

Some opportunities of wood biomass use for coal replacement through SFM in Mongolia

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3E Nexus Annual Meeting,
January 18-19, 2017. University of Tokyo

Challenging issues

- Continuing **deforestation and forest degradation**; inadequacies in natural forest management;
- Fall in forest productivity; poor quality of forest plantations; **wasteful logging operations**; negative environmental impacts; closure and **low capacity utilization of wood processing units**;
- Fall in forest based employment and income; **very low (insignificant) level of investment in the forestry sector**; low priority; **lack of ability for policy enforcement**; lack of adequately skilled human resource; weak research capability; and weak relationships between entities engaged in forestry.

What is Sustainable Forest Management ?

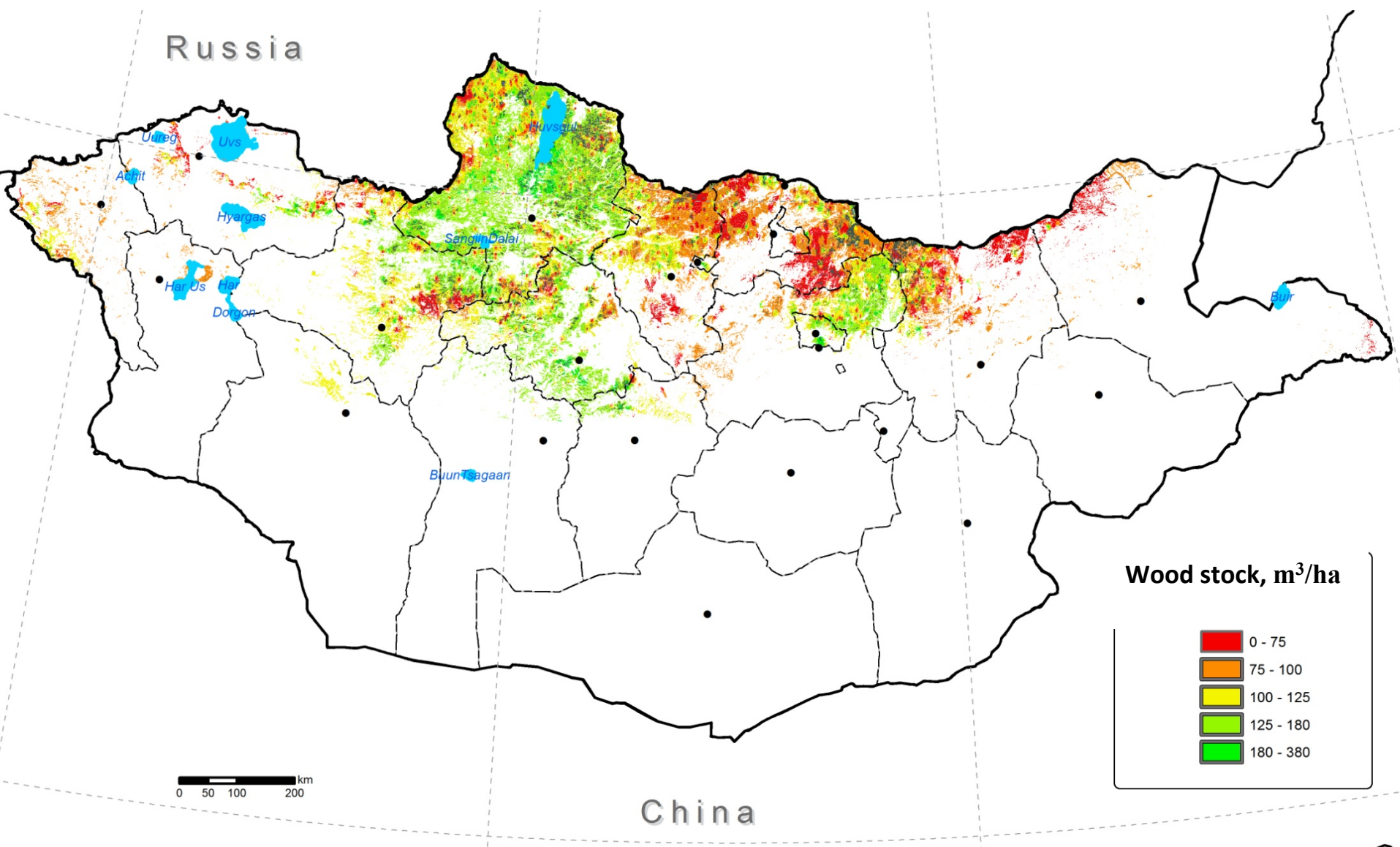
“Sustainable forest management is *a dynamic and evolving concept, which aims to maintain and enhance the economic, social and environmental values of all types of forests, for the benefit of present and future generations ...*” UNFF 2007.

Thematic elements of SFM

These seven thematic elements of SFM are:

1. Conservation of forest resources
2. Forest biological diversity
3. Forest health and vitality
4. Productive functions of forests
5. Protective functions of forests
6. Socio-economic functions of forests
7. Legal, policy and institutional framework

Distribution of forest resources in Mongolia

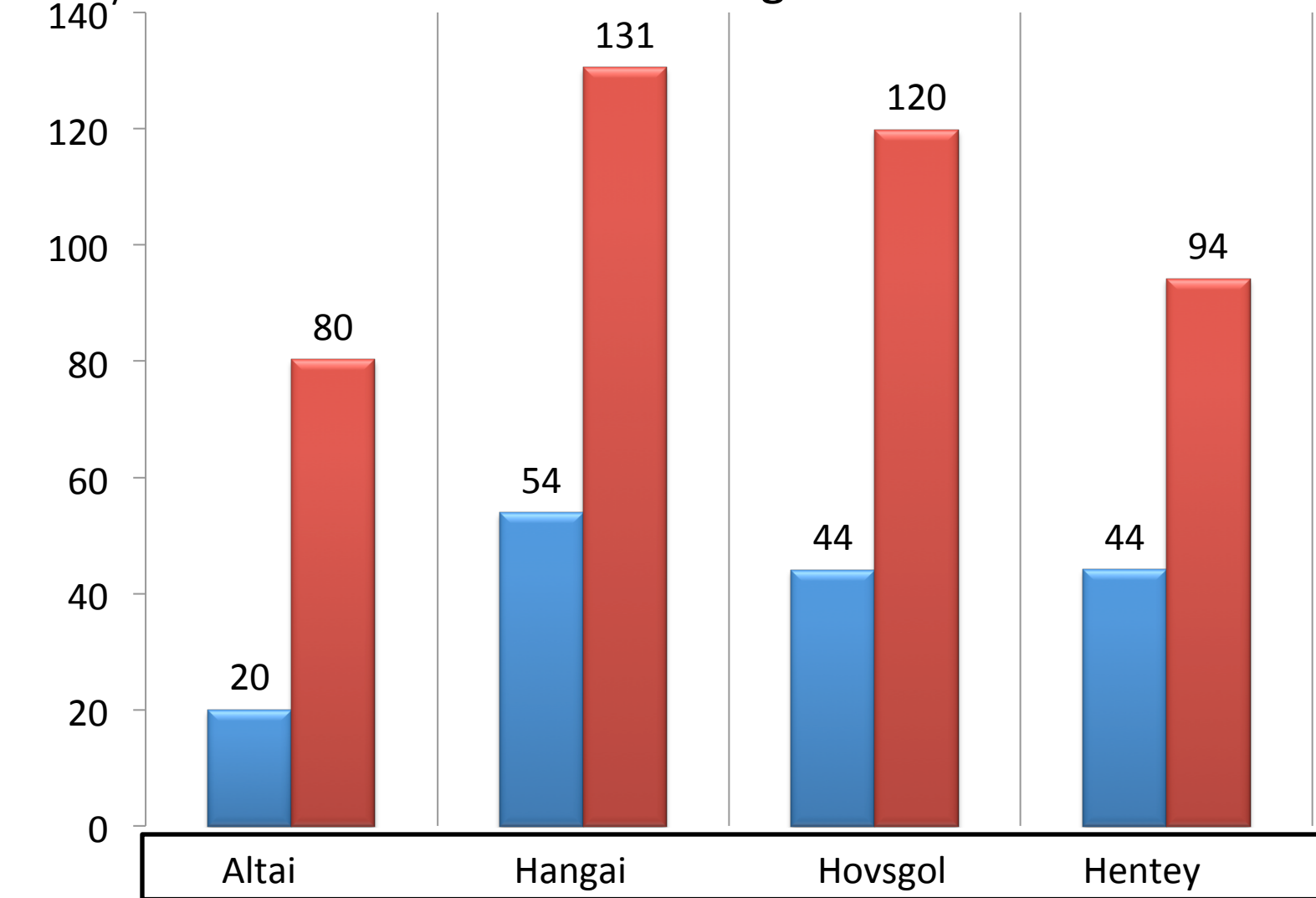


Growing stock by tree species

Tree species	Forest vegetation regions					Average	
	Altai	Hangai	Hovsgol	Hentey	Buffer area	m ³ /ha	(%)
Total	73.4	129.2	121.0	95.4	98.4	111.7	100
Larix sibirica	69.8	125.1	104.8	47.5	82.7	88.3	79.0
Pinus sibirica	0.1	3.4	5.1	16.1	5.1	8.0	7.2
Betula platyphylla	0.1	0.5	7.2	13.4	4.0	7.6	6.8
Pinus sylvestris	0.004	0.01	2.5	15.3	5.8	6.2	5.5
Picea obovata	2.8	0.1	1.1	1.1	0.5	1.0	0.9
Aspen	0.0004	0.02	0.1	1.2	0.2	0.4	0.4
Abies sibirica	0.2	-	0.05	0.8	0.1	0.3	0.2
Populus	0.4	0.01	0.06	0.01	-	0.04	0.03
Ulmus pumila	-	0.003	0.01	0.003	-	0.01	0.01

Comparison of Growing stock and Dead wood in forest regions

cub.m/ha



Dead wood classification

According to the FAO's Global Forest Resources Assessment 2005, forest deadwood can be defined as all non-living woody biomass not contained in the litter, either standing, lying on the ground or in the soil; deadwood includes the following components :

standing dead trees, lying dead trunks and fallen branches and twigs and stumps.

Important structural and functional component of forest ecosystems

It is an essential substrate **for numerous insects as well as fungi** (Nordén et al.2004; Herrero et al.2014);
a key factor in the **nutrient cycle of C, N and Mg** (Krankina and Harmon1994; Holub et al.2001);
a fundamental element in the **ecological and soil hydrological processes** (Bragg and Kershner 1999) and
a valuable **forest carbon pool** (Ravindranath and Ostwald 2008).

Price of coal for heating at soum centers in forest areas of Western Mongolia

no	Name of soums	Price of coal for heating per ton /thousand tugrik, MNT/		Distance from coal mining (km)
		For heating of local organizations	For heating of households	
1.	Ikh Uul	70,000-90,000	no use	153
2.	Tosontsengel	60,000-70,000	no use	107
3.	Telmen	70,000-75,000	no use	100
4.	Ider	110,000-120,000	no use	160
5.	Uliastai	120,000-130,000	130,000-150,	200
6.	Otgon	130,000-180,000	000	328
7.	Yaruu	110,000-120,000	130,000-200,	258
8.	Tsagaanhairhan	100,000-120,000	000	244
9.	Nomreg	60,000-65,000	110,000-130,	107
10.	Tudevtei	70,000-85,000	000	122
11.	Tsetsen-Uul	140,000-150,000	n/a	198

Price and usage of coal for heating in Hovsgol aimag

№	Name of soums	Name of coal mining sites	Distance from coal mine / km/	Price per ton /MNT/	
				For entities and organizations	For households
1	Tsagaan-Uur			None use	None use
2	Chandmani-Undur	Mogoin gol Coal Mine	300	50,000	None use
3	Erdenebulgan			None use	None use
4	Tunkhel	Gilchig Coal Mine	45	39,600	None use
5	Tarialan	Ereen Coal Mining	160	55,000	None use
6	Khatgal			None use	None use

Price and usage of coal for heating in Hovsgol aimags (in southern areas)

№	Name of soums	Name of coal mining site	Distance from Coal mine /km/	Price per ton /MNT/	
				For entities, organization	For household
11	Tsagaan-Uul	Mogoin gol	80	45,000	50,000
12	Tsetserleg	Mogoin gol	22	44,000	44,000
13	Galt	Mogoin gol	160	50,000	No use
14	Rashaant	Mogoin gol	110	110,000	110,000
15	Jargalant	Gilchig	170	70,000	100,000
16	Shine-Ider	Mogoin gol	220	36,300	40,000
17	Burentogtoklh	Mogoin gol	175	65,000	No use

Deadwood resources selected aimags of Mongolia

Name of provinces	Forest area, 000' ha	Areas and resources for forest cleaning			Forest areas and woody stock under concession, 000' ha/ 000' m ³
		Area /000' ha /	Snags /000' m ³ /	LDW /000' m ³ /	
Arkhangai	1082.62	88.87	2016.4	956.7	251.3/222.0
Bulgan	1905.01	423.77	5833.0	3363.3	506.1/893.5
Darkhan Uul	71.99	1.15	28.3	4.5	56.4/3.5
Dornod	222.38	53.73	528.6	275.5	99.8/123.7
Zavkhan	490.73	137.99	7242.7	1532.4	170.6/532.6
Selenge	1534.11	298.17	4358.8	4180.7	549.6/1497.9
Tov	544.51	140.29	4133.4	1602.1	240.2/706.7
Hovsgol	4005.41	748.23	12189.4	4470.0	663.8/740.7
Hentii	1132.69	197.81	7311.6	2712.1	335.9/804.3

Source: Forest Research and Development Center, MEGDT.2013

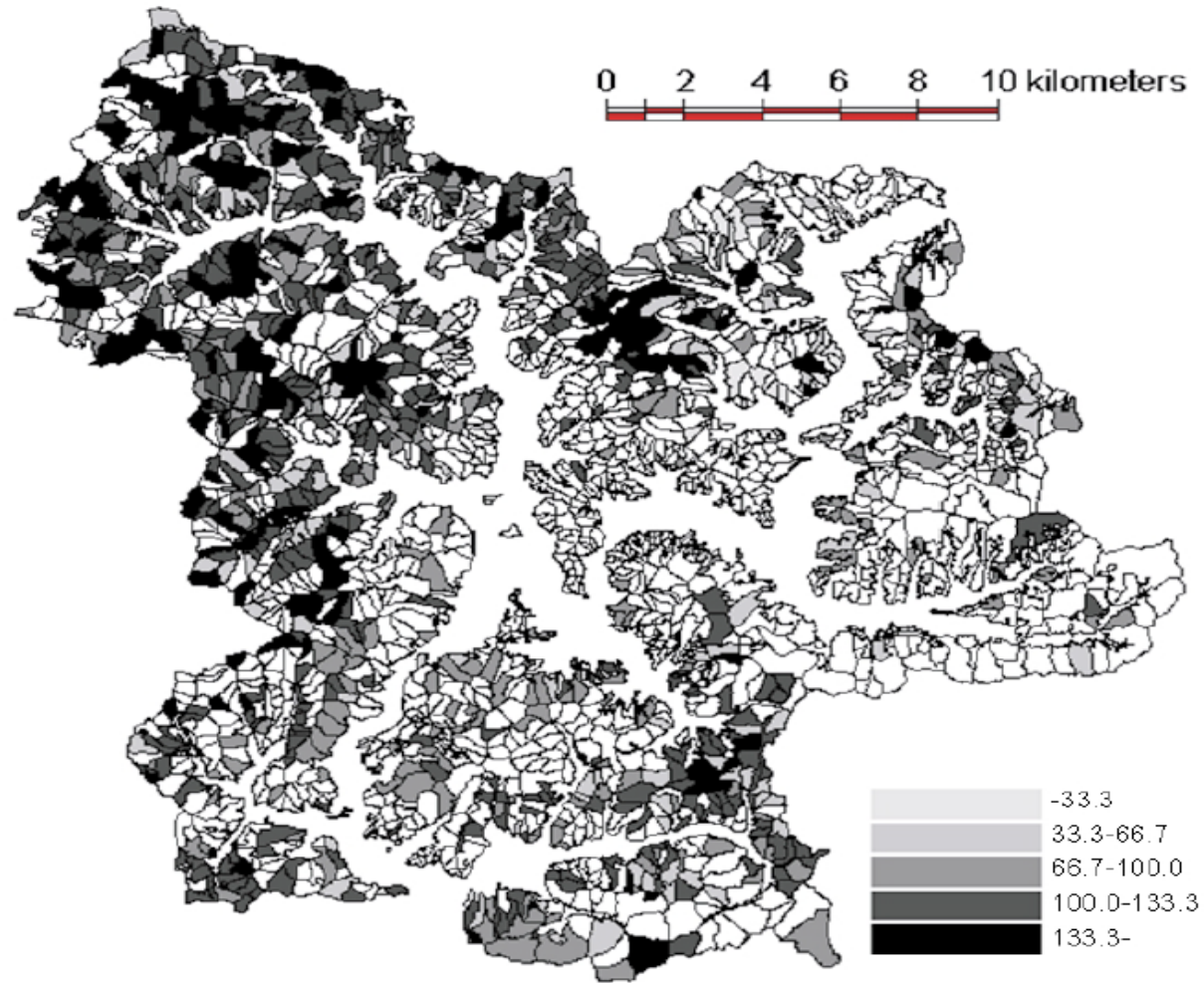
Comparison Wood Briquettes vs. Wood Pellets vs. Bio-carbon Pellets vs. Coal

INDICATORS	Wood briquettes	Wood Pellets	Bio-C Pellets	Coal
Moisture Content	6 %	7 - 10 %	1 - 5 %	10 - 15 %
Calorific Value (GJ/t)	17 - 19	16 - 20	20 - 24	17 - 28
Bulk density kg/m³	1 000	550 - 750	700 - 850	800 - 850
Off-gassing	Moderate	High	Moderate	Moderate

Enrollment of FUGs in SFM implementation (by-Law)

Stages	Actions of SFM	Enrollment of FUGs in SFM
1.	Natural forest conservation and protection	Responsible
2.	1 st thinning and pruning	Not allowed
3.	2 nd thinning	Not allowed
4.	3 rd thinning	Not allowed
5.	4 th thinning	Not allowed
6.	Tree felling	Not allowed
7.	Establishment of stands of next generation (enrichment of natural regeneration, rehabilitation and reforestation)	Responsible in some case

Example of extraction cost analysis for biomass energy harvesting in Japan (harvesting costs in USD/ton) from Yoshioka (2011)



Productivity of wood extraction

- **MANUAL
TRACTOR
SULKY**

DISTANCE (500M; 1000M; 2000M)

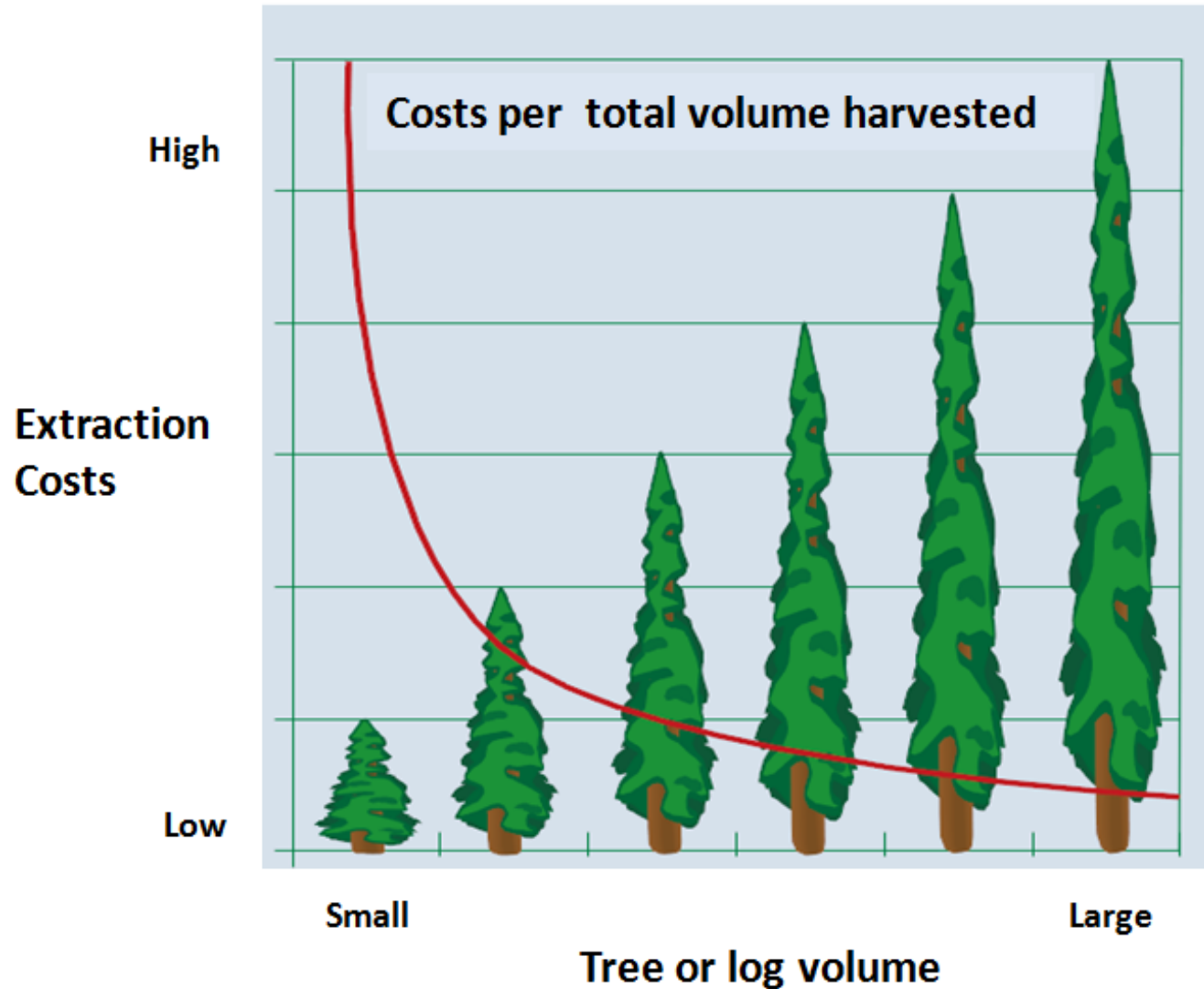
DAILY PRODUCTIVITY

**Mini cable system for wood skidding
300 m reach for up and downhill extraction**



Usable 50 to 70 HP tractors, double drum winch , cost 4-5000 USD

Effect of piece volume ratio



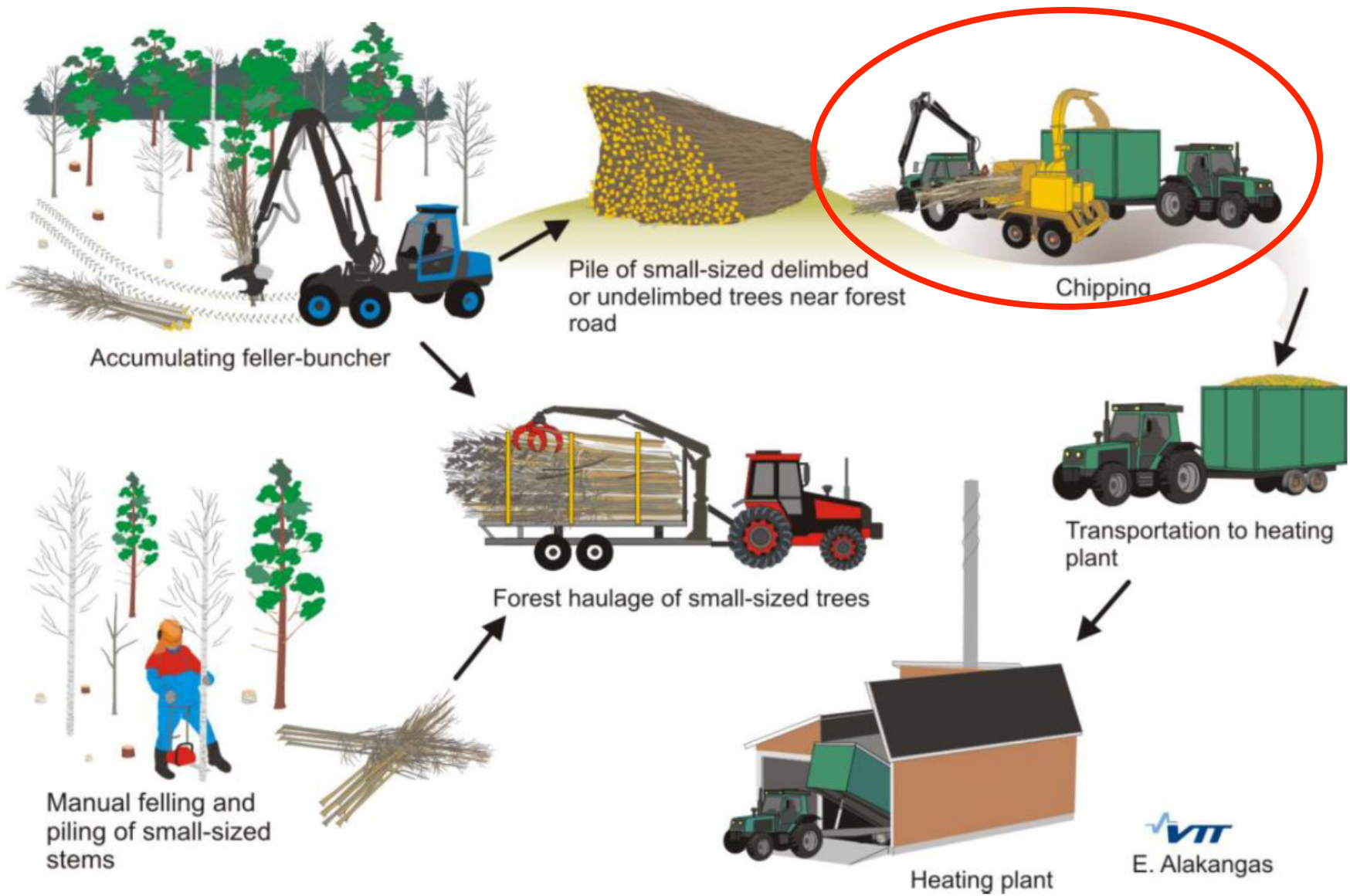
Challenges - Transport

A Basic Problem:

Transporting a low-value, low bulk-density material with a high moisture content over a long distance

- Importance of maximizing payload





SOURCE: E. ALAKANGAS, VTT

FIGURE 2: WOOD CHIPS SUPPLY CHAIN FOR HEAT PRODUCTION (MANUAL AND MECHANICAL FELLING)

Tractor attached firewood processor with manual cross cutting



Tractor attached firewood processor with automatic cross cutting **40 HP** (Superpilke)



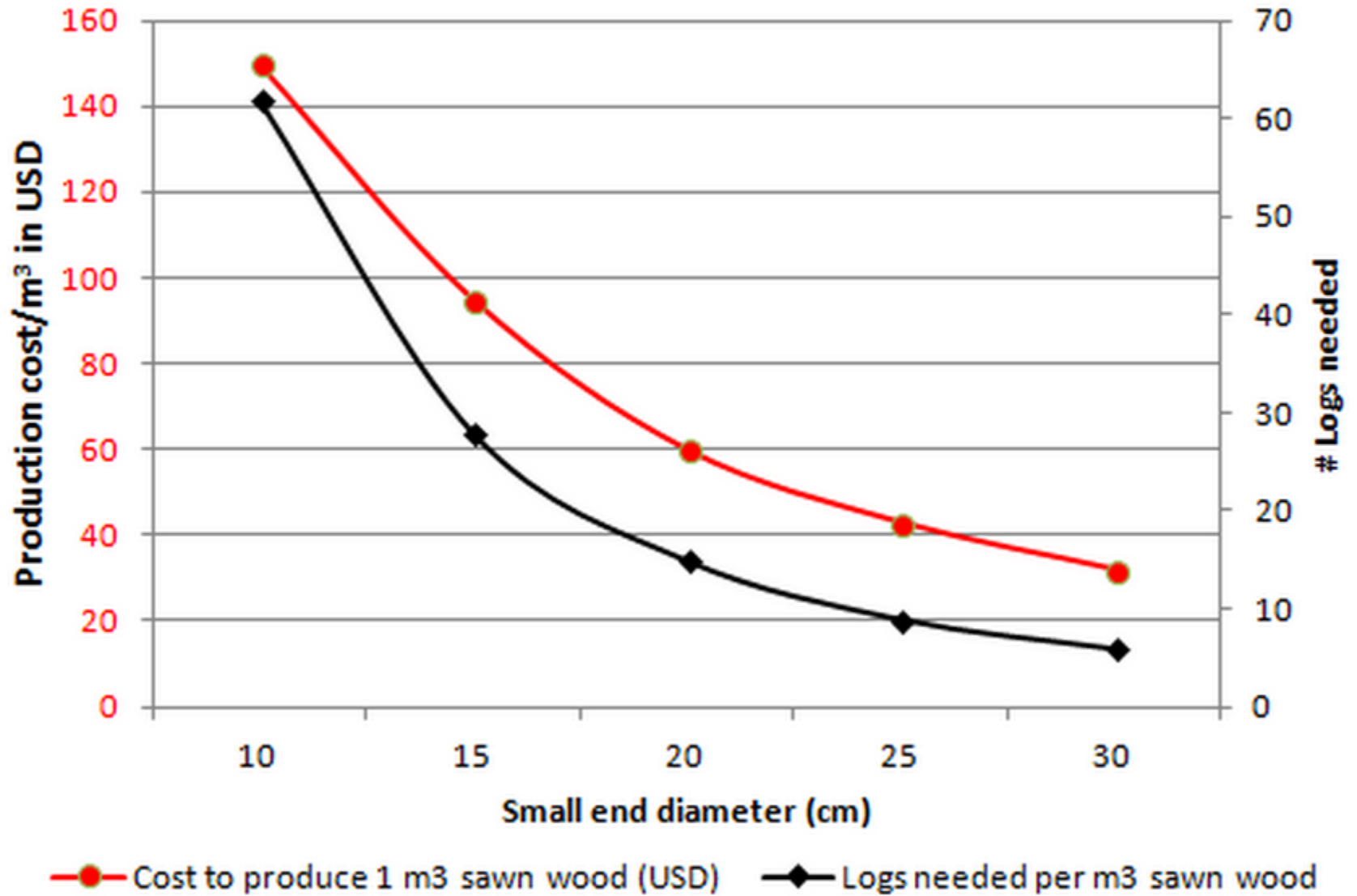
Firewood processor with electric motor 22 + 7 HP



Sawmill waste with value of less than 10 USD/cubic meter

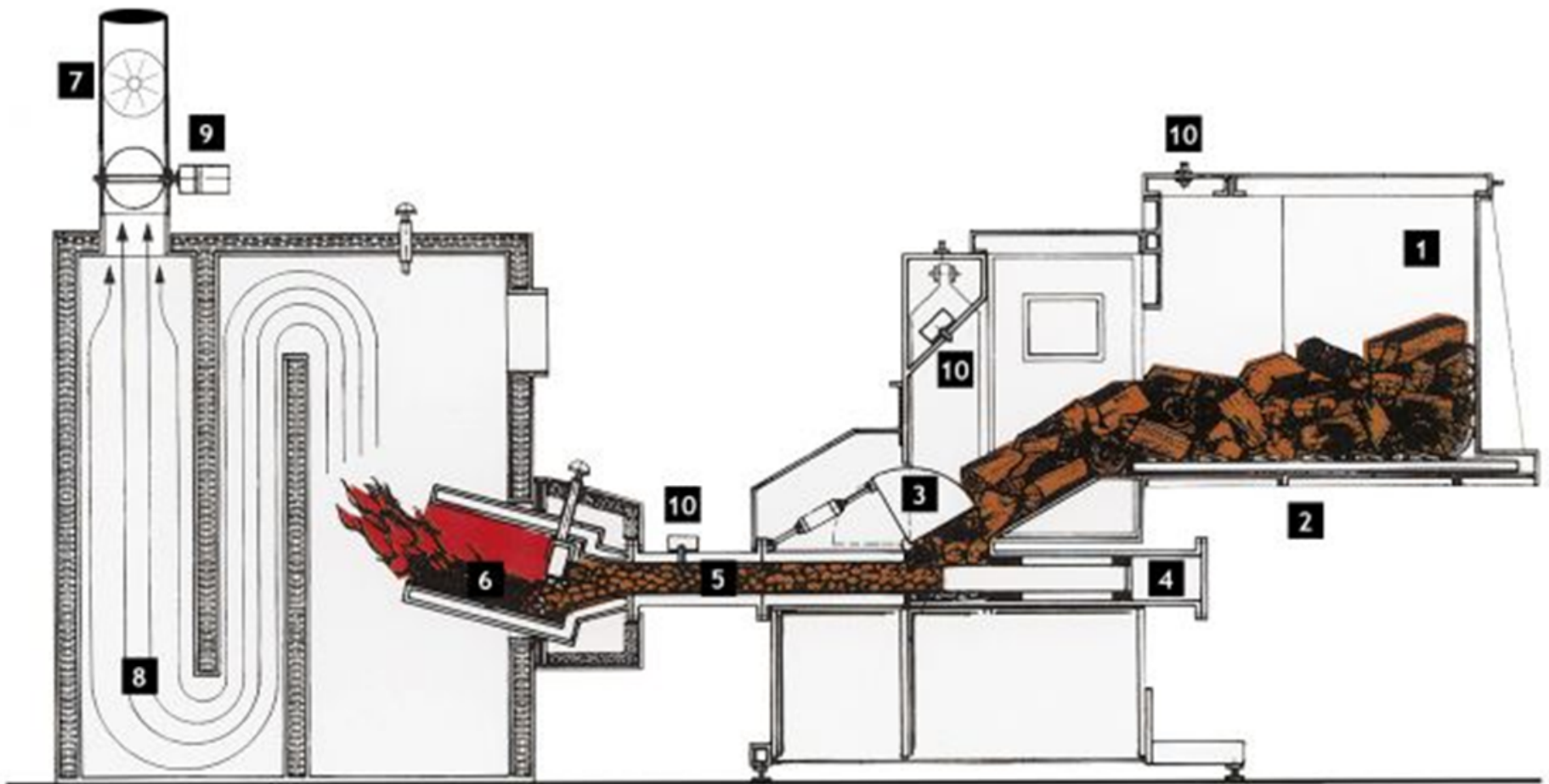


Sawmilling production costs of small logs cutting



Systems for firing solid wood/small logs

1. Feeding system with reduction of fuel material size



System for wood briquette processing



Further work for Enforcement

- Capacity and Training Needs Assessment of Line Agencies in SFM;
- Defining the main target groups for SFM in rural areas;
- Review of Mongolian SFM guidelines, International Best Practices for SFM and Coal Replacement;
- Demonstration and piloting on wood biomass use for heating in local areas;

Findings on dead wood processing

- Deadwood for furniture: **very limited** opportunities due to **availability of similar quality waste wood in industries** (possibly wood turning products , export or tourist markets)
- Deadwood for heating: most likely the **only** pathway for **large scale extraction of deadwood**.

Likely upper price limit of **20 to 25 \$/ton** (coal **40 to 60 \$/ton**) will only allow **split wood** supply chain

Chipping and briquetting to expensive in district heating

Possibilities for briquettes pellets and charcoal for urban markets

- Improved fuel efficiency and building insulation: **focus on co-firing** in coal based systems due to **supply risks**.

Summary

- Focus on split wood production from dead wood for district heating with firewood processors as attachment to 50 to 75 HP
- Technical, financial and ecological lower limit possibly around 10 to 12 cm DBH
- Maximum primary extraction 2000 m and road transport 30 to 40 km
- Assess opportunities for higher quality wood biomass products (high density briquettes and pellets) from sawdust in wood industry for urban markets

Thank you