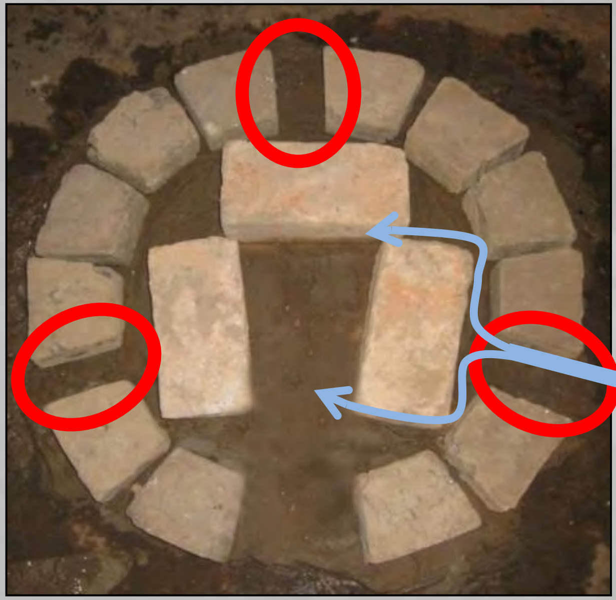
- Fired bricks (9 in total) stacked to 20 cm height
- Open triangular shape encloses the fire
  - Good flame formation
  - Good residence time
- Achieves high temperatures:
  - Incoming preheated air
- Provides a stable pot support

Element #2: Shroud

- Custom built to create a 1.5cm gap to the pot
- Unfired bricks used to save $
- Small front door minimizes cold air entry into the combustion chamber
- Viewing window to monitor the fire
- Is an excellent wind screen
- Provides outstanding safety

How is the Primary Air Preheated?

- Size of front door limited
- 3 primary air holes are non-aligned with combustion chamber and provides counter-flow
- Space between combustion chamber bricks allows air to enter
- Gap between shroud and combustion chamber allows air to preheat



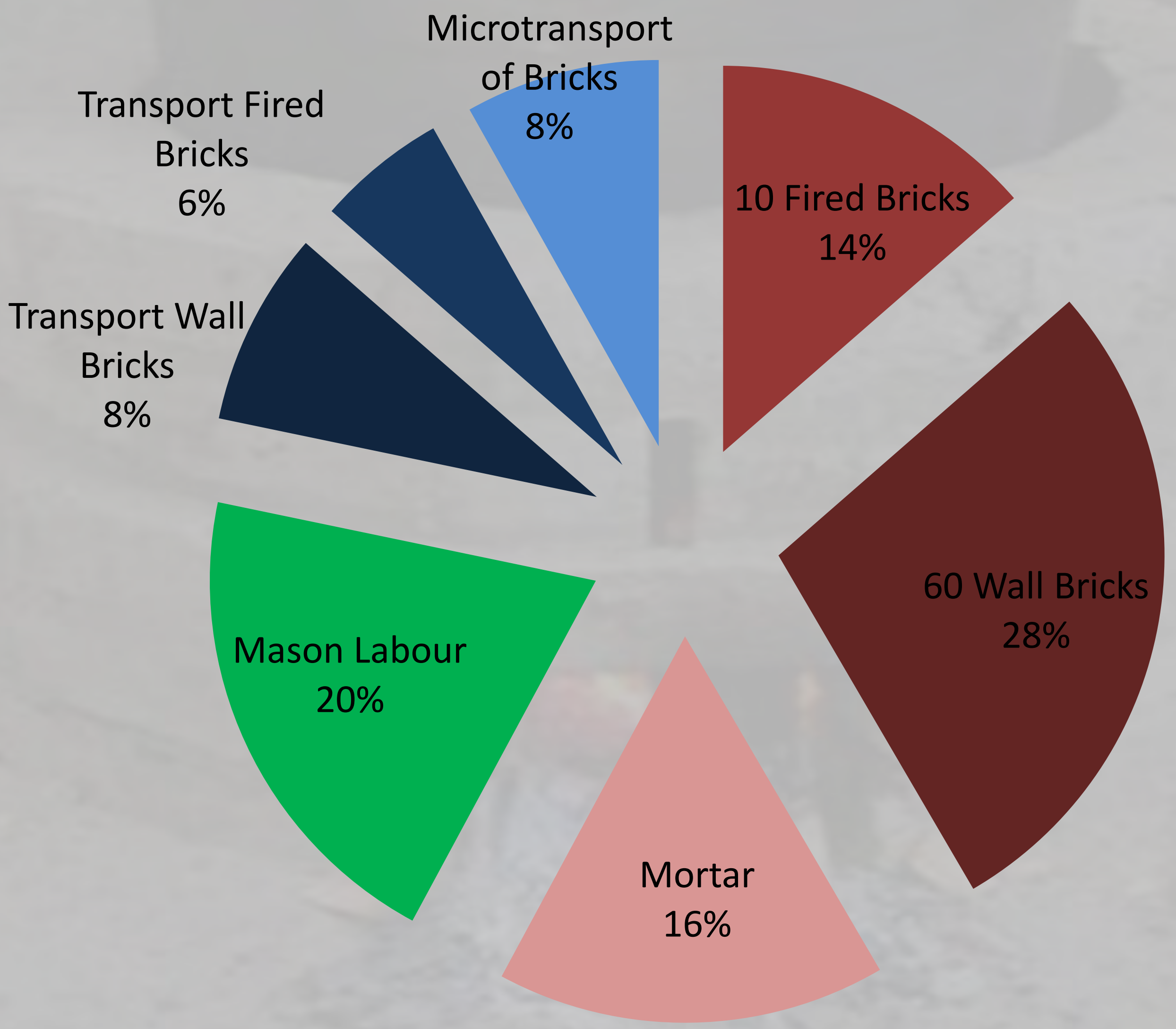
Secondary Combustion

- Air holes are created in the 4th row to allow for more complete burning of the gases

Preliminary Results: Cooking and Fuel

- Boils 5 liters of water in 17-20 min.
- Saves fuel (early feedbacking ~ ⅓ – ½ reduction)
- Can use much smaller pieces of fuel (shrub branches/bark)
- Low particulate load relative to 3 stone fire
  (“*no more tears in the kitchen*”)

Preliminary Cost Breakdown: ~$10



Training the local team

- Men and women farmers learn the brick making techniques rapidly and can produce ~200 bricks per day

- Best to use teams of local masons who can build 5 stoves per person per day

- Closely monitor the stove installations for creating correct gap and using good mortar mix

High Cultural Acceptance

- The cookstove is intuitive to use and easy to operate
- Fuel savings and wider fuel diversity greatly appreciated
- Speed, low tending requirement, low smoke and safety all commonly reported

Environmental Sustainability

- Reduces fuelwood consumption by 1/3rd to 1/2 thereby protecting landscape ecology

- Reduced particulate loading

- Low material consumption and all local natural materials (No fossil energy requirement or steel)

- Most transport can be done using horse/donkey cart

Social Sustainability

- Money is retained in the community & supports local rural jobs
- Brick makers & masons advance skills & entrepreneurship
- Women & men can partake in the activity
- Less conflict over fuel gathering

Next Steps

- Complete in-field emissions testing and lab testing at McGill University, Montreal
- Scale up from 2000 to 10,000 Noflay stoves per year
- Make incremental improvements in the design, brick production and stove installation
- Develop the business model to strengthen the "clay economy" by using the kilns for other household applications (house bricks, floor tiles)

For more information:

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