Doctoral (PhD) Dissertation Theses

THE LOGISTICS OF WOOD-BASED CENTRALISED CURRENT-PRODUCTION AND ITS EFFECT ON THE WOOD CONSUMPTION ACTIVITY OF EGERERDŐ ERDÉSZETI ZRT.

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1. The significance of the topic and its scientific precedents

The basis of the survival and development of the biosphere is the use of produced energy at disposal and characteristic of the individual phases.

The role of humans determines the development of technology, furthermore, according to some, the endless growth of the demand of the present era might push the Earth to the limits of its output capacity, might speed up or slow down the climate changes.

There is no global solution to deal with the global problems but, realising the necessity of prevention, fitting into the system, everybody is to take the necessary steps in his own area of science.

Thus the utilisation of renewable sources of energy, the exploration of the mechanism of its effects is a dominant part of the establishment of the proper proportions.

In its proportions, 81% of the use of primary energy of the world – which was 448 EJ in 2003 – was of fossil origins. The extent and effect of the concentration of the combustion products released during the course of the burning of these energy-producing basic materials does not belong to the series of natural process changes. Its weight is debated, however, it is a fact that the CO_2 contents of the atmosphere – due to bonding of coal related to the development of vegetation on the Earth – has been decreasing continuously and stabilised at the end of the 18^{th} century at a level of 270-280 ppm, its present value reaches 360 ppm (IPCC-WGI, 2001). The presently rather intensive exploitation and use of fossils most probably contributed to this, which – although it is hard to model – influences life on Earth.
This motivates the representatives of science and practise to explore any related area to the tiniest detail.

My dissertation is built on these foundations and I hereby intend to declare my research objectives.

2. Objectives

Within renewable sources energies, the dissertation deals with the necessity of use of dendromass – belonging to the sphere of concepts of biomass – in energetics and the effects of its application (energy sector, sylviculture).
One of the objectives worded was that the research be limited to the framework of traditional sylviculture. The dissertation is to explore the effects of the topic

on ecology and economy, and, going beyond the presently established situation, provide a prognosis and methodological guidelines with the help of which well-founded decisions can be made.

Research work took 4 main directions:

2.1. Of the applicable and accountable renewable sources of energy, the positioning of the role of biomass and, within that, dendromass

Research meant the processing of professional literature. A significant part of the literary results and forecasts with only a couple of decade-long history – with view to the international and domestic directives and undertakings published in the meanwhile – is really varied. Often, contradictory statements could be encountered, primarily in the area of the judgement of effects on life on earth.

The main areas of the exploration of the relationships:

- the trend of the volume of energy demands, the detailed analysis of the European and domestic situations (the processing of the most important directives and undertakings in these)
- the definition of the volume traditionally at disposal from traditional sylviculture within the potentially accountable domestic renewable source of energy that can be actually fitted into the system

2.2. From the beginning of the possibilities of supply to power plants, the examination of impacts on sylviculture, in the area of EGERERDŐ Zrt.

A chronological analysis was needed with respect to the changes following the large volume power plant supplies launched by EGERERDŐ Zrt. – as compared to the characteristic features spanning a short period of time, taking place before the change - and whether those were regular

The following has been researched and analysed:

- the factory plans and the time-sequential analysis of their records, as well as their prognosis with view to the assortments to be taken into account
- the change of the structure of assortment and the effect of its flexibility on the definition of wood trade strategies, with special respect to export-import changes.

2.3. The examination of the possible alternative of the use of the energetics forest assortment supplied to AES Borsodi Hőerőmű (AES Borsodi Power Plant)

The series of examinations of outstanding importance of the doctoral research took four years. The aim of the continuous analysis of concrete processes and the analysis of the changes taking place was to find out whether the "simplified" trade policy of great volume carries the loosening of raw material management ("waste"), and whether indeed this was the only solution for the realisation of domestic wood energetic developments in the present research era. The aim of the examination in the wood-mill and parquet factory was to get acquainted with the possible output volumes, by putting the losses realised in numbers, and comparing with the results that can be achieved with the raw materials actually meant for processing.

2.4. The necessity of the changing of wood felling and cutting, stocking and material movement technologies, and their possible effect on future systems

During the course of the development of this part of the topic, the main objective was to evaluate the logistical system. During the examinations, samples of different types of wood have been taken from different forest sections, which were then analysed in the laboratory. By using the results received thus – on the basis of the energy values that can be put into figures as the end result – comparisons have been made between the different expenditures. It became obvious that from among the expenses, the most dominant is that of material transport. The task that emerged was what kind of a connection – which can also be described by means of formula – can be demonstrated on the basis of the data received, and what solutions can be developed with the help of these.

3. The research methods

The scale and significance of the topic, as well as its short history called for the establishment of a novel method of research.

3.1. From among the usable and accountable renewable sources of energy, the positioning of the role of dendromass within biomass

The most difficult part was the analysis of indispensable data before the recognition of climate-change problems because these materials of professional

literature were produced not only for the strictly meant climate-change research and also, only certain parts of it were applicable for the approach of the topic.
In doctoral works, similar analyses usually appear only in the introductory parts, however, the novelty of the topic made it a must. At present, we can only talk about a discipline "just growing up", which still carries a lot of contradictions. Results to be evaluated were provided by the comparison and analysis of professional literary publications. In case of the analyses, it was also an important aspect that – during the course of the evaluation of the situation of the topic – the analysis I carry out also support the processing of the domestic data. This is how the unique situation emerged that after the exploration of the shortcomings found during the analysis of the domestic databases, I often helped to make them more precise with the results of my own research.

3.2. The examination of the impact on sylviculture at EGERERDŐ Zrt., from the beginning of the possibility of the power plant supplies

The energetics utilisation of dendromass in case of an energetics user may be evaluated as a simple market – supplier problem. A similar approach can be accepted in the case of cultivated biomass (agricultural side products, energy plants) as well. The questions of raw material supply of plant-scale energy-production based on substantial sylviculture, however, pose the demand for completely new and multilayered analysis. In Hungary, nobody has undertaken this before, and there are scarce examples of similar attempts in international professional literature as well.

The wood use data base of EGERERDŐ Zrt. recorded between 1990 and the present day have been used for the research work. As a demarcation line, the year 2001 was picked (it was in this year that the negotiations with the power plant started); then the periods following that were compared, through the exploration of the changes affecting the use of wood. The following has been examined:

- the true volume of wood felling and cutting, as compared to the factory plan data
- the change of wood type structure exploited, the re-evaluation of "under the threshold" forests
- the examination of the trend of stacked assortments
- within stacked, the change of the order of energetics raw materials, the exploration of the situation of other players at the marketplace
- export effects that are the strategic issues not only of sylviculture but of domestic wood industry as well
- the exploration of the economic "turning point"

- the presentation of the 30-year prognosis, with special respect to the energy contents of the energetics assortment.

3.3. The evaluation of the utilisation of the energetics forest assortment delivered to AES Borsodi Hőerőmű by comparison to the alternative method of use

For four years, "lengthened" firewood" on stock was sampled in the order of wood industrial workability. The aim of the examinations was to analyse whether, during the course of processing, profitable products can be produced from the wood produced for energetics purposes – if it is processed with traditional wood industrial methods?

The more important aspects and solutions of the examinations:

- the place of sampling was the power plant depot and the forest depot, from the stocks already recorded as energetics assortment;
- the selected material, regardless of the data of stocking, was re-registered as saw-log;
- the selected material was delivered to another wood-mill using the same technology, and was processed there;
- the product and the waste emerging during the course of the primary wood industrial activity were entered separately;
- sawn goods were delivered to Mátraparkett factory, Gyöngyös;
- in the interest of comparison, one product was selected: mosaic parquets;
- parquet factory technology: drying of unedged timber, frieze cutting, the productions of mosaic parquets, stock taking.

In the interest of comparability, the processing of traditional saw-logs also took place.
In the given year, economic information was put into figures with the data at disposal.
The research carried out was comparable both on financial and volume basis, thus it was suitable for the drawing of conclusions.

3.4. The examination of the necessity of wood felling and cutting, stocking and material movement technologies, the planning of new technological variants and their possible impact on future systems

3.4.1. The delivery and shipping of energetics assortment

A period before the deliveries (between 1999 and 2002), and one following them (between 2003 and 2006) were explored. The flow of materials and the

fleet of machinery at disposal were analysed from the database of the sylviculture at disposal. With this method, we could obtain an answer to the question of the transport density of the road networks and their impact of the exploration network.

3.4.2. The examination of the moisture content of energetics assortment, and the examination of the impact of changes on logistics, the energy demand of material movement and specific energy price

Amounts suitable for sampling (3-3 m^3) were stocked in three different wood sections of EGERERDŐ Zrt. but from wood-felling and cutting carried out at the same time, of the same wood type (oak, Austrian oak, beech, hornbeam) at isolated forest depots.
From every lot, 1-2 kilograms were sampled at the same time of every month, with the help of a motor saw; the samples were wrapped in airtight foil right at the scene.

The samples prepared thus were taken to the laboratory of Nyugat-magyarországi Egyetem, where the following examinations were carried out:

- W = moisture contents (%)
- $H_{w=mért\%}$ = calorific value at moisture content measured (J/g)
- $H_{w=0\%}$ = calorific value at 0 % moisture content measured (J/g)
- Ash content (%)

By averaging the laboratory database received thus, with the help of parabolic and linear approximation, the formula of wood humidity and calorific value was demonstrated.

For the establishment of the connections between the moisture content of timber and the expenses of timber delivery, the database of the timber delivered by EGERERDŐ Zrt. between 2004-2006 was used. From the data of the timber delivered to the power-plant, the following information was collected and analysed, in a distribution by year and by forestry:

- m^3
- ton (t)
- atroton (att)
- moisture content (%)
- shipping tariff (HUF/t)
- total cost of delivery (HUF)
- acceptance price (HUF)
- the cost of production at the forest depot (HUF)

With the help of the wood moisture and calorific value function defined with the help of the laboratory data, by giving different wood moisture percentages, the calorific value of the wood delivered was demonstrated in the form of a table. On the basis of this, specific expenses were calculated for the calorific value. The connection between moisture content and calculated specific delivery expense (HUF/GJ) was defined in the form of a function, with the application of parabolic approximation. With the help of the formula obtained thus, a model table could be drawn up by giving certain freely selected percentages of moisture percentage.
With the above method, you can approach those limit values at which – due to the volume of the cost of material movement – the delivery district of the energetics base must not be extended any more.

4. Summarizing the scientific results

4.1. From among the usable and accountable renewable sources of energy, the conclusions of the examination of the role of biomass, and within that dendromass

It can be established on the basis of domestic and international professional literature, energetics scenarios and the objectives of the EU published recently, that in connection with the extension of the use of renewable energies, the application of biomasses for the purposes of energetics is coming to the forefront more and more as this is the source of raw material that can be used for stable energy production, it contributes to the bonding of CO_2, and if need be, it can be grown, that is, their base can be increased. The increasing application of biomass was followed by several disputes, ever weakening by now. It can be concluded from the tendencies that the domestic situation – which is still puzzling and contains a lot of contradictions - is becoming more stable, and its domestic opponents are becoming rarer. To this we can add that while the CO_2 contents of the atmosphere of the Earth – due to the bonding of coal related to vegetation development – was decreasing gradually, and at the end of the 18th century stabilised at 270-280 ppm, nowadays it reaches 360 ppm. However, we should not forget the scientific statements according to which the cyclic nature of the climate change of the Earth is a proven fact. Still, it can be established that the overloading of the atmosphere of this scale, together with the satisfaction of human demands, will affect this cyclic nature.

The energy demand of the world, 81 percent of which is satisfied from fossil derivatives - shows a continuous increase. Within this, the use of fossil fuel for the production of electric energy – showing the most significant increase (between 2000 and 2030, it will increase from 16,074 TWh to 31,657 TWh) – is

64.3 % at present. According to the prognosis, as the world does not have any other alternative, within production almost doubling by 2030, the proportion emitting harmful materials will increase to 73.2 %.

On the basis of the above surveys, the treaties, directives and undertakings reached under continuous control are well-founded even though until 2030, the predicted increase in the total amount of primary energies used in the world is 66 %, while in the production of electric energy it is 540 %.
By taking into consideration priorities, Hungary developed its own energy strategy – integrated into the EU Directive – with view to the fact that there is no common energy policy in the EU.
In this, a corner point is the liberalisation of the energy market, but energy efficiency and the greater spread of renewable energies also get a lot of attention.

The strategy does not change the undertakings made earlier but explores possibilities in a scenario-like fashion and puts into numbers the potentials, in relation to the also desired energy-saving programme.
Two scenarios have been set up for the definition of the target values with respect to the proportions of renewable energies in the total use of energy sources. The basic difference between the basic scenario (BAU) and the strategic (Policy) scenario is that while the basis of BAU is the result of the decisions already made or presently known and under preparation, the Policy scenario also counts on the effect of further measures encouraging the utilisation of renewables.

Final results:

Renewable energy use - sum total	2005	2020 BAU	2020 Policy
Sum total	49,93	135,94	186,28
Bio fuel	0,21	19,55	19,55
Total (without bio fuel)	49,72	116,39	166,73
Water energy	0,73	0,88	0,88
Wind	0,04	4,04	6,12
Solar energy	0,08	0,42	1,66
Geothermal	3,63	7,27	11,36
Biomass	43,56	93,70	130,81
Biogas + biomethane	0,30	6,75	12,57
Renewable part of rubbish	1,38	3,33	3,33
Renewable electric energy production	2005	2020 BAU	2020 Policy
Total	1802,1	7556,5	9469,5
Water energy	202	243	243
Wind	10	1122	1700
Solar energy	0,1	0,5	0,5
Geothermal	0	520	656
Biomass	1506	4982	6011
Biogas	25	547	717
Renewable part of rubbish	59	142	142

By taking the data of the forest assortment structure of recent years as the basis and applying the basic formula for the calculation of calorific value, we can declare with high certainty that – calculated at the present level – the energetic assortment produced by our forests represents close to 45 PJ order. Compared to BAU prognosis, dendromass will be able to produce close to one half of the programme plan for biomass, along primary lines. If we examine the TPES equivalent of electric energy as compared to energy of 51,43 PJ of the BAU prognosis, this number is even more significant, taking into consideration that Hungarian energy production is following this route.

The most important establishment is that biomass-based energy production developed in the area of the EU amidst a lot of controversies, however, in the future it will become dominant among renewable sources of energy, and one of its main achievements (among others) will be the decrease of CO_2 emission. The topic is still argued in Hungary; the same counter-arguments are to be expected (lobbies with opposite interests, the lack of information of the residents, misunderstood environmental approach, the resistance-generating activity of wood users, as market competition) as were dominant in the EU 15 years ago. Therefore, the domestic possibilities of the topic and its objectives to the merits are to be researched and the information of the public is to be reinforced continuously.

A new research result (though the method of research is literary analysis) is the analysis of tendencies, the definition of the more important aspects of the EU decisions with respect to the evaluation of wood energetics based on domestic sylviculture, and especially the continuous evaluation of domestic database for which – during the course of the different analyses – I provided basic data and aspects of evaluation as well.

4.2. The results of the examination of the impact on sylviculture in the area of EGERERDŐ Zrt., from the beginning of the possibilities of delivering to the power-plant

4.2.1. Exploited volume

The analysis of the database going back to 1990, clearly illustrated that – apart from the movement within the usual volume-interval – there were no other changes in the total volume of wood-felling and cutting. Which supported the fact that the sylviculture-related decision mechanism is controlled primarily by ecological aspects.

4.2.2. Changing wood-type structure

Typically, the change in the proportion of the classification and production of Austrian oak stock took place, which can undoubtedly be traced back to the changes of market demand. At the same time, we can establish that during the period under examination, the producer did not cross the limits adversely affecting ecology but, knowing the period of the turning point, it got close to it.

4.2.3. The trend of stacked assortment

There was no significant change in the interventions of the same wood type, age and method of use. However, because of the increase of volume of the typically Austrian oak stocks, a close to 10 % firewood proportion increase could be witnessed. This did not influence the assortment structure of the "more valuable" and at the same time more wanted and – from the aspect of wood industry – at present more sought after wood types.

4.2.4. The changes of firewood proportions within stacked

Within the period under examination (between 2001-2006) the 10% firewood proportion increase clearly led to the decrease of fibre-wood proportion. However, it has to be noted that in the event of the increase of Austrian oak felling and cutting, the fibre and shavings-wood factories do not lay claim to the shaving, or lay claim to only a small extent.

4.2.5. Export effects

As compared to the average of earlier years (1990-2000), export fell back to more than its half. The season for this was that with the establishment of energetics demand, re-organisation was necessary in the environment without the increase of wood-felling and cutting volume. The producer gave priority to household firewood - even though it was always hectic – and to the demand of the domestic fibre-wood market.

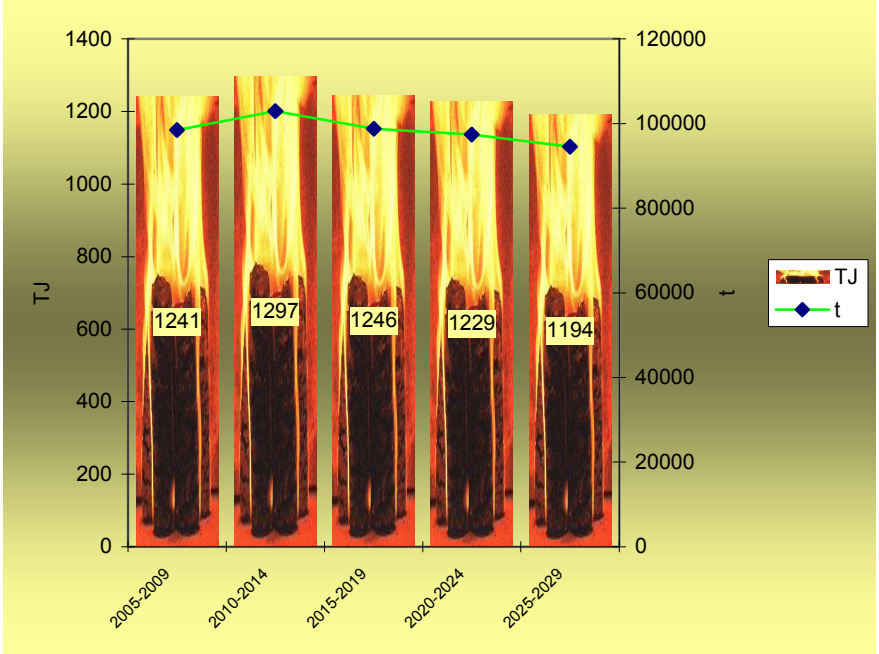
4.2.6. Economic turning point

By the end of the 1990s, the fire-wood recession lasting since the 1990s had dropped under a manageable nadir, that is, fire-wood could be sold at a price under self-cost, furthermore, in an uncertain market (for the purposes of charcoaling). When the possibility of delivery to the power-plant surfaced, the most debated point was the issue of price-formation. The guiding principle was calorific value proportionate price-formation. Though this could not be fully achieved, price-formation based on energetics unit calculations – which was also

accepted by the buyer – could be approached. The price formed was close to three times the starting value.
Compared to 2000, just in the year 2006 and just in the area of the energetics assortment, at absolute value, this meant close to 16 billion HUF extra revenue for the branch. In the case of the other primary values, the other bull movements are to be examined separately.

4.2.7. Wood use prognosis

In the interest of the conclusion of long-term contracts, the prognosis of wood use with respect to the expected assortment structure is indispensable; this prognosis shows a decreasing trend within the margin of error, thus the raw material at disposal can be designed exactly, without the change of the forest area; this is clearly presented by the figure below:



The statements related to the exploration of the reasons of the appearance of domestic wood energetics, the relationship between substantial sylviculture and wood energetics, and the development of new methods of wood application and technologies for the use of wood can be regarded new research results.
It could be established that the fast development of wood energetics was helped by the lack of the demand for "low value" wood, as raw material, while its application helped the improvement of the profitability of sylviculture. It could also be established that in the scheduling system defined by the forestry law currently in force, wood energetics can be continued without the infringement of the professional aspects of

substantial sylviculture. Under the influence of wood energetics, wood-felling and cutting did not increase in the area of Egererdő, however, the proportion of the domestic utilisation of timber produced improved, that is, the export of raw materials decreased.

4.3. The results of saw-mill processing carried out as the alternative to the use of energetic forest assortment supplied to AES Borsodi Hőerőmű

The large-scale (60-100 thousand tons per year) delivery to the power plant required the development of an individual standard, the aspects of which were the following:

- the processing technological demand of the receiver
- stocking on an interim loader
- wood material movement

The ideal dimension for the receiver was maximum 6 m length and maximum 80 cm diameter; in the lower limit, the parameters of normal fire wood standard were guiding, however, due to a capacity demand, the volume-restriction was part of the statements.
Stocking, especially in hilly country, has loading area limits; often, only placement in 1 m long, traditional firewood stacking is possible, in the case of other lengths, piling used for saw-logs is applied.
The parameters of the shipping fleet established for the movement of wood material, as well as the dimensions of the ideal carriage in the event of transportation by rail, are also to be taken into account.

In the interest of the maximum utilisation of the loading area, the "lengthened" firewood assortment was introduced (at the length of 2.50, 2.60 and 3.00 metres). As a result, the supplier received severe criticism for producing and "burning" lumber industrial raw material.
With the inclusion of wood-industrial experts, 61.38 m^3 long firewood and 15.62 m^3 standard saw-logs were selected on the basis of their dimensional features, in four different periods.
After frame-saw, sawing industrial processing, only mosaic parquets were produced.
Even upon the processing of timber, due to curve in space and plain-curve, there was a 20-30 % poorer quality output among the firewood assortment.

After processing into mosaic frieze, an output weaker by another 10-15 % could be demonstrated when compared to saw-logs; this difference could be traced back to the frequency of internal wood-faults.

The difference between the proportions of mosaic parquets actually manufactured from mosaic friezes further increased output losses. During the four experimental productions of those produced from the selected firewood, on average, 47.43 m^2/m^3 output values were measured, as opposed to the processing of normal saw-logs, where 54.16 m^2/m^3 was produced.
A significant difference emerged again upon the classification of finished mosaic parquets, where the so-called industrial proportion of that produced from firewood reached 25.8 % on average (the same price of which is 60-70 % of the normal average price) as opposed to 8.8% of the parquets produced from saw-logs.

In contrast to the same processing expense inputs, due to the shift in high output losses and the quality proportions (industrial - normal) influencing direct sales turnover, without exception all the firewood sample processing produced losses. With respect to the basic material, in the processing of firewood, the loss was close to 2,400 Ft/m^3, while in case of traditional saw-logs the profit was close to 2,700 Ft/m^3.

The development and application of the examination method on the basis of which the timber produced for purposes of energetics and standard saw-logs – by applying the same traditional wood-processing technology – through the production of a particular target product, the results received are analysed and compared, can be considered a new research result. It was possible to compare output indices with respect to identical units and achievable incomes, as well as expenditures. The results proved the correctness of energy-centred selection in substantial sylviculture.

4.4. The results of wood felling and cutting, stocking and material movement technologies, the surveys carried out for the support of demands for change, laboratory measurements and the analysis of calculations

4.4.1. Effects made on the forest exploration network

Upon the analysis of wood material movement, it could be established that the volume difference between the two time intervals examined (between 1999 and 2002 and 2003 and 2006) was not significant (24 thousand m^3). In case of demonstrable transport load, the difference was posed by the fleet change adapted to the power-plant supply.
Though with the appearance of vehicles with a higher load-bearing capacity, the number of runs dropped by close to 12 %, the transport load increased by 20 %, which could be reached by comparing traffic load factors constituted by the ratio

of the single run unit axle-conversion factor and the cubic meters to be delivered by one vehicle.
On the basis of the figures measured in the period under examination, according to the route planning norms accepted as standard, the life expectancy of the track structures designed for 20 years may drop by 8.5.

4.4.2. The moisture content of the energetics assortment and its effect on material movement, laboratory measurements, data collected and the results of calculations

The data of the change of the moisture content of the energetics assortment of different species were defined through the laboratory examination of the sample quantity originating from the monthly sample-taking.
With view to the fact that 92% of the delivered timber was constituted by oak, Austrian oak, beech and hornbeam species of wood, the experiment extended to these species.
From the samples originating from three forest segments, time-sequential averages were produced for every species from the moisture content and the heat energy contents. The values received thus are all the prevailing average values, on the basis of the data of which a linear function could be calculated.

$$y = 19363.056 - 195.106x$$

where x = wood moisture in %, y = calorific value in J/g

The data of the firewood supplied to the power-plant during the period between 2004 and 2006 were processed, the most important data of which were m^3 and atroton (att), as well as the costs and revenues.
One of the results of the calculation was that variable ton values could be coupled with the different moisture contents, on the basis of which the varying turning figure could also be defined. It could be established that – compared to the delivery of live-moisture timber – after storage at the forest loader for 5-6 months, the number of runs – as a result of the decrease in weight – could drop from 13,403 to 8,935 (that is, by close to 30 %). This can counterbalance the negative consequences of the increased wear and tear of the roads.

By defining the laboratory calorific values, another formula could be set up to put the connection between moisture content and specific transport costs into numbers:

$$y = 0.04x^2 - 0.03x + 118.76$$

where x = wood moisture in %, y specific transport cost in HUF/GJ

With the help of the formula it was possible to calculate and put in a table the calorific value of the amount of wood supplied in the individual periods, per

forestry. In the knowledge of the tariff system of deliveries, it was possible to calculate the expense of delivery with respect to GJ, as well as the input cost of the forest loader (HUF/GJ) and the sales turnover (HUF/GJ). By comparing the former values, the result measured at the delivery point could also be demonstrated.

Just by delivery carried out after stocking for 5-6 months, as compared to live-moisture delivery, profit could be increased by 80% (from 87.24 HUF/GJ to 159.01 HUF/GJ).
It can be established beyond doubt that the moisture content of the raw material is dominant not just in the (power plant or heating technical) technology utilisation in a narrow sense but – from the aspect of the production of primary products – from the point of view of cost efficiency as well.

The establishment – supported by extensive examination – according to which there is close connection between the logistics of wood for the purposes of energetics and specific energy price characteristic of the marketable energy content, transportation costs and the costs related to the use of transportation routes can be considered a new research result. The close connections can be demonstrated on the basis of the functions defined with the analyses based on measured and collected data but we can also establish that natural pre-drying (related to stocking), which is advantageous for other reasons as well, also contributes to the cut of road-use costs to be achieved through the decrease of the axle pressure of the transportation vehicle.
We can also establish that – for the purposes of the optimisation of the transportation vehicle size fitted to the size of the road network – the research related to logistics is to be continued.

5. The practical utilisation of the results, future research tasks

During the course of the research, the reasons for the changes of the recent past were defined, which are outstanding even with respect to the policies of the branch. That is, why the branch had to and was able to move in the direction of wood energetics.
How did this shift influence the reorganisation of production in the branch, presented through an individual example? In this environment of increasing flexibility, the question whether the forest itself is affected and may be affected by this change that is of historical scale from the aspect of the politics of the profession has been explored sufficiently.

Social, professional and related professional concerns and questions have been answered, counter-arguments have been dealt with – through the presentation of the results of processing, based on sampling, put into numbers. Establishments motivating one to carry out further research have been made, the issue has been examined from the side of the user as well.

The influence of obligatory changes taking place in technological processes has become transparent, with special respect to the introduction of the effects made on forest exploration networks.

Through time-sequential sampling and the processing of laboratory results, we presented a formula that – when fitted into the right software – can be applied as supplementary material in decision-preparation and with its help we can reach connections that can be prepared for the individual wood species. Furthermore, the formulae used for the commonly know calorific value calculations can be certified or corrected with such measurements. The results of the connections between moisture content and costs of delivery with respect to GJ – which can also be developed further - can also be used well.

For large-scale projects, this is the first step to become operative but at the same time preparations are to be started for the situation following the completion of the project. In its totality, it is quite obvious that industrial-scale delivery is only the first but a finite step. It can be established even without the creation of a picture of the future that hereinafter the research made in the area of delivery will undoubtedly be made in the direction of general energy management, presenting as a demand the more significant cut of transport costs, which has one possible solution: the establishment of regional co-generational power-plants or heating plants of smaller capacity, thus of greater number, that will lead to the drop of transportation distances.