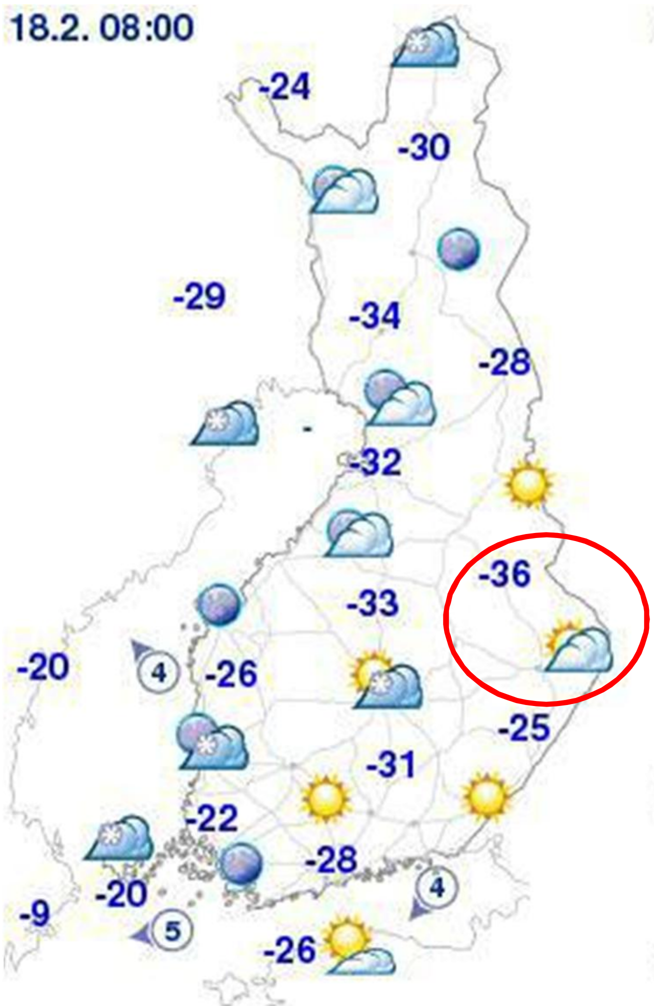
Forest Biomass Resources

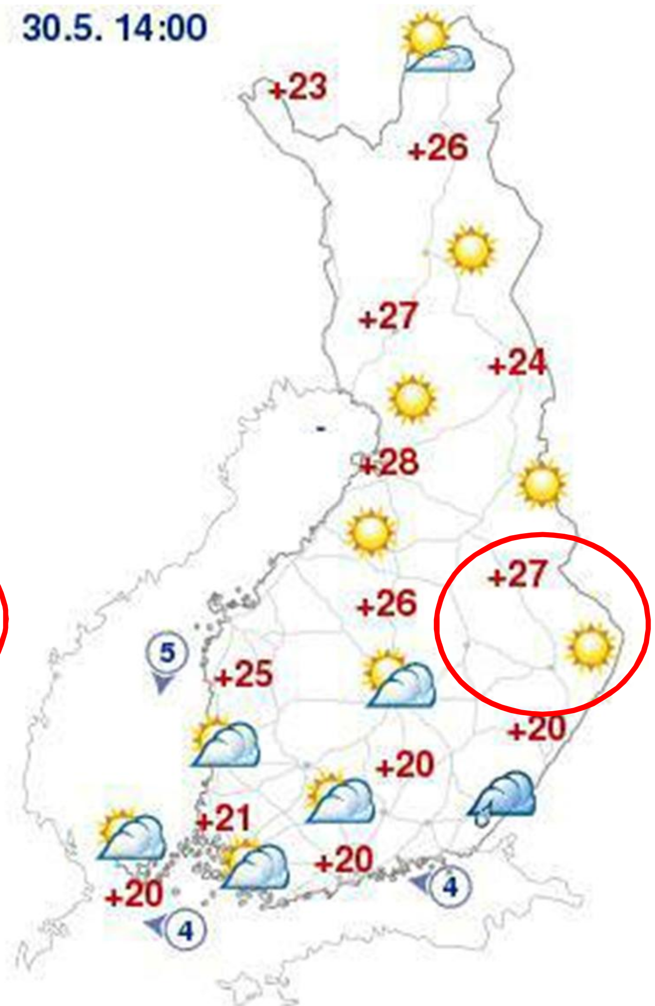
KUAS Training program

Mikko Nivala, FFRI/Metla
Robert Prinz, FFRI/Metla

29.10.2013

Welcome to Finland





Content

- Introduction to Methodology

- Quick Overview of Forest Biomass Resource Assessment in Finland

- Forest Biomass Assessment in Romania: Case Berzasca
  - Selecting End-User and Defining Procurement area
  - Estimating the availability of the energy wood resources on the procurement area
  - Results
  - How to use wood energy resource data:
    - Deciding supply chains to be compared
    - Calculating costs

Introduction to the methodology

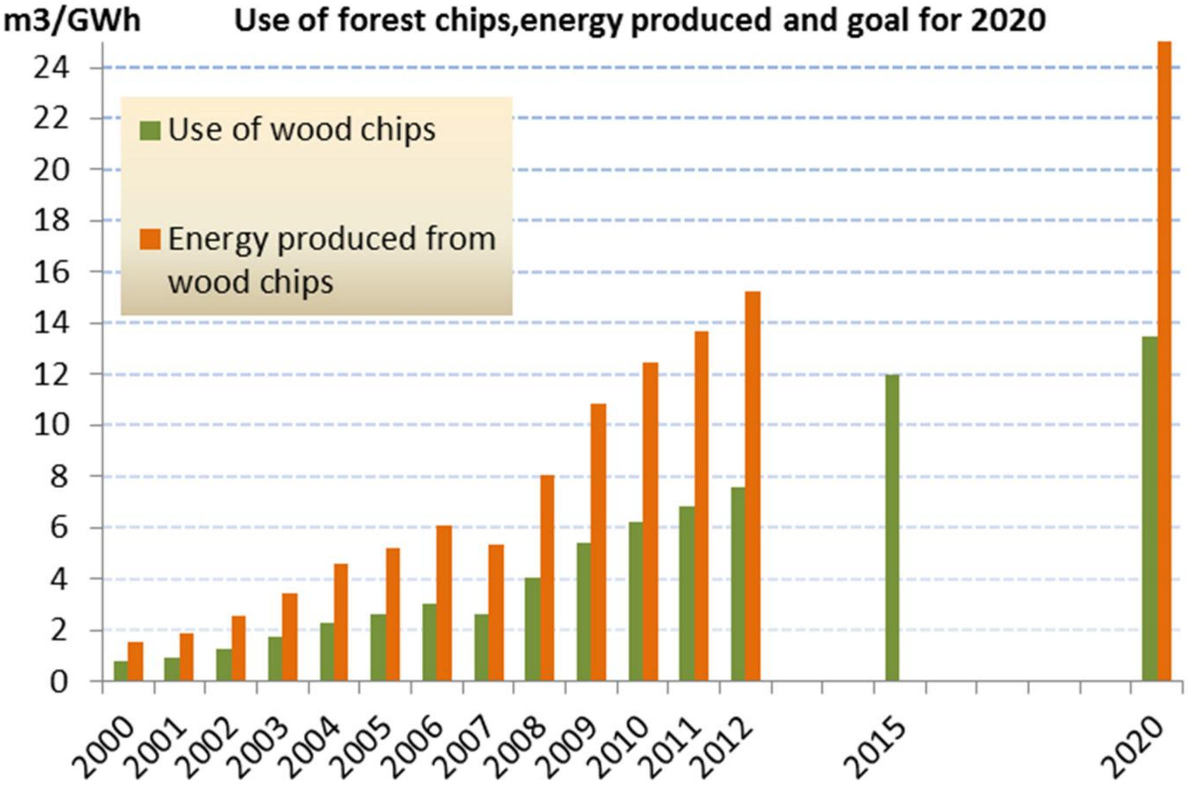
Both studies follow similar procedure as, e.g., the papers by Anttila et al. (2011) and Tahvanainen and Anttila (2011).

The main steps of the estimation procedure are as follows:

- Select the end-user(s) and define the procurement area
- Estimate the availability of the energy wood resources on the procurement area
  - Case/Country depended, Data source (NFI, Remote Sensing, Forest plan,..?) and quality?
- How to use estimation data:
  - Decide upon the supply chains to be compared
  - Calculate costs of each working phase and the total cost of chips delivered at plant.

Quick Overview of Forest Biomass Resource Assessment in Finland

- The Use of Wood Energy



Productive forest land in Finland 20,3 M ha

In Romania around 6,0-6,5 M ha

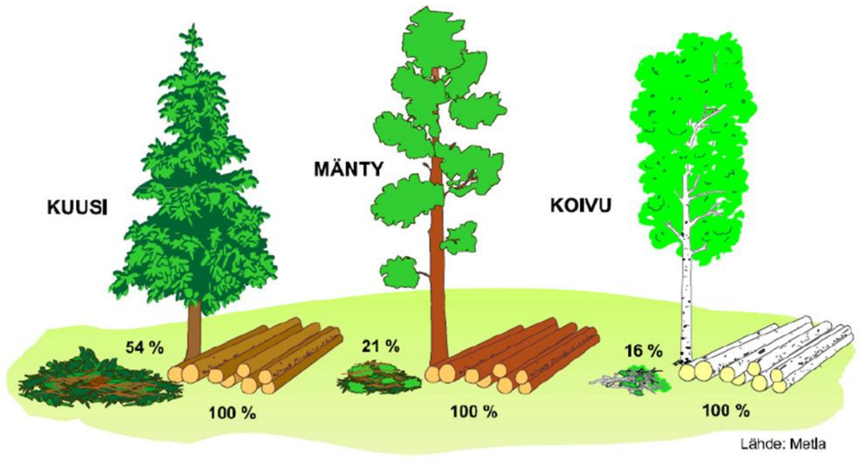
Source: MetInfo

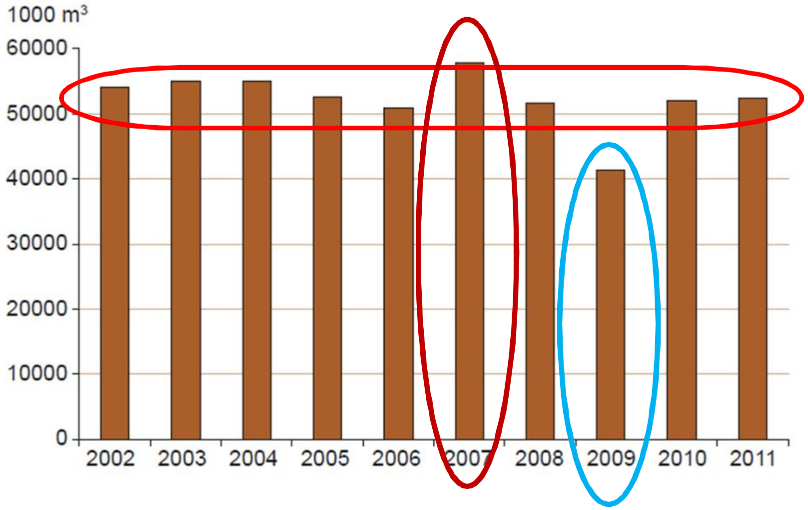
Quick Overview of Forest Biomass Resource Assessment in Finland

- Source: Final Cutting (Forest/Logging Residues and Stumps)

Potential From One Final Cut area?

Amount of Clear Cuts?



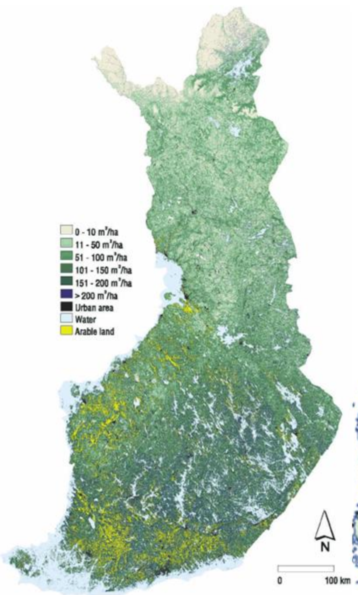


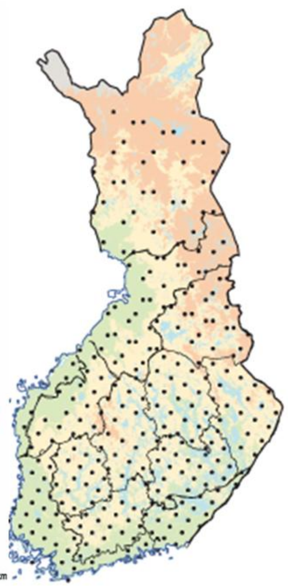
Based on combination of simulations, models and practice

Quick Overview of Forest Biomass Resource Assessment in Finland

- Source 2: Small diameter thinning wood

National Forest Invetory data



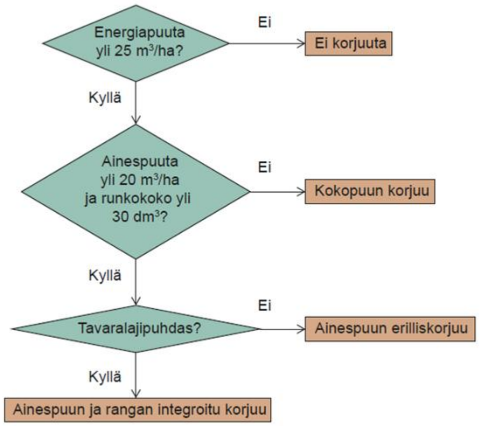


+

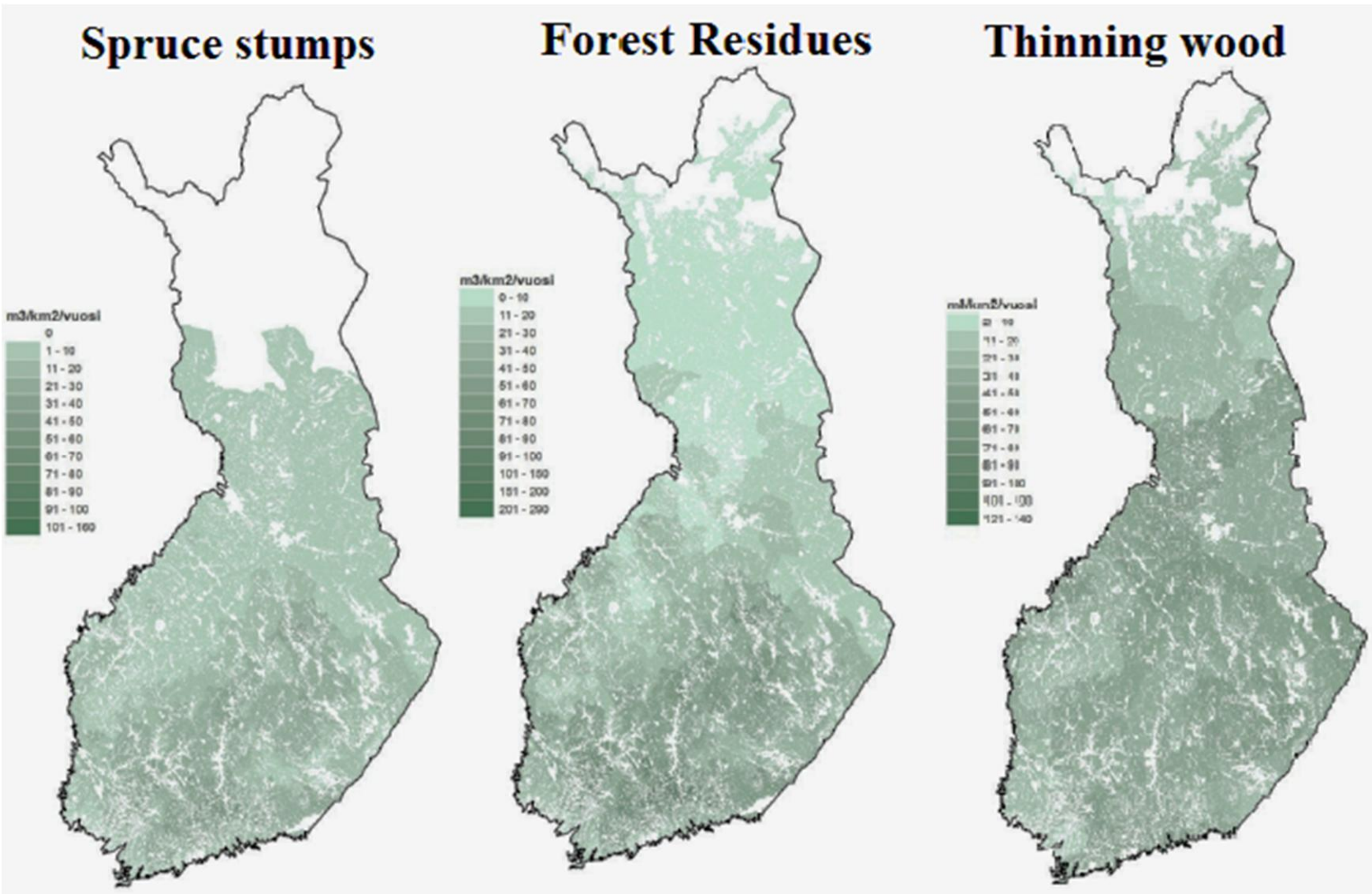
Choosing stands which have potential for harvesting small diameter wood

+

Estimating potential using different harvesting styles and scenarios (simulation)



Quick Overview of Forest Biomass Resource Assessment in Finland



In addition Forest Biomass residues coming from industry

Source: www.trada.co.uk

Forest Biomass Assessment in Romania: Case Berzasca

- KIEMET-project. More information http://www.metla.fi/metinfo/kie/

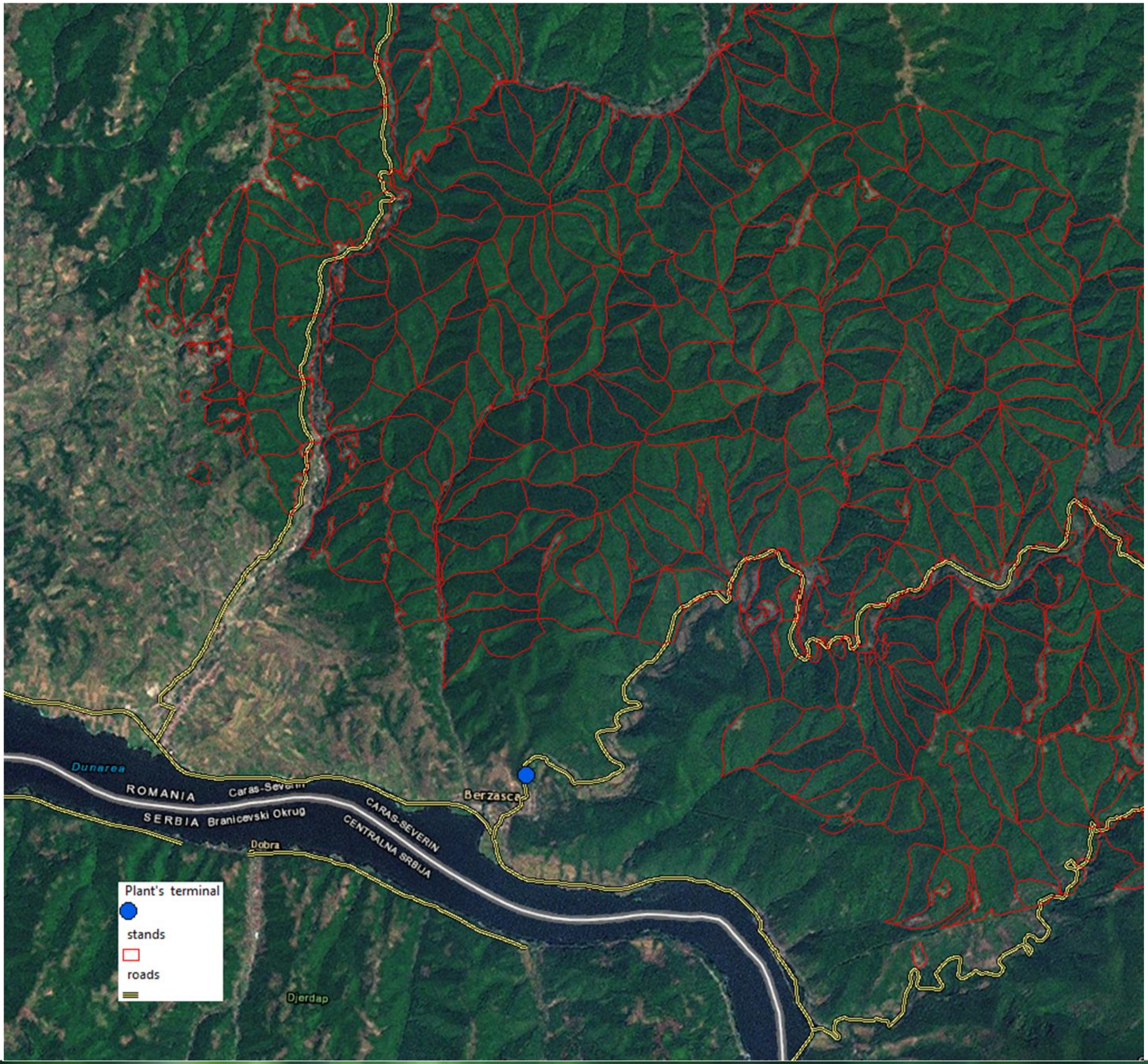
- Data Source:
  - Forest Specialist: Availability, Procurement and Costs
  - ArcGIS: Road data, Slope data, analysis
  - Fores Plan –data (versus NFI in Finland)
  - FAO (Statistic of Romanian Forestry and Practice)
  - World salaries database
  - Calculation has been done by using ArcGIS analysis and Microsoft excel.

DATA was quite limited

Step 1: Defining End-user and Procurement area

- Area of Berzasca
  - Commune in Caraş-Severin County, in the Banat region of western Romania with a population of 3,123 people
  - Interest for Power plant which procurement need is around 2000 solid cubic meter yearly (roughly 1000 MWh).

Case area



Source: Wikipedia, ESRI

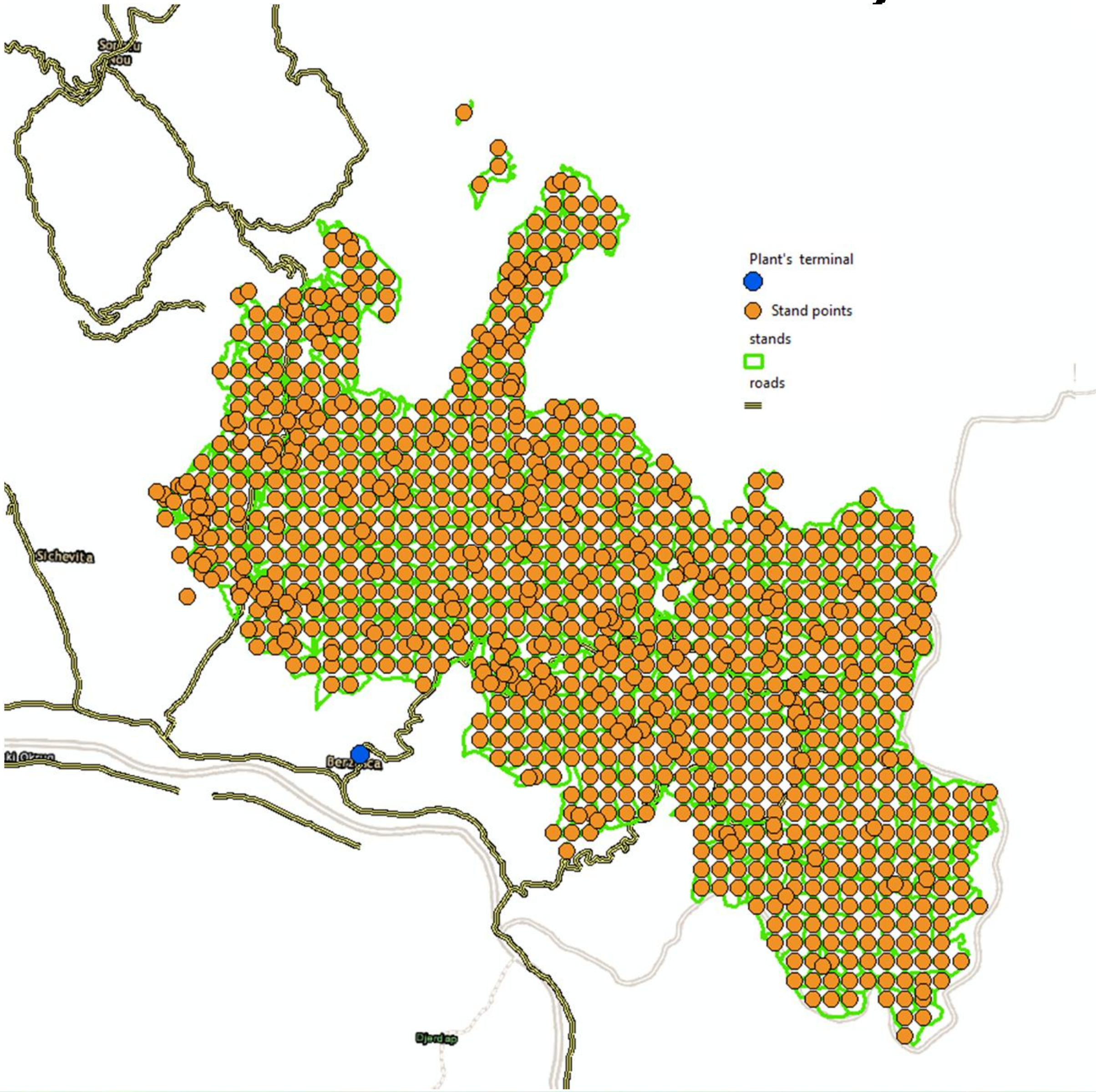
Procurement analysis

- Procurement analysis has been made using following assumptions:
  - It is not allowed to harvest stands which have cherry trees as dominant species
  - It is are not allowed to harvest stands which slope is more than 35 degrees steep
  - The maximum cutting allowance is around 20 000 solid cubic meter (based on sustainable criteria from local expert)
  - Cutting has been made only from one production unit yearly
  - No clear cuts, minimum thinning depending on annual growth and total volume
  - Maximum thinning for energy wood purposes is 15 % of maximum volume of stand (rest for protection, log and pulp production)
  - No restriction for forwarding or transportation distances

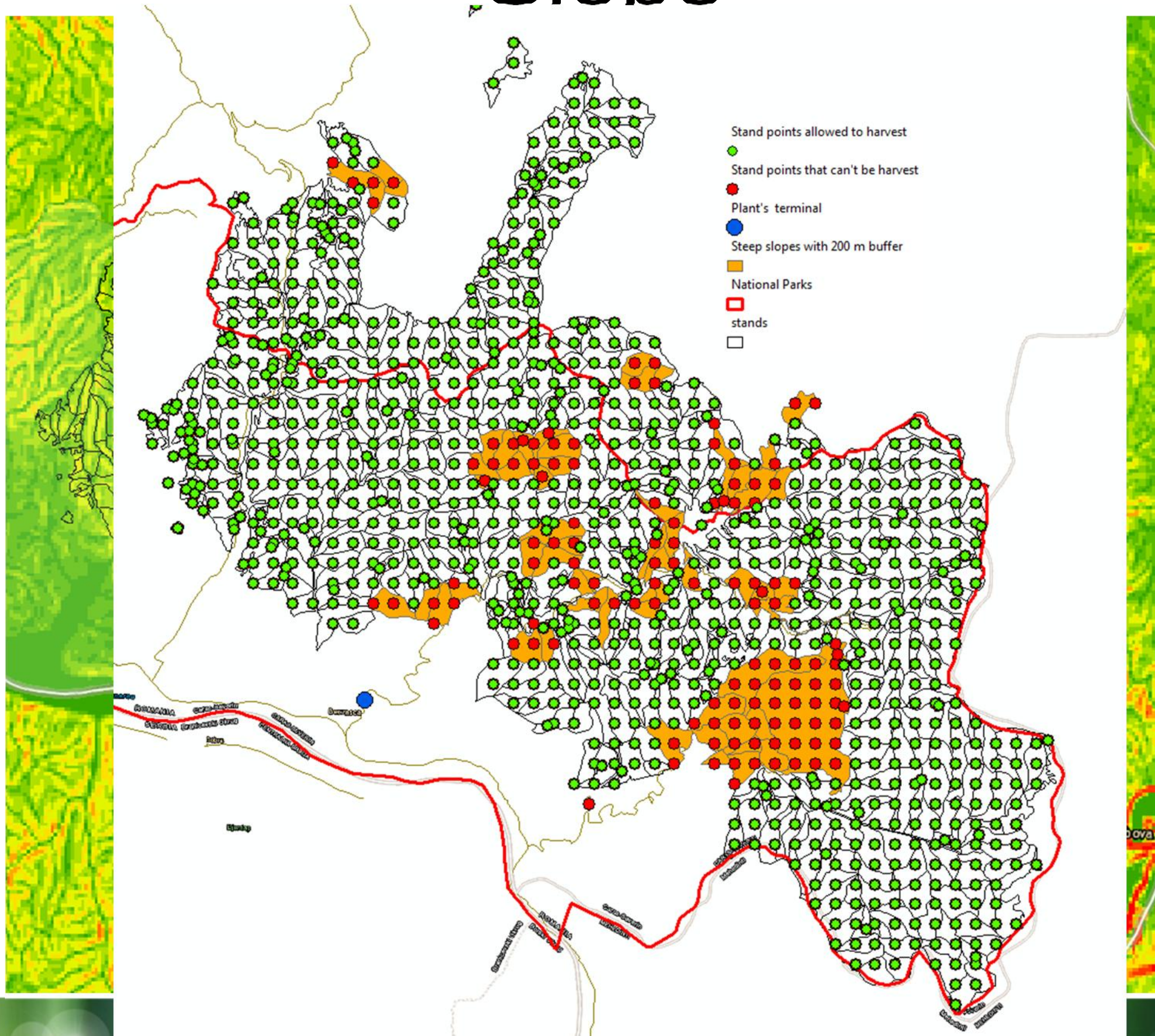
Procurement analysis continues

- Procurement analysis has been made by building lattice point network on the calculation area.
- The distance of each point is 500 meter but there has been added some points manually to make sure there are points also in small size stands.
- Each point has been joined with the stand information from year 2004.

Procurement analysis



Accessibility/Cutting allowance: Slope



Potential calculation (Excel)

- Different scenarios and sensitivity calculations:
  - Minimi potential depended by the lowest harvesting rate from FAO stat’s (Based on FAO's statistic of Annual Growth and the Total Volume in Romania). The amount for wood energy was then only 1,5 % of total volume
  - Maximum rate based on local expert, 15 %

Results of potential calculation

- The bioenergy potential varied from 2280

AL2 =IF(AH1="";P2/L2*Parameters!$B$26;P2/L2*Parameters!$B$26*0,5)

AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN
Transportation time, h	Transportation distance, km	FID_3	SUPRAF	NUMERIC_ID	CODE_	Volume, m3/ha	Growth m3 (if annual growth 5,2 m3/ha/year)	Minimum Potential for energy, m3/ha/year (thinning according national procentual growth)	Maximum Potential for energy, m3/ha/year (Thinning rate 0,15)	Min_TOTAL Energy,
0,26	14,87	2	109882			150	0,52	1,18	11,25	0,12
0,22	14,25	2	108474			160	0,52	2,53	24,00	0,25
0,24	14,63	1	80123			180	0,52	2,84	27,00	0,28
0,25	15,28	1	85464			67	3,64	1,06	10,07	0,74
0,27	16,08	1	85464			130	1,04	2,05	19,50	0,41
0,22	14,59	2	106830			145	1,04	2,29	21,75	0,46
0,18	11,85	2	96147			145	1,04	2,29	21,75	0,46
0,38	26,30	2	128196	Portile de Fier	D	310	0,52	4,89	46,50	0,49
0,10	6,18	1	56976			170	1,04	1,34	12,75	0,27
0,25	16,58	2	98612			170	1,04	2,68	25,50	0,54
0,28	17,56	1	64098			70	3,12	1,10	10,50	0,66
0,29	16,18	1	80123			99	4,68	1,56	14,83	1,40
0,27	18,47	2	128196	Portile de Fier	D	53	9,36	0,83	7,92	1,50
0,33	22,63	2	106830			95	5,20	0,75	7,13	0,75
0,19	11,55	1	73255			167	1,56	2,63	25,00	0,79
0,33	21,26	1	85464			170	1,56	2,68	25,50	0,80
0,24	14,52	2	112172			172	3,12	2,71	25,75	1,63
0,33	20,30	1	76918			88	3,12	1,39	13,25	0,84
0,24	15,33	1	85464			193	1,56	3,05	29,00	0,92
0,24	13,82	2	128196	Portile de Fier	D	290	2,08	4,58	43,50	1,83
0,25	16,68	2	128196	Portile de Fier	D	150	2,08	1,18	11,25	0,47
0,32	20,91	1	85464			159	4,16	1,25	11,91	1,00
0,18	11,15	1	42732			232	3,12	3,66	34,75	2,19
0,33	19,80	1	64098			178	2,08	2,80	26,63	1,12
0,25	16,02	2	106830			89	9,36	1,41	13,42	2,54
0,26	16,56	2	106830			208	2,08	3,27	31,13	1,31
0,22	13,51	2	128196	Portile de Fier	D	105	4,16	1,66	15,75	1,33
0,25	12,39	2	128196	Portile de Fier	D	210	4,16	1,66	15,75	1,33
0,30	15,06	2	128196	Portile de Fier	D	122	7,28	0,96	9,16	1,35
0,25	12,70	2	128196	Portile de Fier	D	129	3,64	1,01	9,64	0,71
0,27	18,44	2	128196	Portile de Fier	D	84	5,72	0,66	6,27	0,73
0,21	10,32	2	128196	Portile de Fier	D	158	3,12	1,25	11,88	0,75
0,22	12,69	1	85464			87	11,96	0,69	6,52	1,58
0,27	13,29	2	128196	Portile de Fier	D	138	4,16	2,17	20,63	1,74
0,18	10,72	1	85464			112	10,40	0,88	8,40	1,77
0,25	12,69	2	128196	Portile de Fier	D	191	6,24	3,01	28,63	3,61
0,22	11,20	2	128196	Portile de Fier	D	116	5,20	0,92	8,70	0,92
0,26	12,75	2	128196	Portile de Fier	D	198	6,24	1,56	14,81	1,87
0,31	21,19	2	113952			170	3,64	1,34	12,75	0,94
0,24	12,08	2	128196	Portile de Fier	D	178	7,28	2,81	26,68	3,93
0,30	19,91	2	128196	Portile de Fier	D	124	11,44	0,98	9,31	2,15
0,25	14,94	1	85464			161	4,68	1,27	12,08	1,14

production unit)

Example stand

Characteristics of example stand	
Area, ha	7,7
Forwarding, m	2094
Transporting, km	29
Accumulation of small sized energywood, m^3/ha	25
Stem volume of whole-tree (with branches), dm^3	164

	m^3	MWh	m^3/ha	MWh/ha
Fresh whole tree	190	326	25	42
At roadside storage dried whole-tree	180	342	23	44

Minimun Cutting allowance in Romania	2 %
Maximum cutting allowance of energy wood from stand	15 %

METLA

How to use the Forest energy stand potential data?

COSTS of working phases

Manual felling & bunching (manual felling bunching's productivity is based on labour agreement)

Other costs

	Set value	Presumed value	Model uses
Stumpage of energywood, €/m3	3	0	3
Overhead costs, €/m3	0	2	0
Covering costs, €/m3	2	0,9	2,0

	Fresh whole-tree, €/m³	Fresh whole-tree, €/MWh	Stored whole-tree, €/m³	Stored whole-tree, €/MWh
Other costs	5,0	2,9	5,3	2,8

Felling & bunching

	Set value	Presumed value	Model uses
Lumberjack's salary costs, €/day	50	153	50

	Fresh whole-tree, €/m³	Fresh whole-tree, €/MWh	Stored whole-tree, €/m³	Stored whole-tree, €/MWh
Felling & bunching	1,6	0,9	1,7	0,9

Hauling

	Set value	Presumed value	Model uses
Load capasity of forwarder, m³	6	6,2	6,0
Gross effective / effective time ratio	1,2	1,20	1,20
Hourly cost of forwarder, €/h	20	47	20
Transferring cost of forwarder €/turn	20	47	20
Productivity (m3/h)	2	3	2

	Fresh whole-tree, €/m³	Fresh whole-tree, €/MWh	Stored whole-tree, €/m³	Stored whole-tree, €/MWh
Hauling	9,5	5,5	10,0	5,3

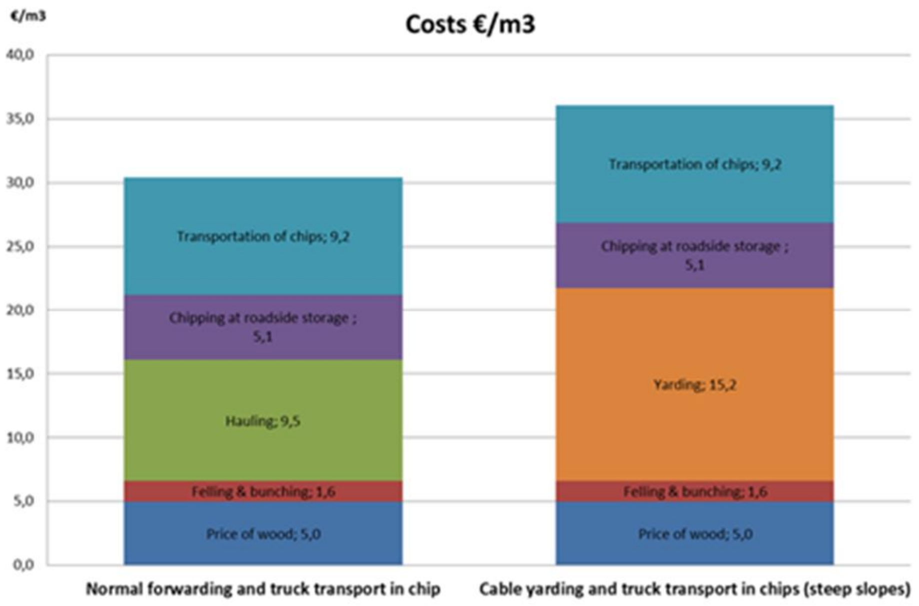
Cable Yarding

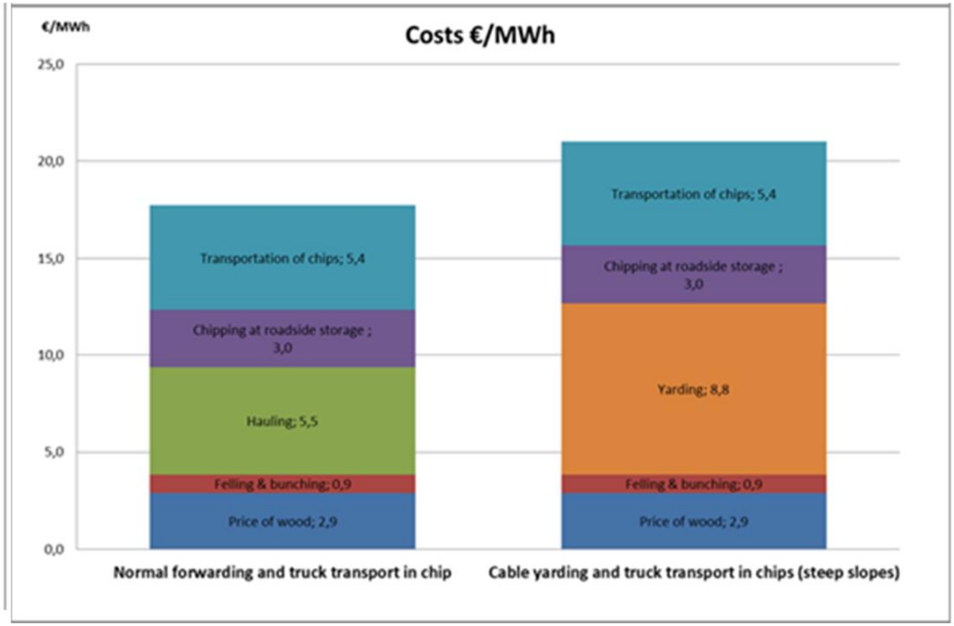
	Set value	Presumed value	Model uses
Hourly cost of cable yarding, €/h	30	47	30
Transferring cost of yarding €/turn	30	47	30
Productivity of yarding (m3/h)	2		2

	Fresh whole-tree, €/m³	Fresh whole-tree, €/MWh	Stored whole-tree, €/m³	Stored whole-tree, €/MWh
Yarding	15,2	8,8	16,0	8,4

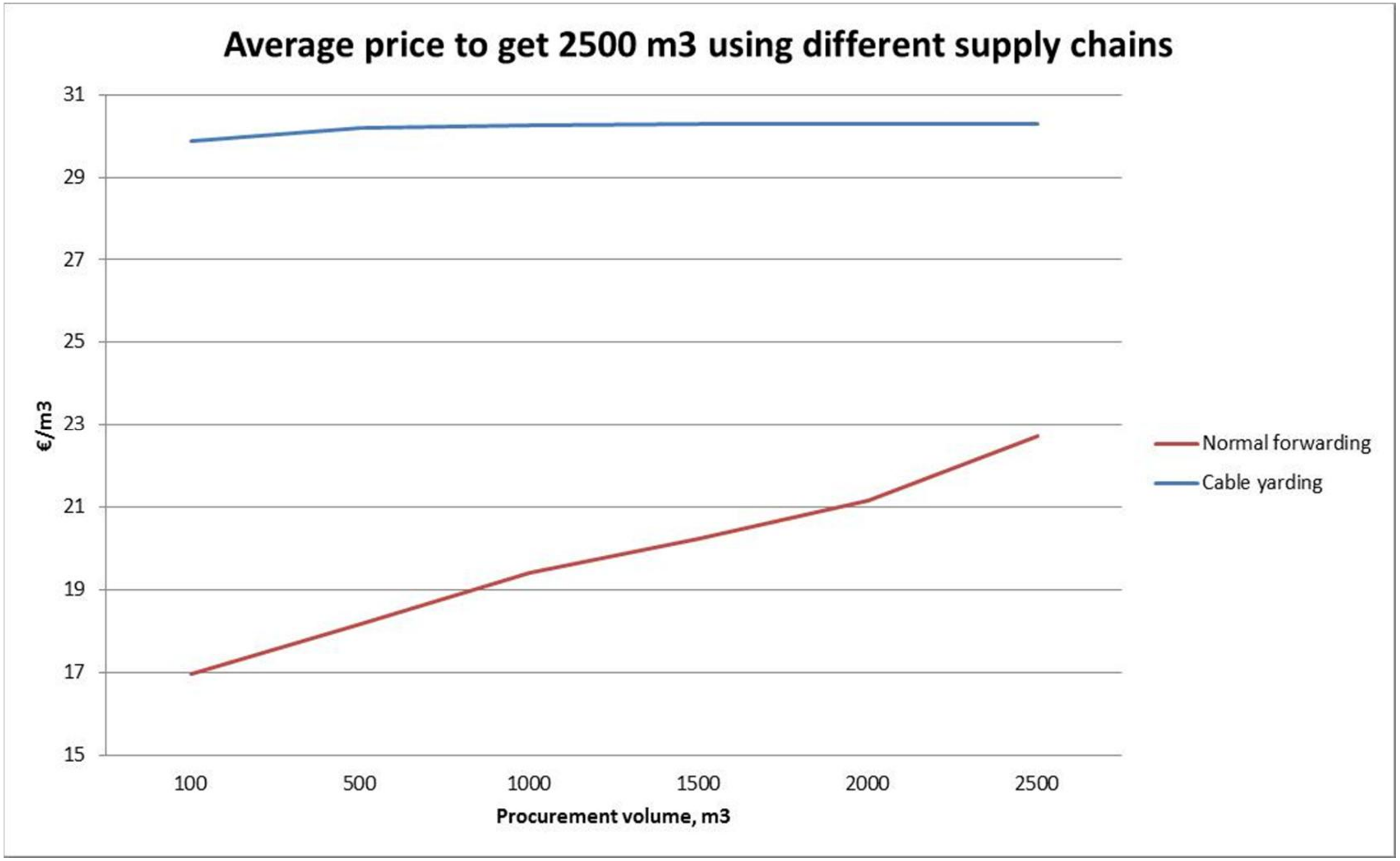
Chipping at roadside storage

Total Costs of selected Supply Chains



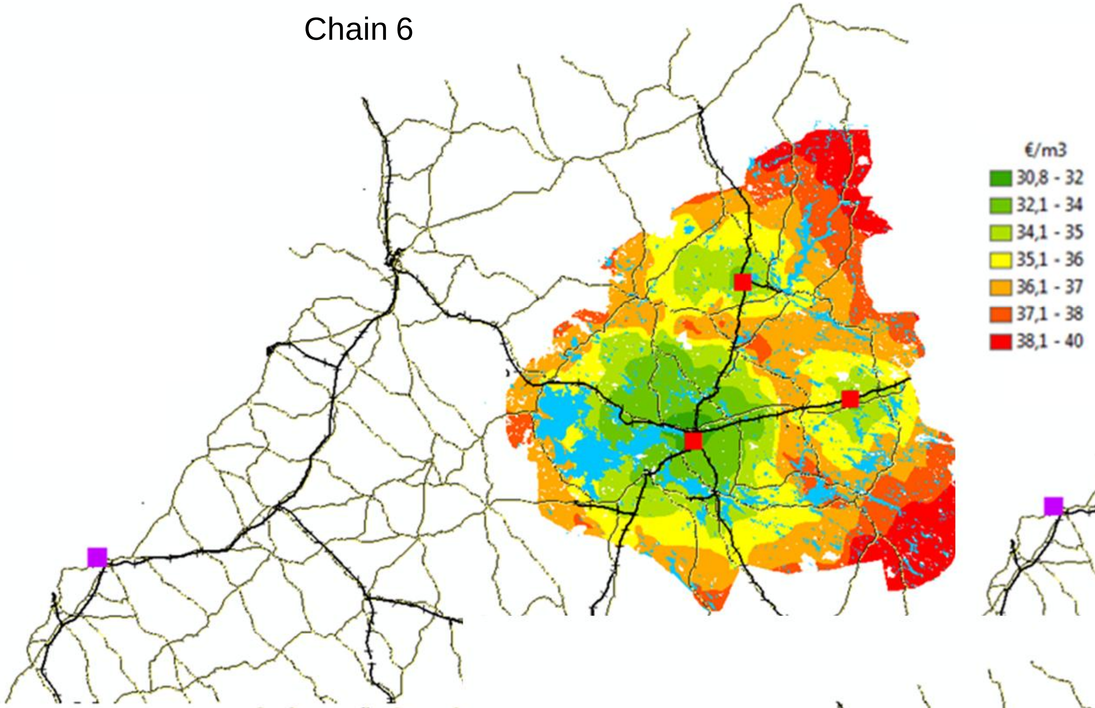


Cost depended by need of Plant

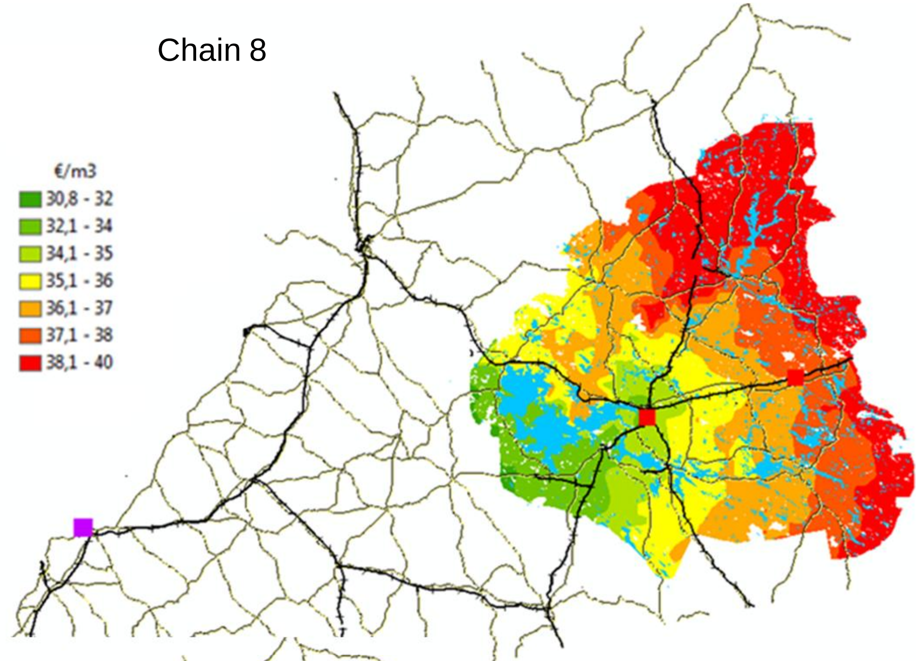


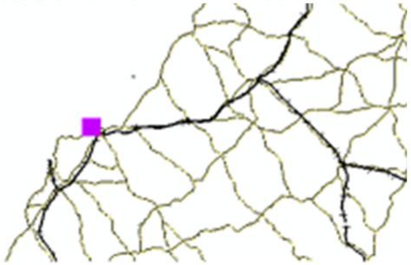
The more you need, the more further, the more it will costs

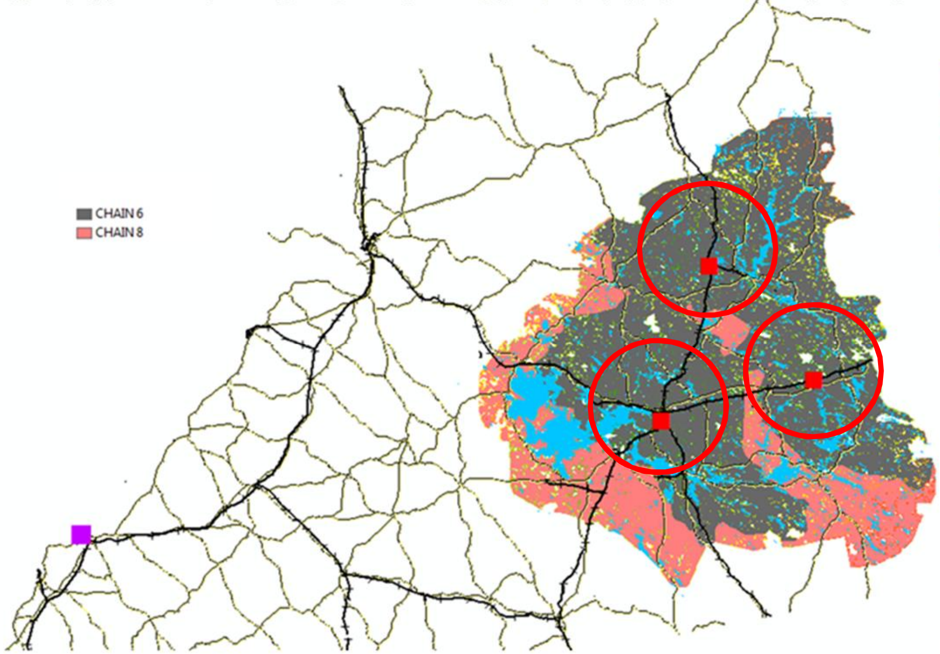
Chain 6



Chain 8







About assessing forest energy resources in Romania

- Accessibility/ Road network (6,5 m/ha) makes only 65% forest possible for industrial/energy use.
  - Better infrastructure might be needed

- Industry use 70 % of the harvested wood
  - around 30 % could be then for energy wood?? (Sustainability, other use of wood/forest)
  - There is potential, but potential need also end-users

Conclusion

- Forest Biomass assessment is always case/country specific
  - Location: Mountain, Lakes, Roads, Forests
  - Species: Different species, different volume and heating value
  - Law: Cutting allowance, sustainability
  - Culture and infrastructure: Data availability, Machinery and Industry (When there is other use of wood, there is much more easier to have energy wood too)

- Assessment is never totally accurate:
  - Forest owner’s willingness to sell wood
  - Different ways to simulate harvesting and estimate the potential from stands → sensitivity analysis is needed
  - Accessibility (Road network, harvesting technology, labour,..)
  - Quality of data

- The combination of different studies are often needed

Additional information

- www.metla.fi
- www.forestenergy.org
- mikko.nivala@metla.fi

References

- Anttila, P., Lehtonen, A., Puolakka, P., Mustonen, J. & Heinonen, J. 2011. Advanced spatially explicit method for estimating the technical potential of forest energy from regeneration fellings (RESGIS). Julkaisussa: Metsätieteen päivä 26.10.2011: Metsäsektorin laajenevat vastuut. Suomen Metsätieteellinen Seura, Helsinki. s. 43.
- Laitila, J., Asikainen, A., Sikanen, L. & Nuutinen, Y. 2004. Harvesting technology and cost of fuel chips from early thinings. In: Uusitalo, J., Nurminen, T. & Ovaskainen, H. (eds.). NSR Conference on Forest Operations 2004 - Proceedings. Hyytiälä Forest Field Station, Finland, 30-31 August 2004. Silva Carelica 45: 99-105,
- Laitila, J., Asikainen, A. & Liiri, H. 2006. Cost calculators for the procurement of small sized thinning wood, delimbed energy wood, logging residues and stumps for energy. In: World Bioenergy 2006. Conference & Exhibition on Biomass for Energy. 30 May - 1 June 2006, Jönköping - Sweden. Proceedings. The Swedish Bioenergy Association, p. 326-330.
- Tahvanainen, T. & Anttila, P. 2011. Supply chain cost analysis of long-distance transportation of energy wood in Finland. Biomass & Bioenergy 35(8): 3360-3375.
- Romanian Forestry FAO: http://www.fao.org/docrep/w7170e/w7170e0f.htm
- World salaries comparison: http://www.worldsalaries.org/romania.shtml
- Cable Yarding: http://www.gurndin.com/preise_en.php
- Presentation: http://www.metla.fi/hanke/7395/pdf/Asfor.pdf

Finnish way of life

Adapting the climate

Increasing the use of wood during summer


metsä
METLA
TIETO
hyvinvointi
osaaminen
Kiitos