

OUR \$14.95 WORLD BEATER, PRICE SMASHER AND THE ENEMY OF TRUSTS
THE ACME AMERICAN RANGE.

\$14.95 Buys the No. 8-18

CASH WITH THE ORDER.
 DELIVERED ON BOARD THE CARS AT OUR
 FOUNDRY IN CENTRAL OHIO.

State whether you wish to burn
**WOOD ONLY, COAL ONLY, OR
 BOTH COAL AND WOOD,**

and we will send you this new big 1902
 model ACME AMERICAN 415-pound
 Range by freight on receipt of \$14.95,
 and if not found perfectly satisfactory,
 exactly as represented, the handsomest
 range you ever saw, and the equal of
 any range you can buy elsewhere at
 \$30.00 to \$40.00, we will refund your
 money.

THIS RANGE WEIGHS 415 POUNDS
 and the freight will average for 500
 miles, \$1.50 to \$2.00; greater or lesser
 distances in proportion.

WITH
 PORCELAIN
 LINED
 RESERVOIR
 AND
 HIGH SHELF.

FOR
 HARD COAL,
 SOFT COAL,
 WOOD OR
 ANYTHING
 USED
 FOR FUEL.

THIS RANGE
 is made in our own
 foundry by skilled
 mechanics, from the
 best material money
 can buy, is the hand-
 somest, most orna-
 mental, best baking
 and burning and
 most economical big
 square oven, high
 shelf range made.

WE ISSUE
**A BINDING
 GUARANTEE**

Guarantee the
 stove to reach
 you in the same
 perfect condi-
 tion it leaves our
 foundry.



MONEY CAN'T MAKE BETTER. Operating our own foundry we fur-
 nish better materials, heavier cast-
 ings, heavier nickel finishings, better connections and fittings than any other
 foundry produces. From our own factory we save you the manufacturer's,
 wholesaler's and retailer's profits, and give you a better range than you can
 buy elsewhere. Our special \$14.95 price is based on the actual cost of
 material and labor, with but our one small profit added.

THIS BIG CAST IRON RANGE is made from the very finest Camden
 stove pig iron. Latest 1902 rooco
 molding, large square tin lined oven door, large deep porcelain lined
 reservoir, handsome rooco base, large high rooco shelf, heavy nickel trim-
 mings throughout, nickel oven door panel, nickel shelf, nickel draft door,
 nickel tea shelf, pins, hinges, knobs, handles, etc. Duplex grate, cut tops and
 centers, large flues, balled ash pan, slide hearth plate.

WE CAN ALWAYS FURNISH REPAIRS FOR ACME STOVES AND RANGES.

Prices are Cash with the Order. Delivered on the cars at our Central Ohio foundry.	Cat'l'g No.	Size	Size of Lids	Size of Oven	Size of Top Measuring Reservoir	Size of Fire Box when used for wood	Height to Main Top	Weight	Price	If desired without reservoir, but with end shelf, deduct \$2.00. If high shelf is not wanted, deduct \$2.00.
	22R375	8-18	No. 8	17½x16x11½	42x25	17x8x5	28 in.	415 lbs.	\$14.95	

Oven measurements **DO NOT** include swell of oven door, and **DO NOT** include pipe or cooking utensils. See pages 580 to 593.

If you do not burn coal at all, make your order read **WOOD ONLY,** and get the exclusively **WOOD FIRE BOX** which will measure 22x9x9, but will **NOT** burn coal at all.

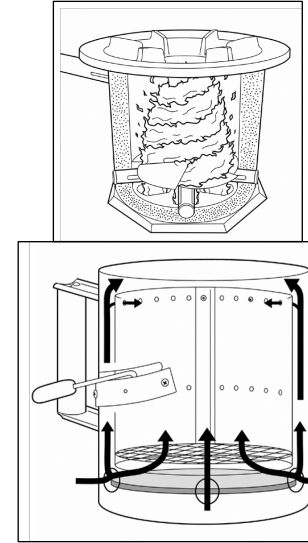
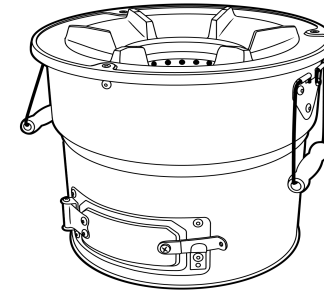
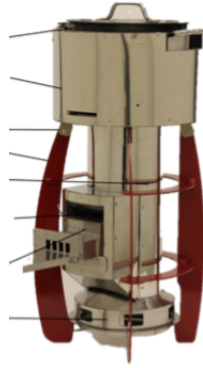
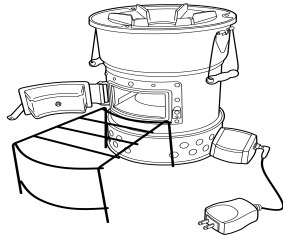
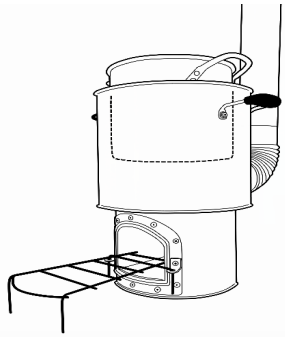
Simple Outdoor Air Pollution Modeling of Vented Stoves

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Aprovecho Research Center

ETHOS 2020

It's very difficult to make and sell unvented stoves that don't release harmful levels of PM_{2.5} into the kitchen.



Stove	High Power Emissions Rate average for two hours <i>mg/min</i>	Low Power Emissions Rate average for two hours <i>mg/min</i>	Background Concentration <i>ug/m3</i>	Kitchen Air Exchange Rate <i>1/hr</i>	Kitchen Volume <i>m3</i>	Predicted 24 hr Average Kitchen Concentration <i>ug/m3</i>
Sunken Pot Rocket (ARC)	11.7	7.7	7	15	30	222
Side Feed Fan (ARC)	4.5	3.8	7	15	30	99
ND Rocket (UW)	1.9	1	7	15	30	39
Mimi Moto, TLUD	1.4	0.9	7	15	30	32
Charcoal (ARC)	1.8	0.1	7	15	30	28
ND TLUD (Kirk Harris)	0.75	0.23	7	15	30	18

Rocket Stoves don't get much better than this

Charcoal has other problems

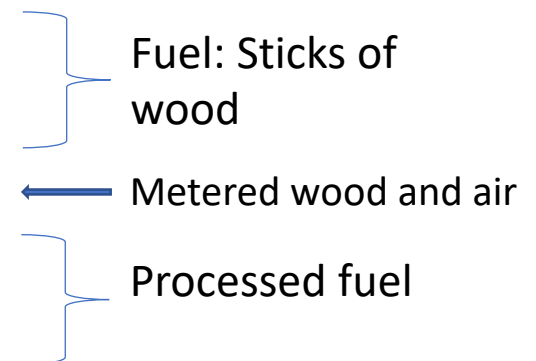
Pellet stoves can be very clean burning

Emissions rates were measured in the laboratory (and represent a **best case scenario**) for each stove and the single zone box model was used to estimate the concentrations in the room. Visit aprovecho.org for drawings of the ARC stoves, and to use the box model.

WHO Intermediate Indoor Air Quality Guideline = 35 ug/m³

It's easier to make vented stoves that release small amounts of PM_{2.5} into the kitchen during household use.

Stove with Chimney at 3x the emissions rate of the lab findings	High Power Emissions Rate average for two hours mg/min	Low Power Emissions Rate average for two hours mg/min	Chimney Removal Efficiency	Background Concentration ug/m3	Kitchen Air Exchange Rate 1/hr	Kitchen Volume m3	Predicted 24 hr Average Kitchen Concentration ug/m3
Sunken Pot Rocket x3 (ARC)	35.1	23.1	75%	7	15	30	168
Side Feed Fan x3 (ARC)	13.5	11.4	75%	7	15	30	76
Sunken Pot Rocket x3 (ARC)	35.1	23.1	95%	7	15	30	39
Side Feed Fan x3 (ARC)	13.5	11.4	95%	14	15	30	28
Side Feed Fan x3 (ARC)	13.5	11.4	95%	7	15	30	21
Mimi Moto x3, TLUD	4.2	2.7	75%	7	15	30	26
Charcoal x3 (ARC)	5.4	0.3	75%	7	15	30	23
ND TLUD x3 (Kirk Harris)	2.25	0.69	75%	7	15	30	15



Emissions rates during household use were estimated based on laboratory measurements that were **multiplied by a factor of three** for each stove and the single zone box model was used to estimate the concentrations in the room.

75% **chimney removal efficiency** is a conservative estimate, **95%** may be closer to a sealed stove like the **many** heating stoves on the USA market.

Outdoor air pollution concentration is easiest to predict with the linear **rollback emissions inventory** approach.

- Select an area of study
- Measure sources
- Measure pollutant concentration
- That's still a lot of work, so let's look at two existing studies to see how cookstove emissions affect outdoor air quality
 - Oakridge, Oregon (emissions inventory, outdoor air concentration, and roll back model in one study)
 - Chittigong, Bangladesh (emissions inventory and outdoor air concentration in two separate studies)

$$\frac{E_a}{E_o} = \frac{C_d - C_b}{C_{\max} - C_b}$$

E_a is new emissions rate

E_o is measured rate

C_d is desired concentration

C_{\max} measured concentration

C_b background concentration from sources outside of the valley

If people in Oakridge, OR cooked with wood it wouldn't impact their outdoor air quality.

Location	Event	Population Density	# of Cooking Stoves	Individual Cooking Stove 4 hr Average Emissions Rate	# of Heating Stoves	Individual Heating Stove 24hr Average Emissions Rate	Background Sources PM2.5 Emissions Rate into Inventory	All Sources Total PM2.5 Emissions Rate into Inventory Area	Concentration of PM2.5 in the Inventory Area
		people/km2		mg/min		mg/min	lb/day	lb/day	ug/m3
Oakridge, OR	Measured worse case day of all sources in the valley	512	0	0	1006	152	66	552	40
Oakridge, OR	Hypothetical all 2020 heating stoves with 2008 background sources and Side Feed Fan Cookstove	512	1006	4.15	1006	36	66	183	13.3
Oakridge, OR	Hypothetical all 2020 heating stoves with 2008 background sources and 3x Side Feed Fan Cookstove	512	1006	12.45	1006	36	66	188	13.6
Oakridge, OR	Hypothetical all 2020 heating stoves with 2008 background sources and Side Feed Fan Cookstove at Chittagong Population Density	4063	7983	4.15	7983	36	66	996	72

Heating stoves produce 88% of the emissions.



Modern heating stoves fix the Oakridge problem.



Cookstoves would be a small source



Clean burning biomass cookstoves can eliminate ambient air pollution within a coordinated policy

Location	Event	Population Density	# of Biomass Cooking Stoves in the Inventory Area	Individual Cooking Stove 4 hr Average Emissions Rate	Urban 24 hr Average Emissions Rate into Inventory Area	Brick Kiln Emissions Rate into Inventory Area	Industrial non brick	All Other Background Sources Emissions Rate into Inventory Area	All Sources Total Emissions Rate into Inventory Area	Concentration of PM2.5 in the Inventory Area
		people/km2		mg/min	lb/day	lb/day	lb/day	lb/day	lb/day	ug/m3
Chittagong, Bangladesh	Measured dry season avearge of all sources in the city	4063	N/A	N/A	12173	6318	10488	2181	31159	100
Chittagong, Bangladesh	Estimated biomass cookstoves emissions rate	4063	348,400	66	12173	6318	10488	2181	31159	100
Hypothetical existing background emissions, but using <i>Below Named Cookstove with Chimney</i>										
Chittagong, Bangladesh	Side Feed Fan (ARC)	4063	348,400	4.15	765	6318	10488	2181	19751	63
Chittagong, Bangladesh	WHO Intermediate ERT	4063	348,400	7.15	1318	6318	10488	2181	20304	65
Hypothetical no brick kiln emissions and using <i>Below Named Cookstove with Chimney</i>										
Chittagong, Bangladesh	Existing Stoves	4063	348,400	66.0	12173	0	10488	2181	24842	80
Chittagong, Bangladesh	Side Feed Fan (ARC)	4063	348,400	4.15	765	0	10488	2181	13434	43
Chittagong, Bangladesh	WHO Intermediate ERT	4063	348,400	7.15	1318	0	10488	2181	13987	45
Hypothetical no brick kiln or industrial emissions and using <i>Below Named Cookstove with Chimney</i>										
Chittagong, Bangladesh	Existing Stoves and biomass usage rate	4063	348,400	66.0	12173	0	0	2181	14354	46
Chittagong, Bangladesh	Side Feed Fan x3 (ARC)	4063	348,400	12.45	2295	0	0	2181	4476	14
Chittagong, Bangladesh	Side Feed Fan (ARC)	4063	348,400	4.15	765	0	0	2181	2946	9
Chittagong, Bangladesh	WHO Ultimate ERT	4063	348,400	0.80	147	0	0	2181	2328	7

Best Solution?

(everyone can cook on wood)



Jet Flame, Chimney, Wok

