



# The Score Stove.

For £20 it will cook and generate electricity  
To help over 2 billion poor people  
Powered by wood, dung or other fuel  
Potential to save 10 Mt Carbon per year

Paul H. Riley Score Project Director

# Why Score?



- 2 billion people cook on an open fire with no electricity
  - Smoke bad for health
- Over-use of scarce wood supply
- Many stove designs
  - Insufficient impact
- Understanding social context is key
  - Poverty < \$2 per day
  - Motivation, e.g. mobile phone
  - Inhibitors
  - Low power (20W) is enough to start
  - Familiarity with local culture
- EPSRC and DFID\* want impact
  - From research money
  - To increase UK science base



Photographs courtesy Practical Action



\* EPSRC = Engineering and Physical Sciences Research Council.  
DFID = Department for international development,  
each are UK government funded organisations

# The Score Stove Project



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Nottingham

- The Charity Practical Action and the Universities of City, Manchester, Nottingham, Queen Mary
- £2M research
  - fuel burning Stove that can cook, generate electricity and provide cooling for use in Developing Countries.
- 5 years started in 2007
  - research to 2010 thereafter exploitation part funded until 2012
- Both High Technology and Social Science content
- Target of 100 Watts electrical for £20 in 1 million quantities
  - with half the wood and no smoke
- World-wide interest
  - in 60 publications, over 10 different languages
  - Score Community Launched
    - » engaging with 10 developing countries and growing



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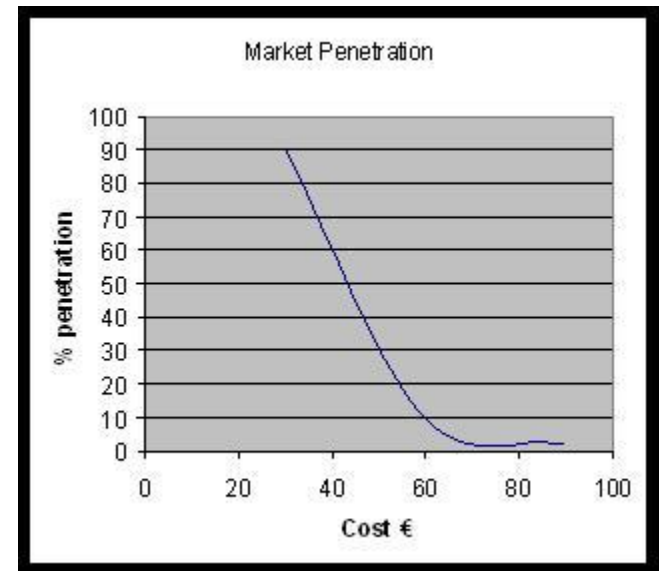
*"god gave us two ears and one mouth, he  
is things us something important"*



# Market Survey



- Nepal survey (results confirmed in Kenya)
  - Yangalot village in Hagam
  - Husband see chart on right
  - Wife
    - » better cooking position
    - » low smoke
    - » better education for children
- Business case
  - Household:
    - » 70p per month saved on kerosene for lighting,
    - » Score pays back in < 3 years
  - Village
    - » shop sells and maintains score to offset kerosene sales.
  - Country
    - » carbon credits
    - » cascade manufacturing.





18 Months later

# Is Score wanted?



- Simulated Score Stove
  - 12 houses in Nepal
  - 10 – 20 W electrical
  - No smoke, less wood
  - Similar number in Kenya
- Satisfaction
  - 100% used electricity for lighting helping education, social
  - 80% used for radio
  - 32% mobile phone charging
    - » 16% sold electricity
- Interest from Developed world





# How does it work?



- Uses Thermo-Acoustics
  - Exciting new technology
  - No moving parts
    - » Stirling engine with no pistons  
Relies on acoustic waves
    - » Making it cheap and reliable
  - Difficult to design but low cost manufacture
  - Used in Space probe  
and a Natural Gas liquefying plant
- Wood or dung is burnt
  - A specially shaped pipe gets red hot
  - Another part of the pipe is cooled
  - This generates sound at 100 Hz
    - » very noisy inside >170 dBA
    - » Outside whisper quiet hum
  - Then a Linear Alternator turns the sound  
into electricity
- The waste heat is used for cooking

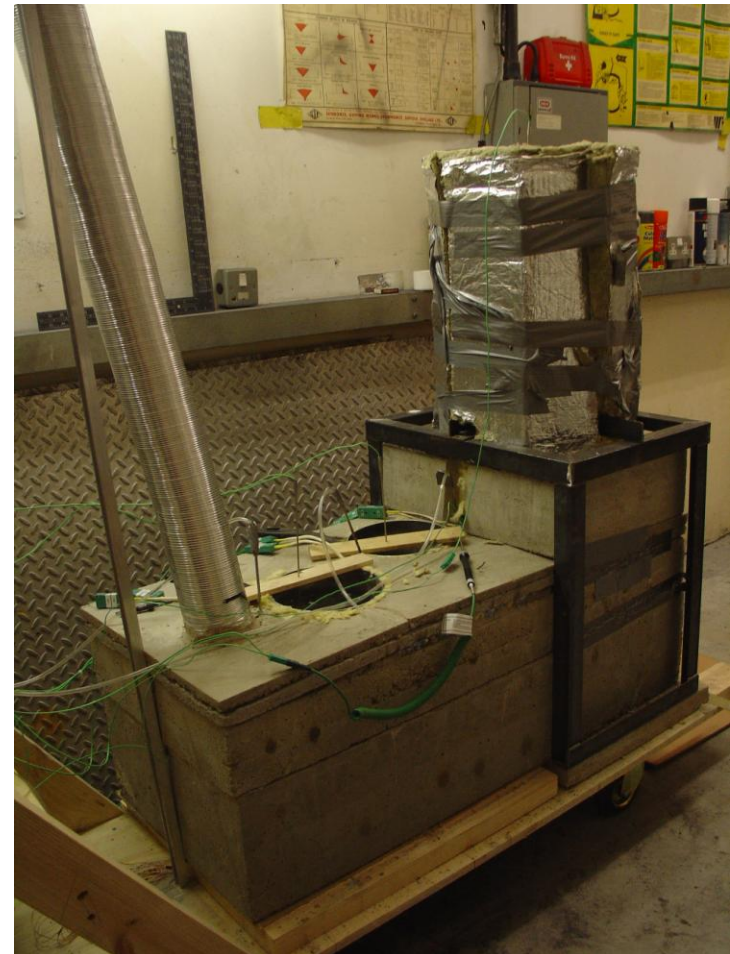


# Manufacture



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- Goal is for
  - local manufacture wherever possible
  - > 1 million per year (should this be higher?)
- Short term
  - Manufacture kit of parts and send to capital city of country
  - Use local Universities and charities for training in manufacture and maintenance.
  - Encourage local business
- Long Term
  - “Factory in a box” to cascade as much manufacture as possible target country
- Photo on right
  - Example casing and hob unit that could be manufactured locally
  - Made from vermiculite and cement that could be sourced locally



# Funding challenges ahead



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- Unusual project does not fit with normal funding
  - Funding for cost reduction and field testing a big challenge
- EPSRC
  - Funds research and some UK follow on, not suitable for the next stage
- DFID
  - has no formal mechanism for product development and transfer
- GTZ (German), USaid,
  - have local funds but low value
- Venture Capitalists
  - want large return on investments
    - » goes against ethos to profit from developing countries
- Currently too risky for charitable donations
  - Like to see fully tested product
- Interested companies
  - BP pulled out of market
  - Shell springboard funding too low



USA aiming  
for 100m  
stoves per  
year after  
2015

# Final Remarks



- Many UK applications
  - CHP (boilers generating electricity)
  - Wood burning stoves
- Social benefit drives Score uptake
  - electrical generation a big plus
    - » Solar does not encourage smoke free
  - Social pressure for electricity forms incentive to drive Score uptake
- Flow of technology
  - Factory in a box
    - » Cascade manufacture to country
    - » Provides finance, training business model and supply chain
  - Needs lower cost than alternatives
    - » Solar ~ £9 per installed watt dropping
    - » Thermopiles ~ \$8 per watt
    - » (Score target <£0.25 per watt )



# Acknowledgements



The University of  
Nottingham

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  - Dr Teo Sanchez
    - » Practical Action
  - Professor Mark Johnson, and Dr Chitta Saha.
    - » My Nottingham colleagues



# Timeline



- Testing
  - 2010, Funding required £350k
    - » £150k for prototypes,
      - Target unit price is £1k with £800 cost
      - £200/ unit returned to cover central costs (Patents etc.)
    - » £150k to retain key staff over 1- 2 years
    - » £50k for travel, manufacturing evaluations, tooling etc.
- Cost reduction and roll out
  - 2011 - 2012, Funding required £3M (to cover 5 years)
    - » £500k capital costs (tooling etc)
    - » £1M to retain key staff for 5 years
    - » £250k central costs (Patents, Lawyer, accountants etc)
    - » £250k manufacturing trials
    - » £750k initial production manufacture
    - » £250K marketing etc.
  - Income generation starts in this phase
- Volume Manufacture
  - After 2013 income builds to > £10M pa
  - Funded by a mixture
    - » micro-finance (income from target households)
    - » International development agency subsidy for very poor regions
    - » Profit from sales to developed countries
  - Rate of penetration (developing) depends on manufacturing cost and amount of subsidy
    - » At £60 per unit, total market = £300M (excluding subsidies)
    - » At £20 per unit, total market = £30B
  - Developed country market not yet determined