Energy Stability and Wood Fuel Consumption in Kosovo

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Issues with Demand

- For the forest sector to be sustainable, the energy system and efficiency efforts would displace the difference 0.75 million cubic meters or 62.8 MW of capacity.
- 68% of households get their wood fuels 0-2 months before the season
- How to measure the dependency and ability to move from wood fuels as an energy source?

Biomass in Kosovo

- Survey 1 & 2
  - 1160 surveys (121 rural villages)
  - October 2013/March 2014
  - 295 Urban households from the 5 major cities (2011)

- Survey 3
  - Low-income, Low-service (electricity) areas
  - May 2015
  - 605 households (rural and urban)

Main Results - Wood Fuel Consumption

- Average Annual consumption (solid m^3)
  - Rural 8.2
  - Urban 6.7
  - For timing of use
    - Year round 7.61 (51%)
    - Heating season-only 8.88 (49%)
  - Low-payment (LP) 10.35
  - Low service (LS) 9.2
  - For timing of use
    - Year round 10.46 (64%)
    - Heating season-only 8.47 (35%)
- Total Estimation = 2.05 Million m^3 annually
- Sustainable Estimates = 1.3 -1.4 m^3 million annually (NFG)

UNFAO modeling

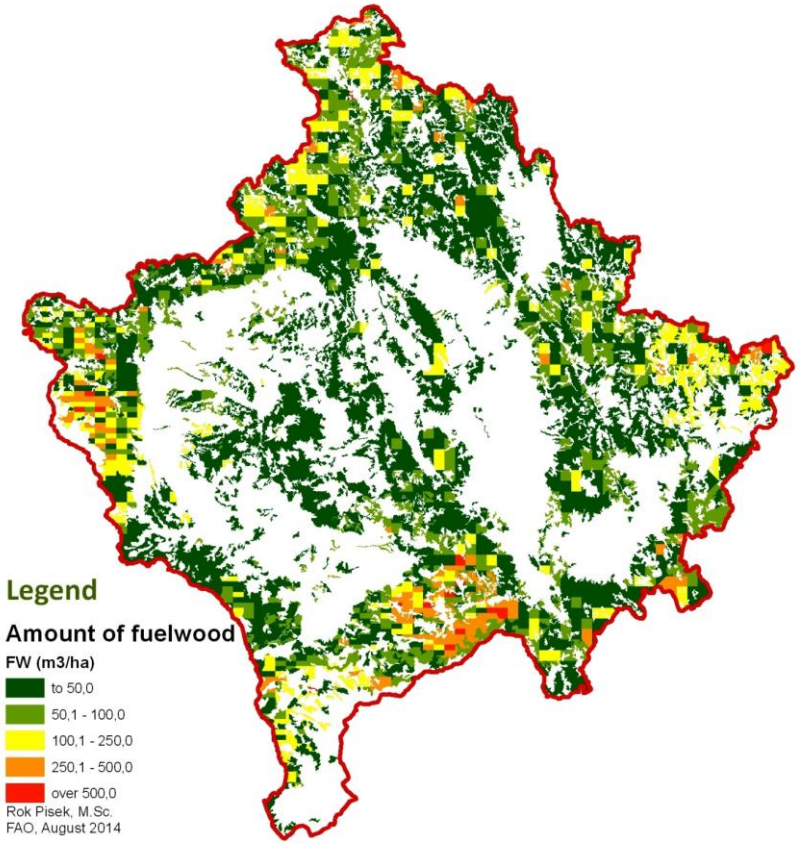


Figure 1. Estimated amount of current amount of biomass for energy

Balance (UNFAO)

Current balance map in Kosovo

Expenditure on Energy Sources (LSLP)

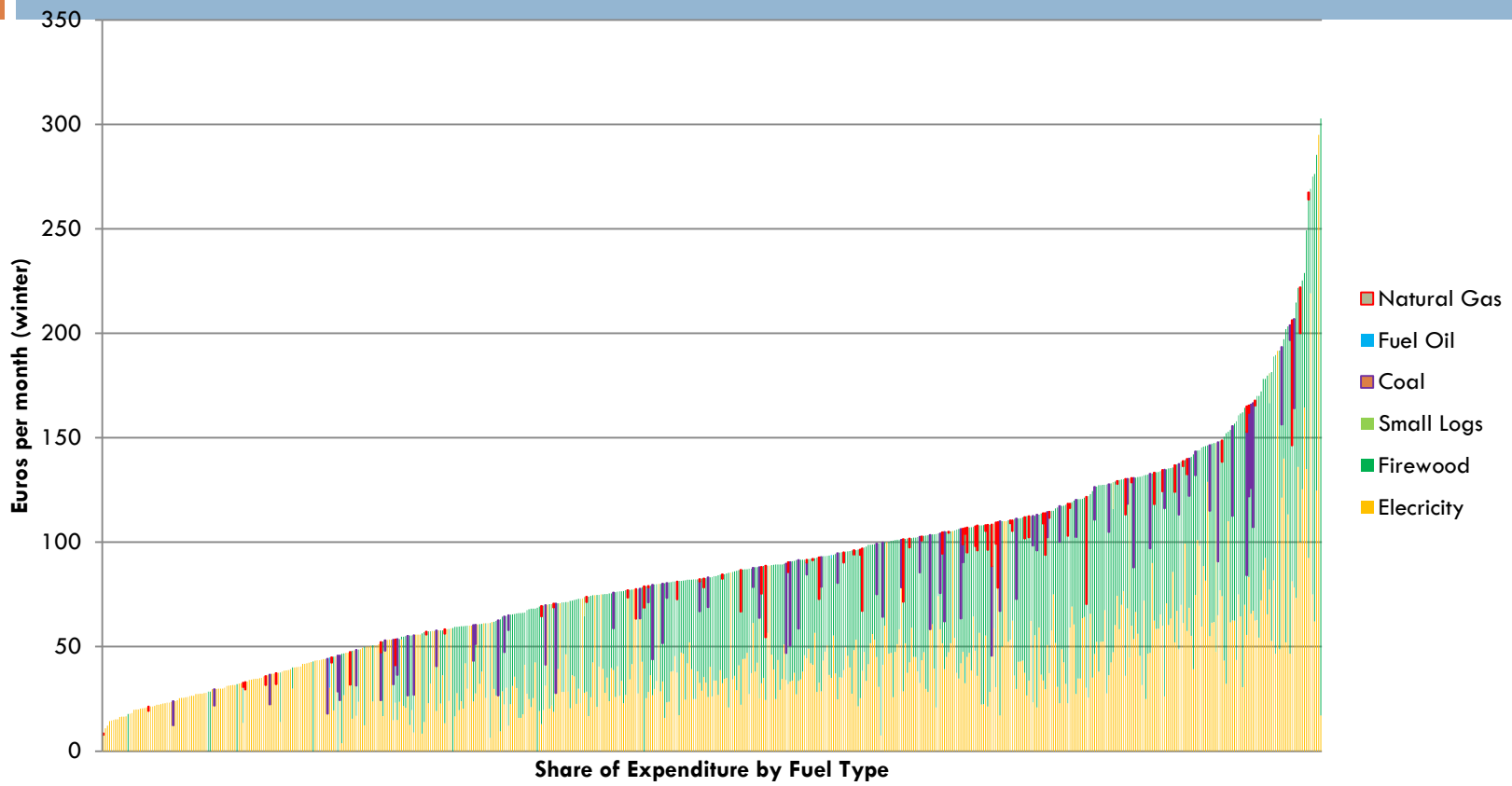


Figure 8. Average Energy Expenditure per Month in Winter on different Energy Sources

Percent of Income on Energy

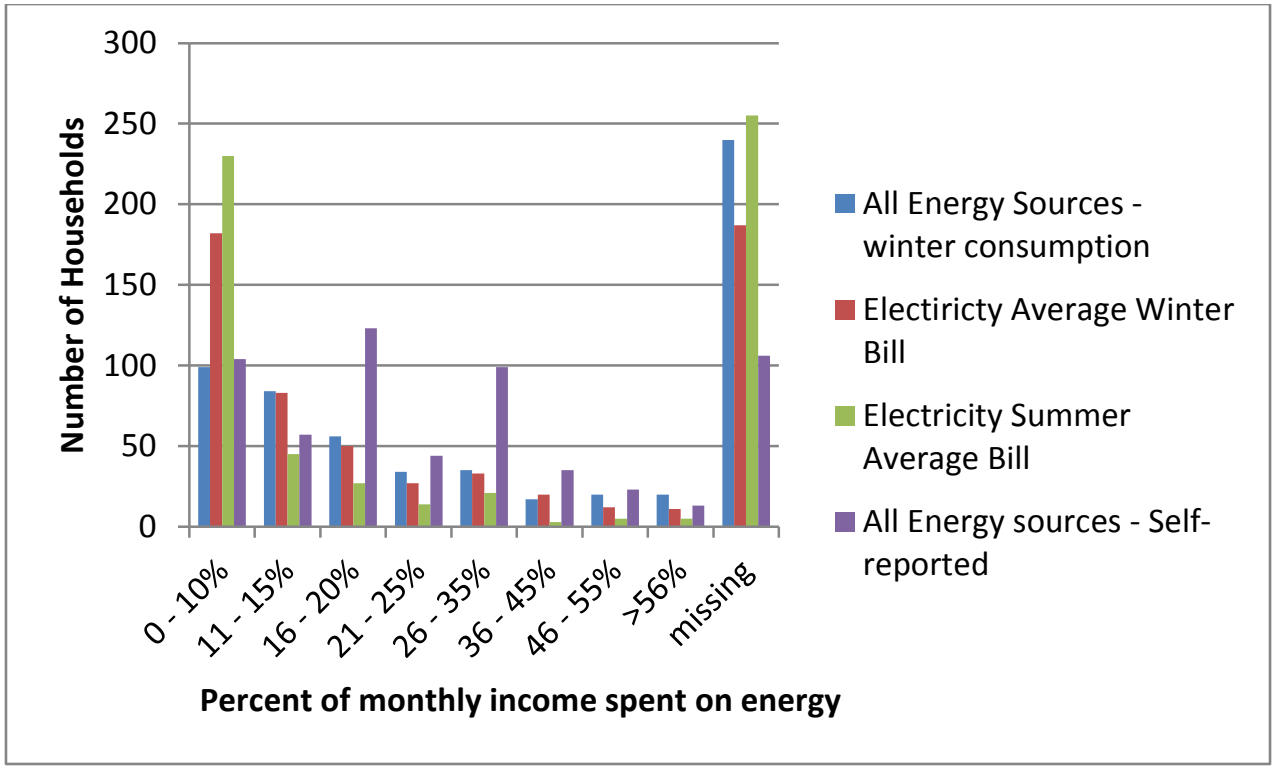


Figure 1. Percentage of Income spent on Energy over the Winter Months

Heating Systems Ranked (LSLP)

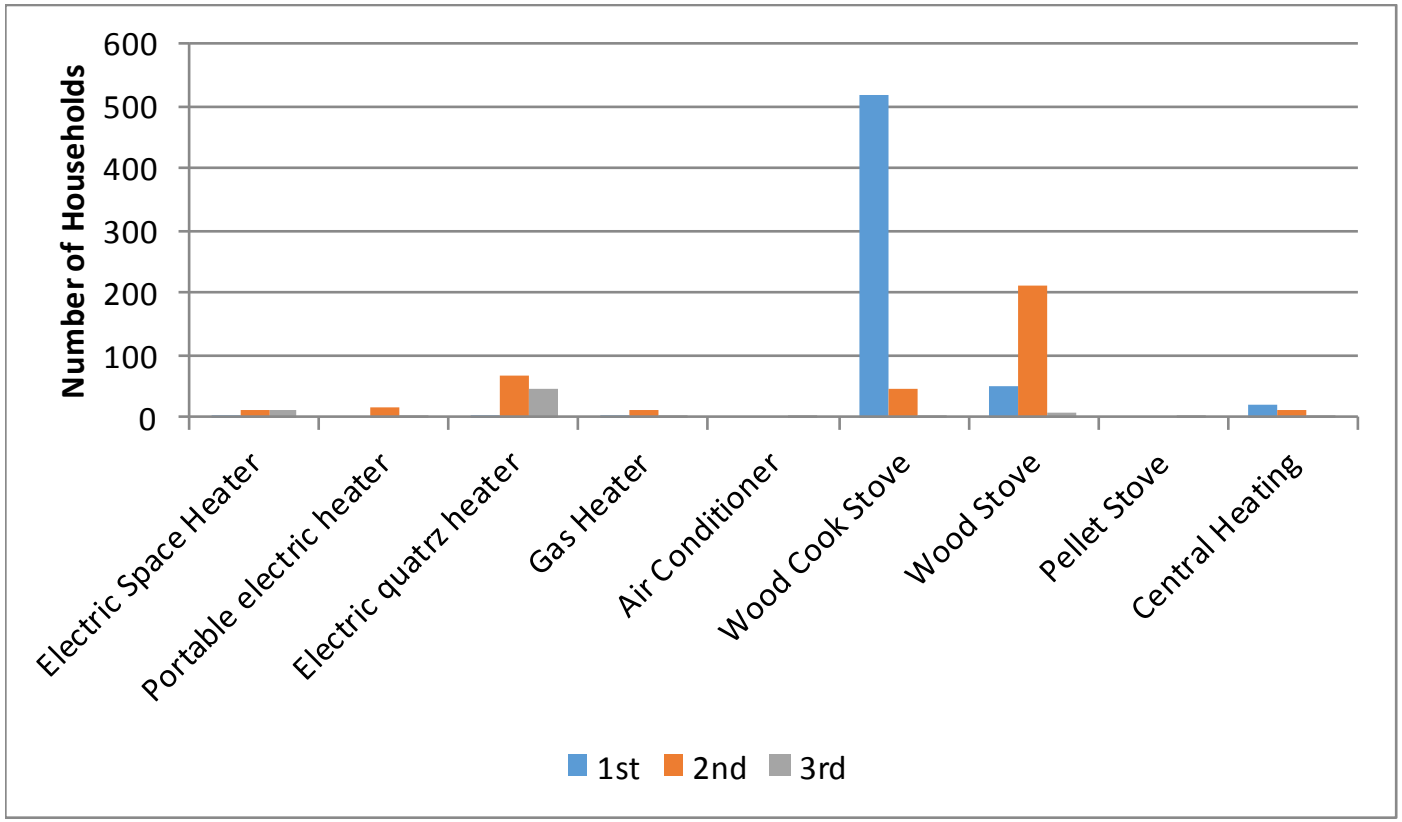


Figure 1. Heating Systems Ranked by Usage

Reasons behind heating source ranking

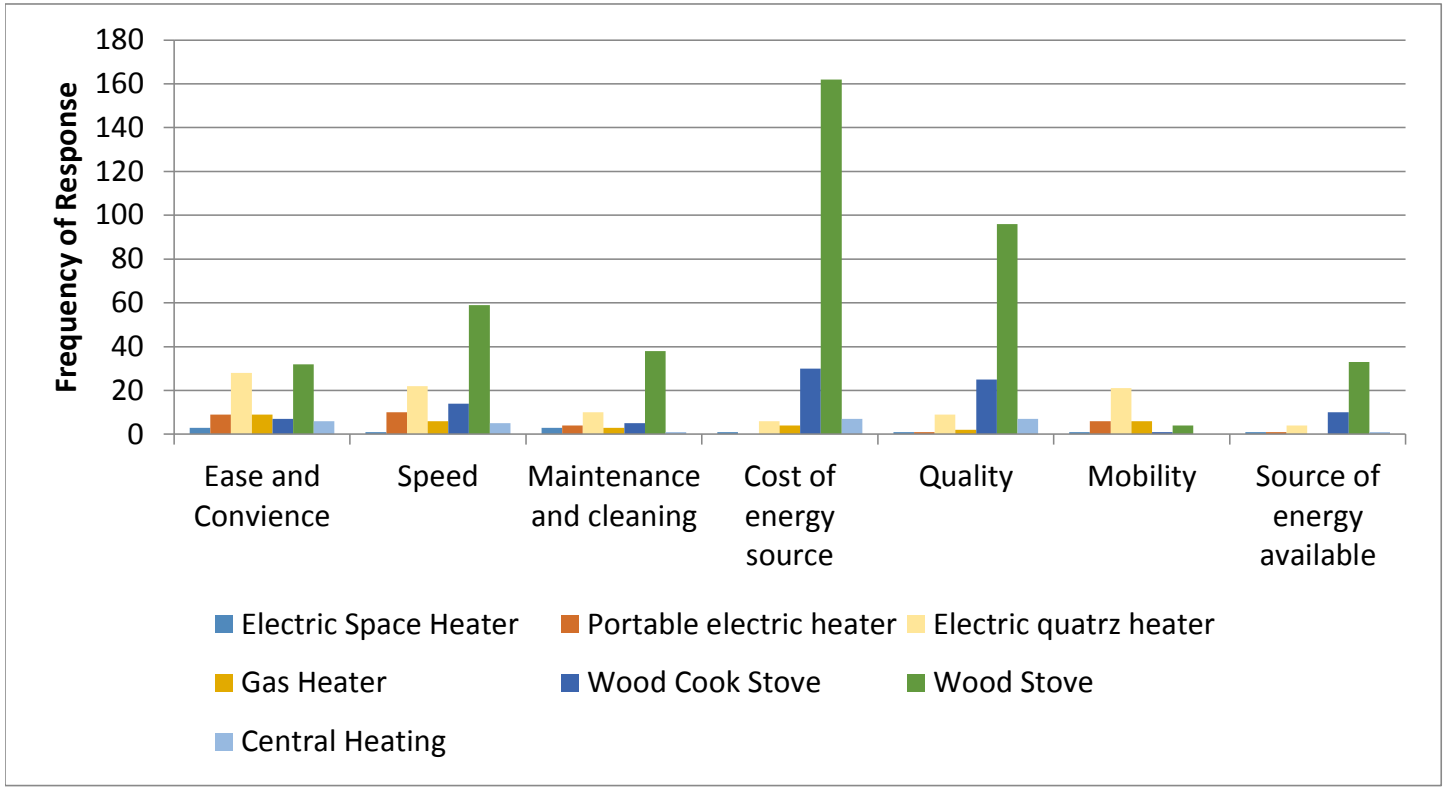
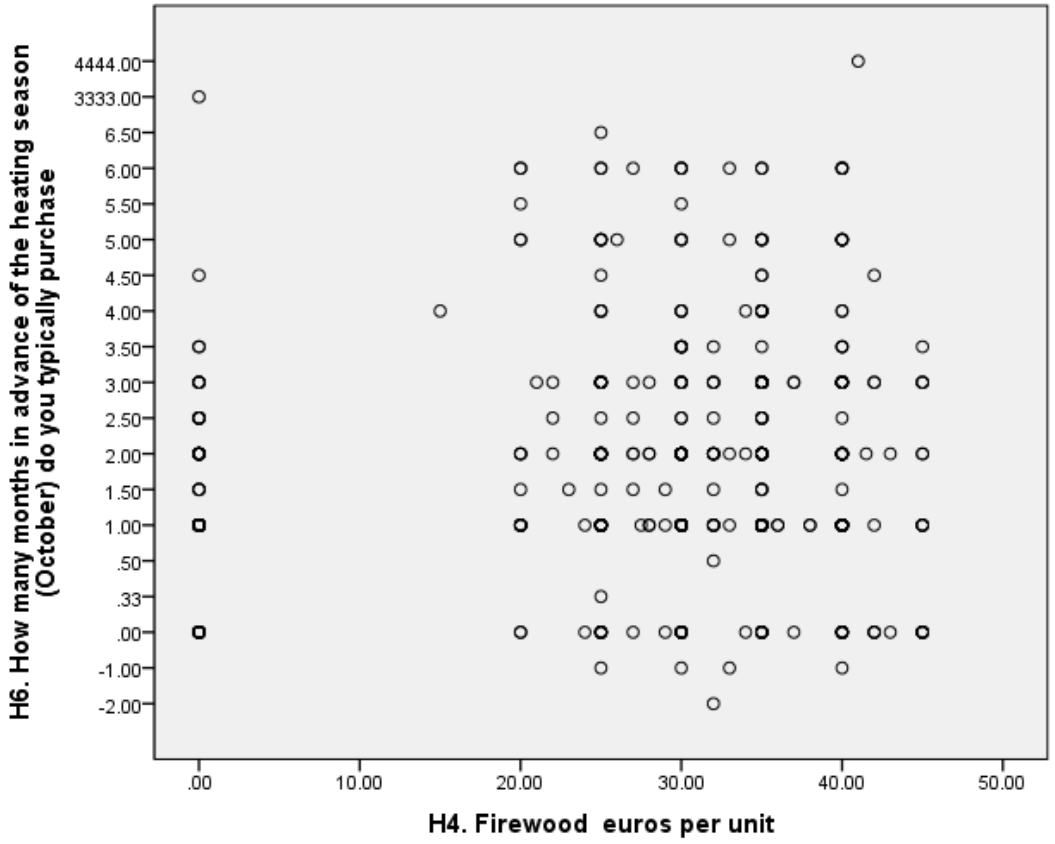
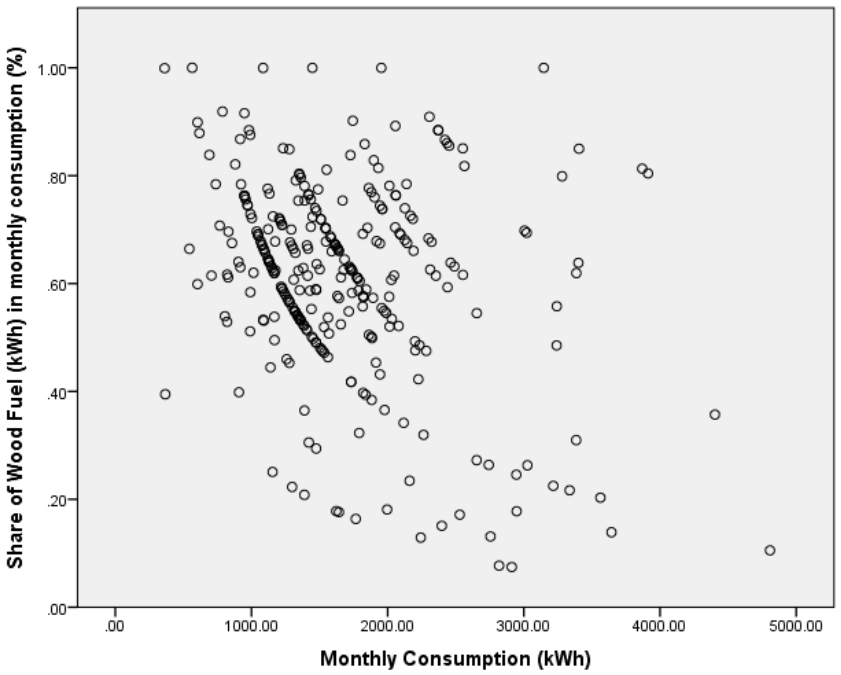


Figure 1. Reasons behind Why Respondents Use their Top Three Heating Systems

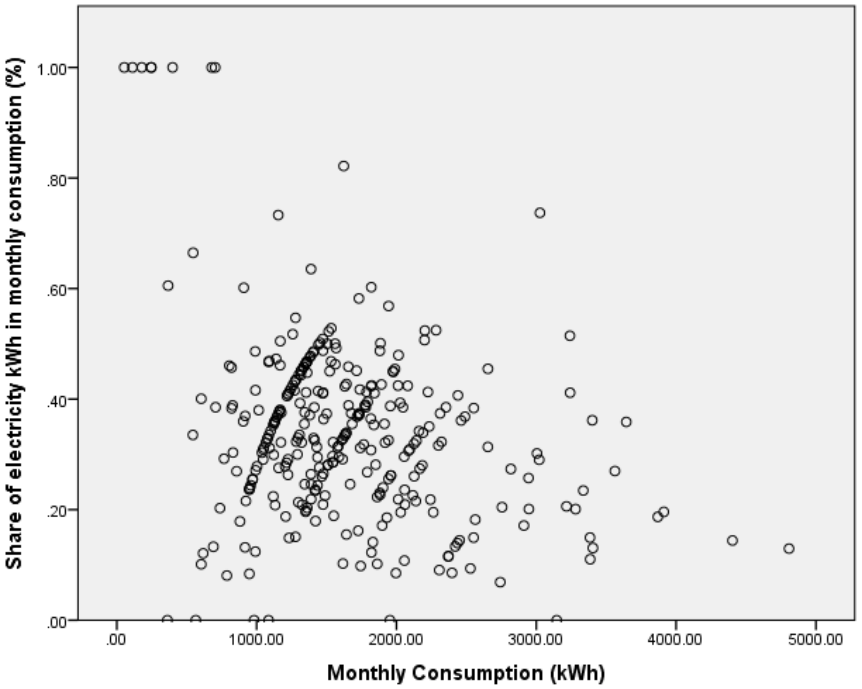
Seasonal Prices of Wood Fuels



Scatter plot of the Share (kWh) for digital meter consumer by their total monthly consumption



Wood Fuels



Electricity

Modeling Elasticity of Demand

- $$\begin{cases} I_i = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \ln(\boldsymbol{E}) + \boldsymbol{\Sigma_j \beta_{ij}} \ln(\boldsymbol{q_{ij}}) + \boldsymbol{\Sigma_j \beta_{3j}} \ln(\boldsymbol{p_j}) + \boldsymbol{\Sigma_k \gamma_{ik} H_k} + u_i \; if \; w_i > 0 \\ 0 \; otherwise \end{cases}$$
- In the second stage, the initial Working-Leser model with the inverse Mills ratio is estimated. The Working-Leser model for the share equations are specified as,
- $$\mathbf{w_i} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \ln(\boldsymbol{E}) + \boldsymbol{\Sigma_j \beta_{ij}} \ln(\boldsymbol{q_{ij}}) + \boldsymbol{\Sigma_j \beta_{3j}} \ln(\boldsymbol{p_j}) + \boldsymbol{\Sigma_k \gamma_{ik} H_k} + \boldsymbol{\theta_i \lambda_i} + \boldsymbol{\epsilon_i}$$
- Where
  - w_i are the monthly shares measured in kWh of the different energy sources (wood, electricity, lignite, natural gas) from the total
  - q_i are the quantities of wood (w, m^3), Ave winter Electricity (e, kWh), lignite (l, tons) and Natural gas (G, Liters) consumed monthly
  - p_i are the relative prices of the different energy sources
  - E is the expenditure on energy (€)
  - H is a vector of household related characteristics
  - λ_i is the inverse Mills Ratio

Elasticity measurements for price and expenditure for Wood Demand

Elasticity	
e_Ln(wood_p)	-0.997
e_Ln(ele_p)	0.363
e_Ln(coalp)	-0.031
e_Ln(NG_p)	-0.017
e_e	0.359

$$e_i = -\boldsymbol{\delta_{ij}} + \frac{\beta - \psi_i \omega_i \{\Gamma_i \omega \lambda_i - \lambda_i^2\}}{\overline{w_i}}$$

Interpretation

- As total expenditure on energy resources increase by 1% it will result in the proportion of household energy demand met by wood fuels to increases by 35%.
- The average share for wood fuels in the LPLS households is 40% (or 9.76 m^3 of solid wood), so a 35% increase of 2.08 m^3 over the entire season
- Equal to the response from households when the price of electricity moves from one tariff block to the next higher, as the elasticity for electricity price is 36%
- The price of lignite increases by 1%, the share will decrease consumption by, 3.1%.

Conclusions

- Substitution elasticities will impact the responsiveness of the market.
- When energy consumption or prices increase, these households will be likely to consume more wood fuels over electricity, given the current tariff system, further straining the unsustainable forest system.
- Secondary impacts -
  - Consumption of lower cost fuel sources may alter the payback periods on improving energy efficiency in terms of heating or in parallel with the costs of isolation of the exterior of the home.

Questions?

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- Forestry Info
- http://kosovoforests.org/

First Stage Estimation – what drives non-zero use

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-3.501	5.176	-0.676	0.4994	
price.implg_wood_p	0.106	0.088	1.209	0.2276	
price.implg_ele_p	-3.060	1.673	-1.828	0.0686	.
price.implg_coalp	-0.018	0.049	-0.372	0.7101	
price.implg_NG_p	0.044	0.051	0.852	0.3948	
E	-0.533	0.300	-1.778	0.0765	.
HC1_BldgType_House_YrC	-0.001	0.002	-0.569	0.5698	
HC2_Surface	-0.009	0.002	-4.326	2.15E-05	***
HEle_Heat	-0.056	0.350	-0.16	0.8728	
HAge	0.005	0.009	0.519	0.6041	
HEmployed	0.199	0.160	1.24	0.2161	
HTotPeople	-0.011	0.046	-0.241	0.81	
HEDU_HH	-0.197	0.205	-0.96	0.3377	
HF5_Inc_E	0.195	0.422	0.461	0.6448	
qty.imp.wwAve_kWh_Ele_Winter	0.005	0.001	7.441	1.38E-12	***
qty.imp.wwH4_CoalQty	0.002	0.001	2.49	0.0134	*
qty.imp.wwH4_NatGas_Qty	0.000	0.001	0.627	0.5311	

Second Stage Estimation – What's driving the amount of consumption

	Estimate	Std. Error	t value	Pr(>|t|)	
price.implg_wood_p	-0.001	0.007	-0.164	0.870	
price.implg_ele_p	0.135	0.097	1.391	0.165	
price.implg_coalp	-0.010	0.003	-2.877	0.004	**
price.implg_NG_p	-0.004	0.004	-1.095	0.275	
E	-0.118	0.033	-3.599	0.000	***
HC1_BldgType_House_YrC	0.000	0.000	-1.007	0.315	
HC2_Surface	0.001	0.000	2.777	0.006	**
HEle_Heat	-0.017	0.024	-0.689	0.491	
HAge	0.000	0.001	-0.488	0.626	
HEmployed	0.001	0.007	0.178	0.859	
HTotPeople	0.012	0.003	3.954	0.000	***
HEDU_HH	0.016	0.015	1.065	0.288	
HF5_Inc_E	0.002	0.028	0.067	0.946	
qty.imp.wwAve_kWh_Ele_Winter	0.000	0.000	-2.999	0.003	**
qty.imp.wwH4_CoalQty	0.000	0.000	2.357	0.019	*
qty.imp.wwH4_NatGas_Qty	0.000	0.000	-0.043	0.966	

Macro- effects

- Cheap wood fuels coupled with high unemployment rates decrease the economic burden of household heating.
- Resources become scarcer or alternatives increase in cost
  - dependency on the forest will increase
  - conflicts are likely to become more prevalent.

Timing (UNFAO study)

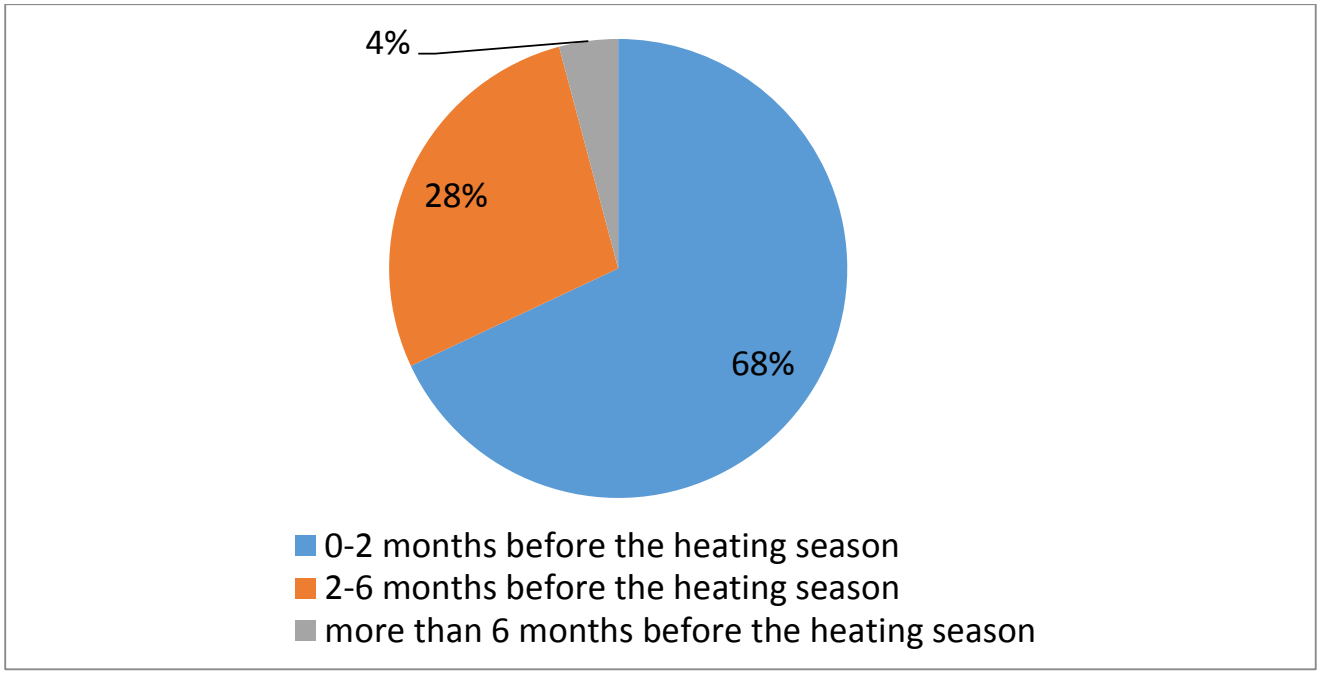

Figure 1. Percentage of Respondents Timing for Preparing or Purchasing Wood(n=1154)

Sourcing Matters

- Huge feedstock questions
  - Farms are on average 1.5 ha, with 80% smaller than 2 ha (1 ha = 2.471 acres)
  - Corn yields are about 3-4 tons/ha
  - Would need about 3% of all ag land to convert into feedstock (1st and 2nd)
  - 50% of the land is estimated to have class 3 &4 soil erosion – most fields are conventional tillage
  - From forests it would need 121,500 m^3 more harvested annually

Forests of the Region

	Serbia	Montenegro	FYROM	Kosovo
Forest Coverage (ha)	2,252,400	826,782	1,159,600	481,000
Standing volume (million m^3)	362.5	122	73.3	46.3
Annual growth increment (million m^3)	9.08	2.9	1.83	1.55
Annual allowable cut, AAC (million m^3)	5.70	0.678	1.30	1.45
Annual realized cut/production (million m^3)	2.99 - 4.6	1.16	0.748	1.6 - 2.27
Annual consumption/demand (million m^3)	6.42	1.06	2.43	2.3
Study, year	(Vasiljevic, 2011)	(UNFAO and Montenegro-Luxembourg Development Cooperation, 2013)	(MAFWE, 2006)	(MAFRD, 2013a; UNFAO, In Press)

Importance on Resources

	Serbia	Montenegro	FYROM	Kosovo
Percentage of households using wood fuels for heating/cooking (%)	40.9	67.91	75	88
Rural households (%)	/	/	95	95
Urban households (%)	/	/	59	78
Study, year	(Vasiljevic, 2011)	(UNFAO and Luxembourg Development Cooperation, 2013)	(MAFWE, 2006)	(KAS, 2011b)