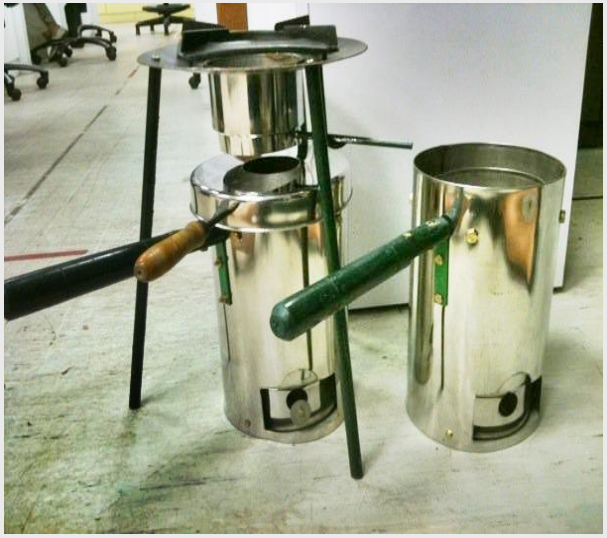
TLUD Gasifier Stove
- A Snapshot -

- TLUD stands for Top Lit Up Draft.

- Most cook stoves are Bottom Lit Up Draft.
- TLUD technology is pursued around the world since it saves fuel.



- is a stove with a canister
- which when filled with fuel (any Dry Biomass waste like twigs, coconut husks, cow dung, Carpentry waste, etc) and combusted,
- will enable cooking for an average of 30 minutes depending on fuel type
- and produces precious charcoal at the end ; can be used for various commercial applications.

TLUD Gasifier Stove
- Key User benefits -

- **Pyrolysis technology**;
  - represents an improved biomass stove that burns clean and green.
- **Lower cost of cooking fuel**;
  - High thermal efficiency of 39% that results in saving of cooking fuel (almost 50-60%)
  - Traditional chulahs only have 9% thermal efficiency.
- **Significant saving of Biomass material.**
  - Only biomass residues used; Supports aforestation.
- **Versatile Biomass possibility**
  - Converts waste to cooking fuel (coconut shells, carpentry waste, dry twigs etc)
- **Low Maintenance**
  - Made of stainless steel; durable; easy to clean and maintain
- **Faster cooking**
  - due to high fire power
  - no need to monitor the flame during the cooking session
- **Reduced indoor air pollution (IAP)**
  - better health for women and children
- **Resultant Charcoal**
  - Is of high grade ; 5300 kcals/kg calorific value
  - Has multiple commercial application.
- **Waste heat recovery** and smoke free kitchen if Masonry construction with chimney is adopted.
- **Excels in boiling and steaming application**
  - boon for all Indian cooking (cooking rice, dals, vegetables, milk, etc.)

Product Differentiators
-How different from other alternatives-

- **“Generic” differentiators**
  - Saves around 40% fuel Vs a traditional 3 stone stove.
  - Versatility of fuel; Tree felling not necessary.
  - Mitigates problem of indoor air pollution.
  - Environment friendly technology reduces carbon footprint while cooking.

- **Specific differentiators**
  - 2 critical design inventions :
    - Longer cooking duration
    - Better flame control.
  - ***Creating energy streams:*** Working towards creating energy entrepreneurs who will sell ‘canister sized fuel packets’.
  - ***Good addition to Keroesene/LPG Kitchens :*** Introduce its “water boiling” application in kerosene/LPG kitchens.
  - ***Create value stream from biochar*** : It is possible to design a monetary stream for the household based on the biochar residue
  - ***Carbon saving eligibility*** : If biochar is buried in the soil

A cooking energy solution; not just a cook stove

The Need for Improved Biomass Cookstoves

- *Understanding the big picture*
- *The need for the product*
- *Some declared statistics*
- *How the Servals TLUD addresses the problems*

Need for TLUDs
-Understanding the context-

- “10 fixes for the planet” – A Newsweek Apr ‘08 article
  - by environmental thinkers towards making the planet greener/energy efficient
  - "Stoves for the masses" one of them.

- Inefficient cooking methods - not a trivial problem.
- 2 billion - cook in rudimentary stoves or over open fires.
- "A family of five can use three tons of wood a year for cooking,"
- "If that family saves one ton of wood per year, that can translate into more than a ton of CO2 saved every year for that family alone."

- “Designing technology for diversity and affordability - harder than sending a man to the moon”.

The challenge: Designing an integrated cooking energy solution for the wood stove market

Product Need

- ***The needs of the poor***
  - Improved cooking conditions ; better cooking experience.
  - Reduce Indoor air pollution; better maternal and child health.
  - Energy efficiency ; saves expenditure on cooking fuel.
  - Enhanced quality of life (less time collecting fuel, more time for productive work).

- ***The needs of the economy***
  - Creates entrepreneurial activity at the grassroots.
  - Promotes energy self reliance.

- ***The needs of the planet***
  - Energy Conservation.
  - Use of alternate energy sources - green energy gen
  - Reduce carbon emissions - climate change.
  - Reduce deforestation - environment sustainability.

Hierarchy of Needs in the Stove Market

Need Assessment
-Some Declared Statistics -

- Address at least 5 of the 8 MDGs that the UN is working to meet by 2015.

- ***Climate Change : Clouds of Pollution***
  - Carbon dioxide, Methane and nitrous oxide present in biomass stove emissions .
  - Apparently 18% of the problem of carbon emissions is caused by stoves.

- ***Indoor Air Pollution: Health Risk***
  - Fourth leading health risk in developing countries.
  - Premature deaths - estimated 1.6 million people each year ; women and children most affected.

- ***Deforestation: Cooking with wood a significant cause***
  - Annual consumption of wood - 10% of wood harvested from the world's forests.

Source (http://www.aprovecho.org)

Global Mandates;
Not Just Needs

How the TLUD addresses the need

- ***Needs of the poor***
  - ***Saving in fuel cost :*** 50 – 60% saving in fuel and fuel cost.
  - ***Indoor Air Pollution:*** Significantly reduces emissions.
  - ***Improved quality of life :*** Longer cooking duration; better flame control; Frees up time.

- ***Needs of the Economy***
  - ***Energy Conservation:*** Saves fuel : TLUD efficiency is 39% Vs 9% for 3 stone stove; use of alternate energy
  - ***Entrepreneurship***: Catalyses economic activity at the grassroots ; fuel sizing and distribution, biochar collection

- ***Needs of the Planet***
  - ***Deforestation:*** Versatility of fuel; including waste materials at almost zero cost; Tree felling not necessary.
  - ***Climate Change:*** Reduces net addition of CO2 into the atmosphere; Process carbon-neutral if the resultant charcoal is burned.; carbon-negative if charcoal is taken out and used as a soil conditioner;

About the Servals TLUD Biomass Stove

- ***Specifications***
- ***Benefits***
- ***Product Certificates***
- ***Customer Testimonials***
- ***Biochar Potential***
- ***Social Impact Balance Sheet***

TLUD Gasifier Stove
- A Technical Profile -

Design	▪ Actively partnered with Dr. Paul Anderson, known as Dr TLUD in the Stove world. ▪ http://lilt.ilstu.edu/psanders/
Technology	▪ Pyrolysis Technology ▪ Represents an improved biomass stove that burns clean and green
Thermal Efficiency	• not less than 36% ▪ Report attached (Received from STARIC Nepal)
Average Fire Power	• 4 KW ▪ A Damper arrangement for reducing the fire power
Life Span of Stove	• More than 7 years • Made of Stainless Steel, No moving parts • Inner canister is designed such that it can be reversed; So life can be extended

TLUD Gasifier Stove
- A Technical Profile -

Target Audience	▪ Biomass Stove Users ▪Rural and Urban Poor ▪Tea Shops, Small Eateries
Applications	•Ideal for Hilly, Tribal, Rural & Remote Areas which are presently subjected to huge deforestation. ▪Generally these areas suffer from poor accessibility for reaching Fossil fuels. ▪Ideal for a family of five
Biomass suitability	•TLUD gasifiers have high versatility with accepting cooking fuels. ▪All kinds of dry biomass ▪Examples wood chips, pellets, cowdung, twigs, coconut shells, etc.
Suitability of Cooking Application	• Excels in water boiling and steaming applications

TLUD Gasifier Stove
- A Technical Profile -

Indoor Air Quality	• Significantly lower than traditional chulahs and three stone chulas (Emission Chart attached) • Certificate on black carbon reduction awaited
Emission in terms of CO, COs and Particulate Matter	• The certificate certifies that the CO/CO2 ratio is less than 0.04 in the combustion gases leaving the stove - which means a clean combustion and emission within safe limits ▪ Certificate from MSME Testing Center of the Government of India, Ministry of Micro, Small and Medium Enterprises.
Residue	• The residue of the cooking session is good quality charcoal. • Calorific value 5300 Kcals/Kg (can vary depending on biomass input) ▪ About 20% of the cooking fuel i.e. 100-125 grms of charcoal per canister per cooking session.

TLUD Gasifier Stove
- A Technical Profile -

Biochar Residue from TLUD - Applications

- Has Commercial Applications (improving soil fertility, composting, agarbatti making etc)
- Can be monetized
- Heating values of chars are comparable with those of lignite and coke

- Fuel for charcoal fuelled stove
- Can be mixed in soil to improve fertility (eligible for carbon finance benefits)
- Composting (e.g. 10% biochar to
- Vermicomposting: The biochar crushed to ~1mm and added about 20% vol to the food wastes that is being fed to the worms. This allows worms do digest the wastes at almost twice the speed.
- When organic fruit leftovers are mixed with 10 % of biochar, it would produce high quality organic biochar-compost-mix
- Agarbatti Making, fillers etc
- Activated Carbon, if the source of biomass is the same

TLUD Gasifier Stove
- A "Pay Back" Profile -

- The TLUD offers two kinds of tangible, measurable, monetary "returns" to the User

1. There will be at least Rs 95 – Rs100 saving in cooking fuel every month for a household of 5.
   - A family of 5 needs to pay around Rs. 315 per month while using traditional three-stone stoves (Rs.10.5 per day –> 3 .5kgs* Rs 3 per kg). This stove design is at least 30% more efficient than three stone stoves, hence saving of Rs. 95 per month.

2. There will be at least Rs 100 generation when the household figures out how to monetize the biochar residue from the TLUD
   - Approximately 125 gms of charcoal is generated during every cooking session. 125 gms * 2 cooking sessions every day *30 days in a month = 15 kg. The price per Kg of charcoal in India is approximately INR. 5-7. This means, theoretically speaking, each household/small caterers/meal centers can generate 15 kg of charcoal every month. This can be valued at Rs. 75-100 per month. This means, that every household can finance the cost of cooking fuel for more than an entire month, by selling the residue

At least Rs. 200 per month

TLUD Gasifier Stove
- A Socio-Impact Profile -

Benefits to User	▪ Saving in Biomass fuel (upto 50-60%) ▪Potential income through biochar ▪Faster Cooking ▪Low Indoor air pollution / smoke ▪Low Maintenance, simple operation, long life ▪Waste Heat Recovery and smoke free kitchen if masonry construction is adopted
Benefits to Tea Shops/Small eateries	•Saving in Biomass •Potential Income through biochar •Excels in boiling/steaming ; can be a good secondary stove •High Fire power; faster cooking •Low Pollution •Low maintenance, simple operation, long life
Benefits to Community	•Potential to create income generation activity around fuel supply •Potential to create income generation activity around biochar

Servals TLUD Gasifier Stove - A Socio-Impact Profile -

Benefits to the planet

- **Energy Conservation: With a thermal efficiency of 39% over the 9% of wood stoves, TLUDs offer a 50-60% conservation of cooking energy**

- **Climate Change: A very environmentally friendly stove; TLUDs reduce the net addition of CO_2 in the atmosphere; a carbon-neutral process**

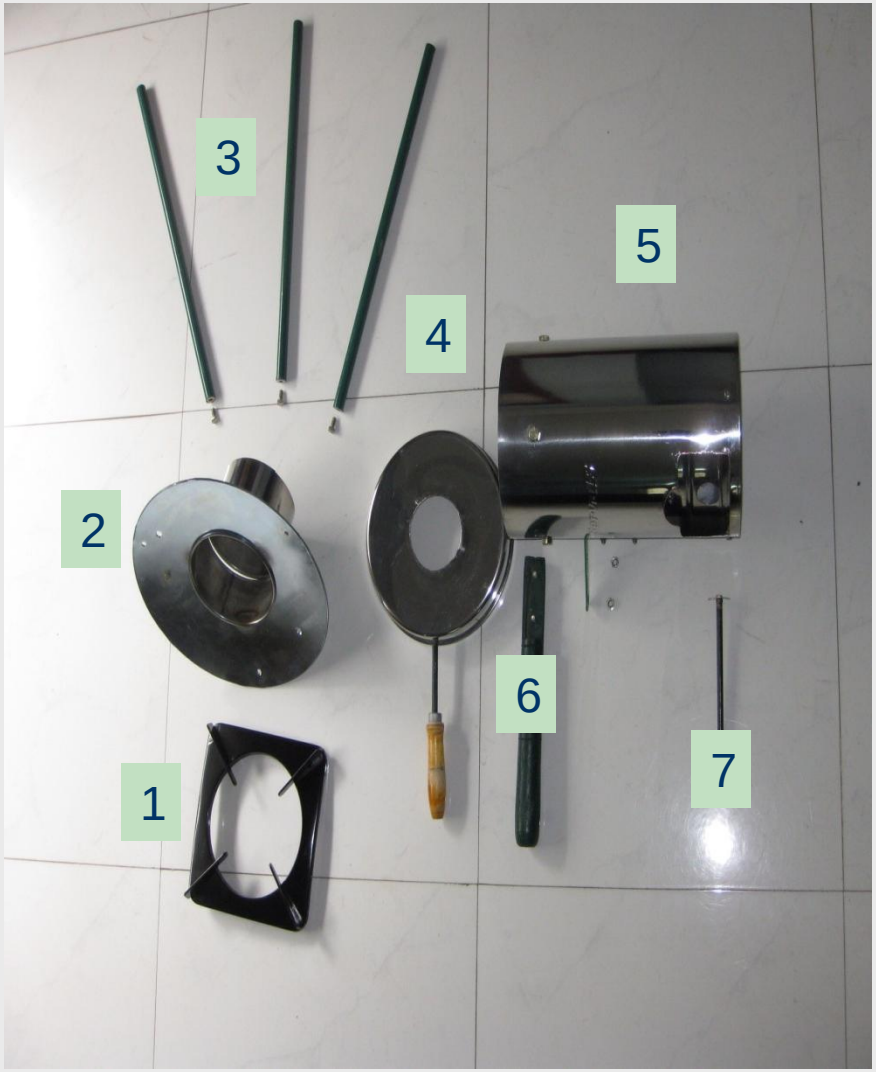
- **Afforestation: Reduces Deforestation; Encourages the use of waste biomass as cooking fuel**

- **Indoor Air Pollution: Significantly reduces cooking pollution and black carbon (Certificate awaited)**

- **Increase in Disposable Income : TLUDs save around Rs100 per month for a family of five on cooking fuel spending; they further add around Rs.100 per month through the potential monetization of biochar**

- **Enhance quality of life: Offers better cooking experience, reduces smoke in the kitchen, frees up time from fuel collection**

Servals TLUD Gasifier Stove
- A Technical Profile -



Dimensions

Canister	**Outer Diameter 180 mm & Height 300 mm**
Tripod Stand	**500 mm Height**

Material Of Construction.

Canister, Top cover, Telescopic connector	**Stainless Steel with suitable handling arrangement made of mild steel and wood.**
Tripod and vessel support	**Mild Steel**

1. **Vessel Support**
2. **Spill Tray with Telescopic Connector**
3. **Tripod legs (3 Nos) with Bolt**
4. **Top Cover for Canister**
5. **Canister**
6. **Wooden Handle with nuts**
7. **Flame control rod**

Servals TLUD Gasifier Stove
- Product Certificates -

- Test Report received from STARIC, Nepal; STARIC/N is a professional NGO engaged in developing and promoting appropriate/rural technologies effective in meeting the basic needs of the rural mass and improving their life support systems.
  - Consumes 700 gms of wood on an average; Benchmark 850 gms
  - Charcoal produced is good and further usable
  - Compared to tradition cookstoves saves 50-60% firewood
  - Simple, easy to use; extra canister increases work efficiency
- MSME Testing Center, Ministry of Micro, Small and Medium Enterprises.
  - Certifies that the CO/CO2 ratio is less than 0.04 in the combustion gases leaving the stove
  - which means a clean combustion and emission within safe limits.
- MNRE Certification
  - Servals have applied for the MNRE certification for the TLUDs on Jan 22nd, 2010.
  - The stove has been submitted to IIT, Delhi, an approved Testing House of the MNRE, for testing.
  - Servals is awaiting the certification.

Servals TLUD Gasifier Stove
- Some customer testimonials -

- **Here is a user feedback received from households from a Tea Garden in Assam; where we conducted a pilot test**

TLUD Test Report Received from Assam Tea Garden (------ TEA ESTATE)

Name of the user	No. of Family Members	No. of days new stove used	Time taken		Approx. quantity of Meal Prepared			Approx Saving Time	Saving in Fuel	User Comments
			Old Stove	New Stove	Avg.Qty/day	Variety	Type			
Smt. Rita Karmakar (Fakir Line)	4	20	80 - 90 Mins	40 - 45 Mins	1.50 Kgs.	Rice, Dal, Veg, Etc.,	Veg.	40 - 45 Mins.	50% (Firewood)	If pre cooking preparations are done in advance then time taken will further reduce. Very Useful & economical & low smoke.
Sri Daman Hembrom	7	10	40 - 50 Mins	30 - 35 Mins	2.00 Kgs.	Rice, Dal, Veg, Etc.,	Veg.	15 - 20 Mins	30% (Firewood)	Good, Useful, time saver & low smoke
Smt. Junmoni Hembrom (Fanchi Line)	7	12	Time acurately not recorde by user. General opinion - it is time saving.		2.50 Kgs.	Rice, Dal, Veg, Etc.,	Veg.	-	20% (Firewood)	It takes time to cut firewood in to small pieces, otherwise better result.
Smt. Nuri Tanti (Gumdhanbari Line)	5	12	50 Mins	40 Mins.	1.50 Kgs.	Rice, Dal, Veg, Etc.,	Veg.	10 Mins.	30% (Firewood)	Less smoke & time saving & portable.

Here is a link to a testimonial of an aanganwadi cook in TN, who compares the TLUD with the traditional woodstove and says that she found that the TLUD emits much less smoke and requires less supervision.

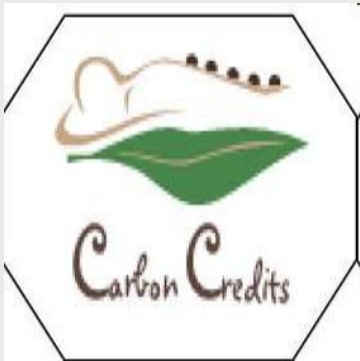
http://www.youtube.com/watch?v=gILzKX-pUic

Some Notable Mentions

- TLUD - Winner of the prestigious Sankalp 2010 award in the "Clean Energy Sector"
  - Sankalp is India's largest social enterprise and investment forum.
  - Recognizes India's top 10 highly investment worthy and innovative social enterprises in 5 key growth areas.

- Charcoal is the residue of every cooking session. Has commercial applications –agarbatti, compost, water filtration
- Biochar - eligible for carbon finance benefits.

- Servals has put up a community cookstove program in India with the aid of carbon finance around the TLUD biomass stoves.
  - Has established the carbon credit worthiness of the product.

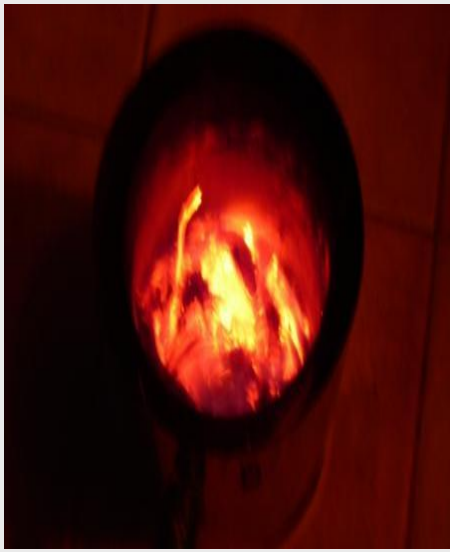


The "Biochar" Perspective

- Charcoal is the residue of every cooking session.
- Appr 125 gms of charcoal per canister; 125 gms * 2 cooking sessions every day *30 days in a month = 15 kg of biochar a month
- Has commercial applications - incense stick making, biofertilizer or briquetting etc.
- The price per Kg of charcoal in India is approximately INR. 5 - 7.

•Theoretically speaking, each user generates at Rs. 75 - 100 per month. Almost the cost of cooking fuel for more than an entire month, by selling the residue from the TLUDs.

•It is possible to conceptualize and implement a system by which all the charcoal from a community is collected periodically; It will result in a fairly large collection of charcoal.



The "Biochar" Perspective

- Heating values of chars are comparable with those of lignite and coke.
- Can be used to fuel charcoal fuelled cookstoves i.e tandoori ovens etc
- Can be used for making activated carbon if the fuel is all from one source
- Can be used as fertilizer ; for composting
- Can be sold to companies that make agarbattis, cigars etc
- Depends on the local demand

The "Biochar" Math

- Here's a quick math :
  - 1000 households; generating appr 15 kg of charcoal every month; total 15,000 kg of charcoal; valued @ Rs5 per kg; Rs.75,000 per month.
  - If the cost of collecting the charcoal (salary, cycle cart, bins, storage and transport to warehouse etc) is Rs20,000 every month the returns are Rs.55,000 worth of charcoal every month.
  - That would mean each month a 3 year payback for 1000 stoves; at 25 – 30 TLUDs every month.
  - The life of the stove would be 7 years; a conservative estimate.
  -
- Benefits for the Stove Sponsor :
  - 15,000 kgs of charcoal every month. Rs 55,000 worth of raw material.
  - A 33% return on their investment. Rs20 lakhs will be their total investment in 1000 stoves; Rs.6.5 lakhs per year is their return (@Rs55,000 per month).
  - Creating new jobs in the community.
  - Promoting green cooking, reduce pollution, saving in firewood, enhancing quality of life of the households etc.
  - The "fuel" expenses to the household will be substantially reduced; almost by 50%
  - Tying up the charcoal prices with the households for 7 years? So ensuring stability in raw material prices?
  - Can report this investment under their "sustainability reporting" which seems to be becoming a mandatory practice in the international circles.