Application of the Coase theorem in case of Czech forestry

Bachelor thesis

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Abstract

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Bachelor thesis deals with the problem of externalities raised due to a development of the power lines in the forest. Showing us the rights of the owner of the forest and also of the developer of the power lines. This thesis is dealing with the possibility of change the planned trace of the power lines to find out whether a better solutions can be find and under what conditions. I am also dealing with other bodies (Nature preservation, building act, etc) that are somehow affecting the development itself. I also compare the development of the power lines in the forest and on the agricultural land.

Keywords

Externalities, transmission systems, nature protection, forest, Coase theorem, SLT.

Content

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1. Introduction

1.1. Introduction

In my thesis I research the possibility of change of the route of the transmission system in the forest in respect of better position of the owner of the forest or more precisely in order to save the forest of the higher order. From the provider of the transmission system point of view I am trying to find a cheaper option of development of the transmission system. I also examine the particular rights of the owners of the forest, rights of providers of the transmission systems and the economic theory used in this type of problem especially the Coase theorem.

1.2. Objectives

Define if there is a possibility to find a new optimum between owners of the affected forests and the operators of the transmission systems if the planned trace of the lines will change and under what conditions and if the new optimum is ecological or financial or both. All this try to solve with application of the Coase theorem.

1.3. Methodology

At the first part I collect all the necessary information that I need to fully understand the problem of transmission system in the forestry, i.e. legislation, economic theory, nomenclature, information about forestry, protection of the nature etc.

At the second part I am searching in the map for a possible trace of the power lines or I copy the trace of planned power lines which are connecting cities and are planned by ČEPS, EON etc. Future comparing between straight and changed lines than show me which case is more efficient. For calculating the length of the lines I use Uhul maps with BPEJ indicators and with an application for calculating length of the lines. Particular cost for compensation is than calculated

again with the help of the Uhul maps. Another option would be to manually measure the length of the trace and then again manually measure the length of the changed line in the forest. This option would be very time efficient and probably not so precise therefore I have chosen the first option.

2. Externalities

„Externalities rises if somebody does not take all his liabilities connected with his activity or if somebody do not get all returns connected with his activity. We distinguish positive and negative externalities" (Holman, 2005 p. 372) This is a simple definition of externalities.

Therefore it is quite clear that if the developer of the transmission lines want to develop the power lines a forest must be „destroyed“ and buffer zones created. Buffer zones make impossible to utilize the forest for 100% and for the owner of the forest losses increase if the compensations are not correctly calculated.

A. C. Pigou and R. H. Coase were the first who were really interested in externalities. Concept of externalities by both A. C. Pigou and R.H. Coase are similar. They have been disagreed the most in the field of solving the problem of externalities and even more about the source of the externalities. A. C. Pigou said that the source of an externality is: ,,*The source of the general divergences between the values of marginal social and marginal private net product that occur under simple competition is the fact that, in some occupations, a part of the product of a unit of resources consists of something, which, instead of coming in the first instance to the person who invests the unit, comes instead, in the first instance (i.e. prior to sale if sale takes place), as a positive or negative item, to other people* (Pigou, 1920 p. 174). This definition and also an explanation of the source of the externalities is understand as a classical point of view. R. H. Coase on the other hand said*:"The traditional approach has tended to obscure the nature of the choice that has to be made. The question is commonly thought of as one in which A inflicts harm on B and what has to be decided is: how should we restrain A? But this is wrong. We are dealing with a problem of a reciprocal nature. To avoid the harm to B would inflict harm on A. The real question that has to be decided is: should A be allowed to harm B or should B be allowed to harm A? The problem is to avoid the more serious harm."* (Coase, 1960 p. 2). It is obvious that Coase is mainly focused on finding a better solution, new optimum. R. H. Coase

further on explains the source and as a matter of fact also the way of solving the externalities. The reason (source) of externalities is the not well defined property rights. In cases when the property rights are correctly defined, there are no externalities because owners of such estates will lead private negotiations and will compensate each other and find the optimum. And this particular note is a Coase theorem: If the property rights are well defined and protected, the private negotiation will lead to the new optimum no matter what is the default demarcation of the property rights. Also, as written above, the externalities do not occur due to failure of the trade, but duo to not correctly defined property rights (my own translation of Holman's definition (Holman, Ekonomie, 2005, chapter-Externality). Distribution of rights determines who can claim compensation, however this does not affect the fact that a new and better solution is made. Restriction of the Coase theorem is the transaction costs. Even Coase himself admitted that his theory works only under the assumption of zero transaction costs (which were later on objects of criticism). Under moderate transaction costs a suboptimal result occurs, under high transaction costs the negotiation is not even started, because it discourages the two parties or the transaction costs are higher than the cost of externalities itself, therefore it is not logical to continue in negotiation (Coase, 1960, p. 15). A.C. Pigou wrote about three groups of people generating externalities[1]. For the first group Pigou suggest financial compensation and improvement of agreement between the lesser and lessee, with a strictly stipulated compensation in it (Pigou, 1920). Private negotiation is used, which is interesting. For the second group (persons who are not producers of the commodity in which the investor is investing, see above) Pigou used the power of taxes and bounties because externalities and agreements between all parties cannot be, for these cases, calculated and created and because : *„The generators of externalities are third parties not included in the contract, that is why other tools must be used“* (Pigou, 1920 p. 192).

[1] *(1) the owners of durable instruments of production, of which the investor is a tenant; (2) persons who are not producers of the commodity in which the investor is investing; (3) persons who are producers of this commodity“.* (*The Economics of Welfare, Pigou, page 174.)*

R. H. Coase criticized this statement in his book The Problem of the Social Cost. Disadvantage of Pigouvian taxes is their coverage area (Coase, 1960 p. 41). They can help to particular place, particular problem, but because they are constructed as an area helping tool they can also affect places where there are no externalities and therefore cause externalities.

2.1 Another point of view

Mr. Donald Wittman is a living economist who created a Wittman Cost Asymmetry method which helps to determine who is the generator of the externalities or more precisely who should pay for the compensation of the cost.

His book *Liability for harm or restitution for benefit* demonstrate the problem of transaction costs in a different point of view which will help us to determinate who is the generator of externalities and who has the right for the compensation and also how high should be those compensations. His work does not include any new information about externalities that I would not already know, but the way of his thinking about the transaction costs is helpful for me and for solving out my problem.

Mr. Wittman is using a well known example of Train versus Farm field with corn (Wittman, 1984, p. 62).

Sparks cause fire which destroys corn and that is how the externality is created. Who and how should be paid the damage? Let's consider that the optimum is when the trains use bars preventing the sparks from flying out of the smokestack and farmers cultivate their corn 20 meters far to railway lines.

First point of view gives responsibility for the costs to the railway. So when the sparks fly out of the smokestack and burn down the corn then the railway pays the costs because they are responsible for the externality, because the externality raised as a result of the negligence of the owner of a rail because he did not used the anti-spark bars correctly.

The Second point of view orders to farmers to pay to railway for not damaging their properties. This decision imply huge transaction costs because

there will be need of installation of the anti-spark bars on each locomotive. The railway owner will claim from every single owner of the field which crosses his train to pay him for not damaging their corn. This option is very complicated.
We know that the optimum is when locomotives have the anti-spark bars and farmers cultivate their corn 20 meters far from the railway. This gives us the baseline from which we can count potential costs. When the railway is behaving carelessly the corn will burn down due to sparks flying out of the smokestack. The cost will be equal to the difference between present condition and optimal condition. Now let's imagine the second case when farmers pay to railway for not damaging their fields. The fact that railways are not paid equally to their raised externalities is also a complication. For example they had to change the trace of the railway because of the shape of the field which is an easily calculated cost, but instead of this compensation they only have benefits from not burning down the farmers' crops. How can we count the amount of the compensation? That is impossible. Therefore there is the Wittman Cost Asymmetry method which helps us to determine which point of view is right and how to decide who has the right for the compensation and who should pay for the costs or more precisely how to reduce transaction costs and reach the optimum (Wittman, 1984 stránky 62-65).

2.2. Economic Resources used for solving the externalities

I wrote that the externalities are a failure of the market. Also I wrote that externalities originate due to not clearly defined ownership rights. A market has its own measures how to solve the externalities and if the people are willing to negotiate they can use these measures. All four options of solving the externalities are very interesting and their simplicity telling us that the market behave logically, exactly as a rational economist should behave. In the forestry are in most cases used the first and third option. Let's have a look.

2.2.1. Property, ownership rights

We have a public forest which does not belong to anyone. Everybody can enter the forest. It lies in a beautiful district and in the period of mushrooms the yield is very high. If the forest belongs to everyone, who can restrict the complete extraction of the forest? It is natural that a man would like to maximize his utility and therefore take as much wood as possible. Logically a conflict arises because there will not be only one person who would like to take some wood. The forest therefore becomes a scarce resource and a conflict rises every time somebody enters the forest. How to prevent it? Preventing this problem is possible only (if you don't want to hurt anybody) if we solve the problem about ownership. Strict definition of ownership rights, which means unlimited and exclusive right to the property, is a solution of this problem.After the ownership is defined it is easy to tell, who has the liability to take care about the forest, ho can claim the revenues from yields of mushroom productions or from stumpage. Also who has the right for claiming the compensation for destroying the forest by vandal, thieves etc (Tereza Urbanová, 2004 str. 4).

When the transmission system in the forest is developed than the easement is used. Change of the ownership is made and an appropriate compensation is paid to the previous owner of the land.

2.2.2. Bargain

If two people own a scarce resource, an estate, they are those unique people which had the right to decide what to do with that resource. If they decide to swap those resources with each other then they are the only ones who can set the value of their property. Whereas each owner has his unique price for the particular resource it may happen that both of them value more the resource that the other one possesses. They swap their resources, if they feel that they are more satisfied with the other resource. A shift has an important attribute and that is that the shift is mutually beneficial (Tereza Urbanová, 2004 str. 4).

2.2.3. Price

Price generated by bargaining of ownerships provides important information and initiative for coordination of individual activities for an "effective" function of a human society. For example, if a price of some scarce resource is growing, it means that the resource is going to be even rarer. Also some of the consumers will stop utilizing that resource some of them restrict the utilization of that resource and lots of producers shift their operations and will start to produce that particular product. Production and consuming flow is adapted for the new circumstances of rarity. On the other hand the opposite case, when the price drops, will cause an opposite reaction. Mutual adaption works (Tereza Urbanová, 2004 str. 4).

2.2.4. Economic calculation, profit, loss

An economical person thinks rationally, therefore when some buying process is up to be made he is mainly focused on that fact if his level of satisfaction will rise. Price is used for calculating the economic calculation. Consumer can, based on the price, determine which investment is convenient for him. Good investments are those in which the input price is lower than the output revenue.

Profitable production is that which went through the profit-loss test and is still profitable. This is another option how to decrease rarity of resources (Tereza Urbanová, 2004 str. 5)

3. Forest and buffer zones as a source of externalities

In this chapter I will define what is the forest and explain how can affect the development of the transmission lines a different type of the forest.

In the Forestry code the forest is defined as:„*forest stand shall mean trees and shrubs of forest tree species which, in their particular environment, fulfill forest functions,"* (Lesní zákon, 1995)

Forest is divided into three classes. Every class differ by its utilization. But for me, more important is, that in every group are different regulations in respect of developing the transmission system. These classes are protection forests, special purpose forests and commercial forests.

3.1. Protection forest

Protection forest can be understand as a forest which protect the nature simply because of the fact that the forest is there. The roots have the power of preventing the landslide. This is therefore the function of this type of class, to prevent the disaster, protect the nature itself and the people:„ *Forests at exceptionally unfavorable sites (debris, [stone seas], sharp slopes, ravines, unstable sediment or sand, peat land, spoil banks or spoil heaps etc.)"* ((Lesní zákon, 1995).

Building up something in Protection forest must be in compliance with the Act n. 114/1992 on The Conservation of Nature and Landscape, Nature 2000 and all bodies somehow connected with the development itself .

3.2. Special purpose forest

Special purpose forest is basically designation of the forests that are somehow different:„*In zones of hygienic protection of water resources of 1st degree,... In protection zones of natural healing and table mineral waters,... on the territory of national parks and national nature reserves..."* (Lesní zákon,1995, Article 8).

There are no special changes in regulations about the ownership rights, but very important is that the Special Purpose forests have the attribute of something special which give them more protection from for example the nature protection institutions.

3.3. Production forest

„Production forests are forests which are not included in the class of protection forests or special purpose forests." (Lesní zákon, 1995, Article 9).

Division into classes is something that distinguishes the particular regulations. Forests in Natural reserves are handled differently than the production forests. But in article 36 of the Forest act there is written that: *„Owners of protection forests shall be obliged to carry out forestry activities in such a manner so as to ensure, in particular, the protection functions of such forests."(* (Lesní zákon, 1995, Article 36). That means if the transmission line is proposed to be developed and the protection function of the forest is not changed than the development can be done.[2] Situation about the Special purpose forest is different. In the Forestry act is written: *„Owners of special purpose forests shall be obliged to tolerate any restrictions during their forestry activities in such forests."*(Lesní zákon, 1995, Article 36). Now you thing that for example in the National park can whoever build the transmission systems because the act is saying that the owner of the forest has to tolerate any restrictions. But that is not true. The article is speaking solely about the ownership rights[3].

[2] Protection forest protects people not the forest itself.

[3] In other words. The owner has no special defense against the restriction of the ownership right. But the forest itself can (for example Natural park) has much higher level of nature protection and that is what can protect the forest against the development of the transmission system.

3.4. Buffer zones

Buffer zone is the line under the power lines without any high trees and buildings. The protection zones are kept free to give better conditions for maintenance and for increased safety of the workers and the forest.

Dimension of the Buffer zones are stipulated in the Energy code (Energy code, 2000, § 46).

The reason why the buffer zones are the source of externalities is the fact that the buffer zones restrict the operational function of the forest. Necessity of creating the Buffer zones is stipulated in the Energy Act § 46. Calculation of the real loss of the production function and determining the amount of compensation is very difficult (see chapter 4.2) and due to a not correctly calculated compensation can, in a first instance (development of the power lines), an externality occur. Further on Power lines can cause damage to animals such as birds or scare of animals because of the sound.

Energy Act did not forget to put down the prohibitions which are in force in the buffer zone:*„In the protection zone of overhead and underground lines, electricity generating plant or an electric station it is forbidden to:*
a) Erect any buildings or install any structures or locate any other objects or store any flammable and explosive materials without the consent of the owner of the respective electrical equipment " (Energy code, 2000, § 46).

3.5. Forestry typology

Forestry typology, as a basic discipline of economic wood modification, is dealing with classification of permanent ecological conditions. This typology divides forests into segments with similar growing conditions, evaluates these conditions and defines the conclusions suitable for the forestry management. Forestry-typological mapping is based in 1 § of the decree number 83/1996 Sb. When the forestry-typological mapping is applied the evaluation of the permanent characters

of the environment is performed (light, heat, water, soil chemistry) and also the reconstruction of the natural composition of the vegetable environment.
On the picture below you can see on horizontal axes the types of the trees. On the vertical axes there are the types of the soil.

This tool is effective and gives so much both theoretical and practical knowledge about the forest. In connection with the Uhul maps and SLT indicators I calculate my case study.

Edafická kategorie		Vegetační lesní stupeň									
		borový	dubový	buko-dubový	dubo-bukový	bukový	jedlo-bukový	smrko-bukový	buko-smrkový	smrkový	klečový
		0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
X	xerotermní	1,24	1,33	1,93	3,85	3,20	-	-	-	-	-
Z	zakrslá	1,77	1,15	1,35	2,13	2,29	4,13	2,90	2,33	2,23	1,25
Y	skeletová	2,79	0,00	1,76	4,45	3,03	3,03	3,46	2,91	2,23	1,74
M	chudá	1,80	2,74	1,81	2,40	3,03	2,78	2,27	2,81	2,23	0,00
K	normální	2,44	1,58	2,58	2,66	4,66	4,86	5,04	3,44	2,23	1,92
N	kamenitá	3,22	1,72	2,36	2,42	4,96	4,49	5,04	2,95	2,23	-
I	uléhavá	-	3,12	3,19	4,24	5,47	6,53	6,64	0,00	0,00	-
S	středně bohatá	-	3,33	3,42	6,00	6,37	6,71	6,71	5,09	2,81	-
F	svahová	-	-	-	7,18	6,53	6,69	6,69	5,20	3,38	-
C	vysýchavá	2,27	2,29	2,47	3,21	3,96	5,07	-	-	-	-
W	bázická	-	2,02	6,30	5,74	5,87	5,91	-	-	-	-
B	bohatá	-	3,98	4,65	7,01	7,56	8,80	7,90	7,81	-	-
H	hlinitá	-	3,64	4,81	6,73	6,44	8,61	6,86	-	-	-
D	hlinitá	-	4,77	7,33	7,13	8,75	10,16	8,44	-	-	-
A	kamenitá	-	3,12	3,05	5,66	7,33	6,46	6,45	-	3,36	-
J	suťová	-	3,44	0,00	5,40	-	6,73	0,00	-	-	-
L	lužní	-	7,16	6,35	1,95	-	1,61	3,02	-	-	-
U	údolní	-	5,49	0,00	5,59	-	6,49	0,00	-	-	-
V	vlhká	-	6,77	6,48	5,72	8,34	7,40	7,34	5,40	3,36	-
O	středně bohatá	3,19	6,73	7,04	4,47	5,43	7,08	6,64	6,56	3,42	-
P	kyselá	3,02	4,44	4,00	3,89	4,01	5,48	5,82	4,92	2,81	-
Q	chudá	1,72	2,80	2,88	2,52	3,95	3,22	4,21	3,17	2,23	-
T	chudá	1,89	1,61	2,66	2,88	0,00	3,10	2,90	2,75	2,23	-
G	středně bohatá	3,60	2,00	6,52	5,48	5,98	6,40	6,48	4,92	2,81	-
R	chudá	2,02	-	-	2,17	5,68	3,95	6,34	2,81	2,23	1,25

Picture 1. SLT Table

4. Protective hand of the state, legislation

In this chapter I will write about five acts that affect the development of the transmission system-Civil code, Energy Act, Building Act, Forestry Act and the Act n. 114/1992 on The Conservation of Nature and Landscape.

Operator of the transmission system has the right to build and utilize the transmission system on somebody's property due to the Energy code of Czech Republic (Energy code, 2000, § 24). Under this code the operator of the transmission line is obliged to create an easement[4] with the owner of the property in which the compensation for losses are negotiated. Most of the externalities arise because of the creation of the buffer zones which make impossible to utilize the forest for 100% of its production function[5]. Obligation for paying up all the compensations is also stipulated in the § 24 of the Energy Code in points 8 and 9 (Energy code, 2000,§ 24, page 74).

Legislation about harm as a harm on property is also (of course) included in the Civil code. It is a base ground for the derivation of the basic principles of liabilities for harm, for defining the harm. In the compensation the real damage is included, which raised due to the felled forests and costs connected with this and also the so called loss of profit, which represents the harm that raised because the owner of the forest cannot multiply his property values although it was expected (Civil Code,2012, § 2969). Nevertheless The Civil code do not mention the other harms caused by developing the transmission systems. These harms are showed in Forestry Code.

Forestry law is the second regulation governing the liabilities for harm caused to the forests in general, legal regulation is concentrated in its § 21., §. 2 and 3. They say that:*„if there is an interruption of continuousness of the forest, forest roads or other object and facilities used for management of the forest then the generator of such harms is responsible to compensate the damaged owner*

[4] Energy Act, paragraph 24, point 4
[5] 458/2000 Sb, § 24, page 72, Energy code of Czech Republic

and also compensate the raised operational costs."(Forestry act, § 21, point 2). In the next point is written*: „the investor is obliged to pay for costs related to harms raised due to the development of the power lines, the amount should be equal to revenues which the owner of the forest would otherwise get if the forest wasn´t felled.*"(Forestry act, § 21, point 3).

Unlike the Civil code the Forestry code defines the claim of the forest owner for compensation of direct costs related with development of the power lines (costs for felled forest, costs for higher expenses for maintaining the forest). Unfortunately it did not cover all costs which occur by developing the power lines in the future. Equations used for calculating the loss or damage caused to forest are explained in the regulation n.55/1999 (n.55/1999, 1999).

Another fact that affect the development of the transmission system is the protection of nature. Protection of nature in Czech Republic is based in the Act n. 114/1992 on The Conservation of Nature and Landscape. It happens quite often that these institutions can forbid the development of the transmission system even if all other bodies agreed with the development. Nature conversation authorities in Czech Republic are: Municipal authorities, District offices, the administrative bodies of national parks and protected landscape areas, The Czech environmental Inspectorate, The ministry of Environment (Act n. 114/1992,§ 75). All of those authorities are have the right to stop the development (in the phase of the proposal).

At first the purpose of the act is to contribute to preservation of the nature in compliance with the European legislation under the NATURA 2000 (described later on). General rules apply to everybody. Therefore the investor must respect the § 2 in the Act n. 114/1992:*„The general conservation of wild plant and animal species, and the particular conservation of those species that are rare or endangered, by positively influencing their natural development and creating the conditions for their preservation, and also by using special growing and breeding facilities."*(Act n. 114/1992,§ 2). If a nature conservation authority sees that the nature is endangered due to the development of the transmission system

than the development is simply stopped and has to be remade to preserve the nature or if it cannot be remade and the possible damage is still high than the project cannot be build.

The investor is obliged to: *„at his own expense, arrange for a natural scientific study of the land concerned and procure a written assessment of the effect of the intended intervention on plants and animals"* (Act n. 114/1992, § 67). If some other compensatory nature protection measures have to be used (building of technical barriers, transfer of plants or animals) the investor must implement these measures at his own expense (Act n. 114/1992, §67).

All bodies somehow connected to the development of the transmission lines are linked because of the Building Act. Opponents or advocate of the development have the space and possibility to raise their objections in the public debate about the development (Building act, 2006, § 39, point 1). In fact Building act links all the bodies that can contribute to the development (also by the fact that they stop the development) and preserve the rights of all those bodies if a harm (or potential future harm) is caused by development of the transmission system because it gives them the possibility and space to defend them self or nature, village, city, park, forest etc.

4.1. Natura 2000

Natura 2000 is the EU tool of nature protection areas which tries to maintain the European biodiversity under the 1992 Habitat Directive.

It consist of two parts: Sites of Community Importance, SCI (in Czech "Evropsky významné lokality", EVL) and Special Protection Areas, SPA (in Czech "Ptačí oblasti", PO)[6][7]

Its aim is to protect the most important animal and plant species and habitats[8]. The total number of habitats included in SCI is 231 (72 are the priority

[6] http://www.nature.cz/natura2000-design-en/sub-text.php?id=6589&akce=&ssHledat=
[7] list of SCI and SPA is available on http://www.nature.cz/
[8] From the European point of view.

habitats[9]) and 911 animal and plant species (255 priority species). Because this number is total for the whole European Union I have to point out the Czech Republic. In Czech Republic are 60 biotopes (19 priority habitats), 39 plant species (15 priority plants) and 65 animal species (8 priority species). In SPA there are 194 bird species. In the Czech Republic concretely 59 birds.

Requirements for protection of those species are stipulated in every national law, in the Czech Republic in the Act n. 114/1992 on The Conservation of Nature and Landscape.

Natura 2000 helps to protect the nature in all European Union countries. How does it affect my case? Let's say that the Czech law Act n. 114/1992 on The Conservation of Nature and Landscape protect the nature well and also the Natura 2000 in Czech republic is implemented by the Act n. 114/1992 on The Conservation of Nature and Landscape. But nevertheless Natura 2000 has a specific and particular list of habitats, animal species, plants which have even higher protection. Natura 2000 as a real tool is therefore active even in my case of developing the transmission system. Ministry of the Environment is an authority which is by the act n. 114/1992 in the Nature conversation authorities list. Therefore if the project proposal affects SCI or SPA and harmfully affect these areas the project proposal is restricted or must be changed in order to protect the SCI and the SPA.

4.2. Counting the amount of compensation for restriction of the ownership right and for premature felling of the trees

General rules which are dealing with the liabilities for costs which raised during the realisation and operation of the power lines (line constructions) are covered by two regulations, by The Civil code and law n. 289/1995 of The Forestry code, both laws are in force.

[9] Priority habitats or priority animals and plants have even more strict protection.

The owner of the forest has three basic options how to apply for compensation of the cost due to the development of the transmission system. We have to distinguish among them because different rules are used for calculating the cost.

Compensations of the costs are divided into four basic groups. The first group is the compensation for restriction of the ownership right. On the place where are the pylons is used an easement because the occupation of the land is total. There is no chance to use the particular ground differently. Second group is the compensation for temporally withdrawal of the function of the forest. This is used for the ground under the lines because there can be for example the planting of the Christmas trees and the ownership right is not restricted at all. Third group is the compensation connected with the damages created by the development of the transmission lines (Act n. 55/1999 Sb.,). The last compensation is a fee for withdrawal of land fulfillment of forest functions. This fee is determined by local state forest management.

For the first group the cost is calculated by equation $S1 = r \times (1 - K)$.
S1 is total cost. *r* is a rent calculated from SLT table as an arithmetic mean. *K* is the rate of the forest which lost its function, zero means that all function was lost. This is for the restriction of the ownership right. This compensation is calculated as annual. If the easement is for 50 years, than $S1 \times 50$.

For the second group the equation for calculating the cost is the same. But there is no easement but only a lease for the particular land. This compensation is calculated as annual. If the lease is for 50 years, than $S1 \times 50$.

For the third group the compensation is for damages connected with the development of transmission system. For example if an excavator damage some trees out of the buffer zones than the value of compensation is equal to the market value of damaged trees.

To the total compensation is also added the damage from the destruction of forest. If the trees are ready for the felling than the equation $S6 = Hlpa - Aa$ is used. *Hlpa* is the value of the forest before felling. *Aa* is an amount calculated as

difference among the yield from the trees and the own cost connected with the felling of the trees. In other words cost connected with the work needed for the felling of the trees which did not paid the investor. If the forest is not ready for felling and therefore the yield is lower because the trees are not in their 100% selling condition (trees are not totally grown) than the equation $S5 = Hlpa \cdot Mn/100$ for premature felling of trees is used. *Mn* is percentage of toll immaturity (Act n. 55/1999 Sb.,).

Prices of land determined from SLT table can be different from the real price of particular land but still SLT table is used because it is a governmental measure for setting a baseline, it is also stipulated in the Forestry act that SLT table for calculating of the compensation for restriction of the ownership right must be used. It gives the right for every owner of the forest to be compensated in a same way. It is also an anti-monopolistic tool.

SLT prices are not those prices that are used for calculating of the value of felled trees. Prices of felled trees are equal to the market prices. Average prices of wood in Czech republic are recorded in the Czech Statistical Office[10]

These are the basic options for cost calculating. For the toll immaturity and for other things that are not easy to estimate are called experts.

4.3. Compensations for restriction of ownership rights in Slovakia

In the past the Forestry act in Slovakia has no notes about compensation for restriction of the ownership rights. That was very unfavorable for the owners of the forests. Nowadays, mainly due to the European Union, there is a big change. In the Slovak Forestry act in § 35 is stipulated that the owner of the forest has the right for compensation if his ownership rights are somehow restricted (Zbierka zákonov č. 326/2005, Zákon o lesoch).

[10] https://www.czso.cz/documents/10180/20549761/011035-14q404.pdf/4471ed76-e213-4eff-8657-1f2c86e2a27a?version=1.0

5. Grid-connected versus stand-alone energy systems for decentralized power

Before I will deal with the example of the case study I need to find out whether a grid-connected energy system is more or less effective than the decentralized energy system and also how ethical limits affect the development or the willingness of people to protect the nature.

This chapter is based on an article from the book Renewable and Sustainable Energy Reviews (KAUNDINYA, and others, 2009).

Is it more effective to build a Stand-alone energy system and protect the forest because of no need of development the transmission system through the forest or it is better to make a Grid-connected system?

High cost of delivered electricity is attributed to centralized energy systems which operate mostly on fossil fuels and a huge investments for developing the transmission system is needed (KAUNDINYA, and others, 2009, page2). On the other hand decentralized energy systems are based in the most cases on renewable energy sources and because of the possibility to build a stand-alone energy system near to the location where it is needed, the price of the electricity can be lower because no investments in developing of the transmission system are needed. This can help to a rural electrification. At the end of the page is an interesting sentence:*„If decentralized energy strategy is adopted, total worldwide savings are estimated to reach 2.7 trillion dollars by 2030*"(KAUNDINYA, and others, 2009, page 2).

5.1. Grid connected

Two types, first one is focused on cater the local needs for electricity. If there is a surplus of the electricity it is fed into the grid, if there is shortage than electricity is drawn from the grid (KAUNDINYA, and others, 2009, page 2).

5.2. Stand-alone

"Stand-alone" because they produce power energy independently of the grid. SA systems are used in remote rural areas or in places which are hardly accessible. The most cost- effective way how to produce SA energy power is by photovoltaic installation. The SA systems have these main disadvantages-low capacity factors, excess battery costs and finite capacity to store the electricity forcing to release the surplus of electricity made.

The question is than what is better for my case. The SA systems are mainly used when the accessibility is the main problem-suitable for supplying hilly regions, remote villages. GC systems have the advantage in electricity surplus storage, GC works as infinite storage unit and therefore no need for costs on storage batteries in case of solar or wind power stations (KAUNDINYA, and others, 2009, page 3). Nevertheless the extension of the GC to the remote location is extremely expensive. SA systems are often used in households or firms to reduce electricity bills, which is often very effective. The problem is we need to secure the whole village (in my case) not only few buildings and also the electricity need to be accessible nonstop[11].

Answer for my question is that the conditions in Czech Republic are more advantageous for the GC system. SA systems are cost effective for places that are really far away from the nearest grid systems, not only dozens of kilometers. Therefore I have chosen GC system to apply in my case.

5.3. Comparison of costs of development of Grid-connected and Stand alone systems

I have chosen that CG system is suitable to my case. Nevertheless I compare the expenses for development of both systems.

[11]Can be solved by batteries. But that is not cost effective.

One SA system which supplies a city of 1000 households should be as big as photovoltaic power station Hrušovany. This power station contains 17 thousands photovoltaic panels that produce 3.8MW (suitable for more than 1000 households). A firm Sollaris Ltd would build this power station approximately for 143 530 400, - CZK. 1 kWp (kilowatt-peak) for 29 600 CZK plus 30% for elements that are necessary for development of such a power station. Other way how to calculate it is to multiply a single price of one photovoltaic panel (11 200 CZK) by a total number of panels. Total value would be 190 400 000 CZK. An arithmetical mean of both prices is 166 965 200CZK[12][13].

In case of GC I need only to calculate the costs for linking, connecting. 1 km of newly developed transmission system (110kV) costs approximately 6.6 mil. CZK[14].

By comparing the results I see that if the connection of remote village would not be longer than 25km the SA system would be feasible. Obstruction is storage of electricity and the cost for batteries but if the total compensation of the owner of the forest in case of CG would be higher than the cost of batteries than SA system would be the best option. For cities and bigger villages is not possible to use solely this method because the size of photovoltaic power station would must be enormously big.

[12]Indicative price.
[13]Fotovoltaická elektrárnavětšího výkonu (2MW), Michal Rod, 2012
[14]Information by CEZ Distribution, Jaroslav Soukup.

6. Ethical limits

I was thinking about how the ethical limits affect the economical behavior. I have learnt that the economist should be rational. That is true, but still, are the "ordinary" people rational? I would not say. They very often act influenced by their emotions. A book *Ecological Economics* by Patrik Soderholm and Thomas Sundqvist is dealing with this though (SÖDERHOLM, and others, 2003).

In the welfare economics people are treated as autonomous individuals who are trying to satisfy their private preferences. This means that individuals have their own preferences for public goods and are let's say willing to take in mind tradeoffs in respect to the quantity or quality of the goods ((SÖDERHOLM, and others, 2003, page 339)

The Basic philosophical positions are saying that the utility (benefits over cost) from reaction (consequence) of some actions determines if that action is good or bad. But I have to say that this ethical principle for social choices does not comes from the fact that the utility maximization is constituting the basement for individual choices (SÖDERHOLM, and others, 2003, page 339).

The decisions are made whether the act is right or wrong with no regard the consequences. In other words the right prevails over the good. I use an example from the Ecological Economics, P. Soderholm and T. Sundqvist. „*For example, people may believe that aspects of the environment, such as wildlife threatened by a hydropower development project, have an absolute right to protection. They are thus willing to defend the existence or the well-being of the environment apart from any instrumental value it provides*" (SÖDERHOLM, and others, 2003, page 339).

However after this I have read something which is showing the mentality of the human being. There were a survey and people were asked if they agree with this statement: "all species of wildlife have a right to live independent of any benefit or harm to people". Most of them (precisely 79%) agreed. The second question was if they are willing to pay higher cost for the goods because the

production of the goods is more expensive due to the higher protection of the wildlife. They answered "No". This example showed that people are reluctant to choose among something with an attribute "instrumental value" (private goods) and a moral value. This is something inconsistent with the welfare economics paradigm (SÖDERHOLM, and others, 2003, page 340).

Last very interesting thing I will mention here is about individuals. In their decision making process are included two different attitudes. First one is that they are acting like consumers with private preferences, the second one is that they are acting like a citizens with public preferences.

My opinion is that in a case of the transmission system development in the forest the public would think about that probably like this: be as more cautious to the animals and plants, do not kill any of them and try to save as much trees as possible and make the transmission system as effective as you can. People are leaving the decision making process to the higher authorities an believe them that they are making the best. I think this is a good way.

7. Case Study Example

Planned trace (straight) of the transmission system does not have to be the most efficient one. If there is another way, longer one, that leads through different and cheaper forest it may affect the total development costs because the cost on compensation is lower. The question is if the lower level forest is that much cheaper and still not so far away from the firstly planned trace is still more suitable to develop the transmission system there.

I have taken consultation with mister Šafařík, who is the director of the regional headquartering of Lesy Čr in Brno. He approved that this idea can be used but he mentioned several obstructions that may complicate or totally stop the process of changing the trace of the transmission system. At first protection of the nature must be taken in account. As mentioned in previous chapters all authorities dealing with protection of the nature must approve the newly proposed trace of the power lines. This means that even if the development is in total cheaper but it affects protected nature (animals, flowers…) it cannot be developed. Secondly the price for the development of the longer transmission system together with the compensation costs must not be higher than in the first (straight) case.

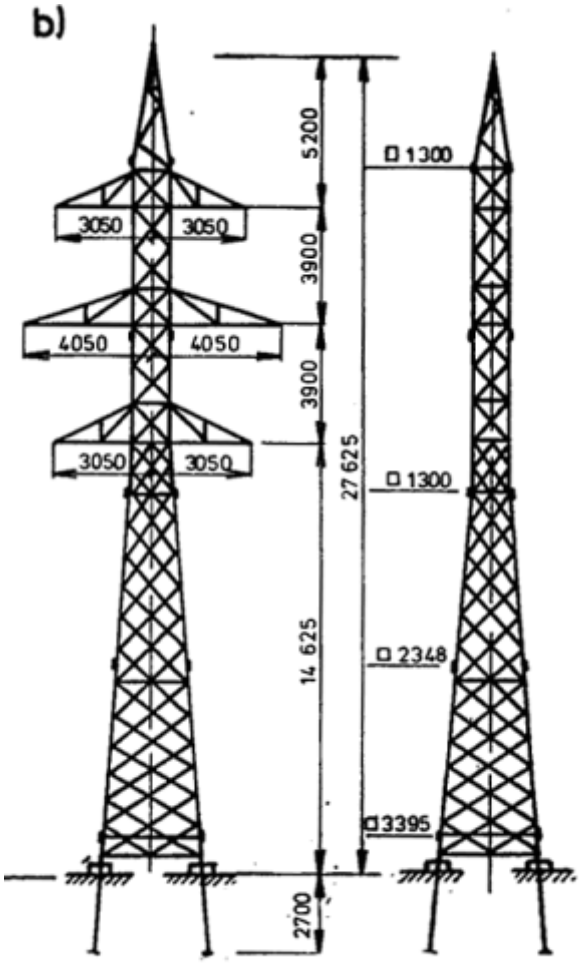
This point of view favors owners of the forests. The legislation protects the owners of the forests and professionals always calculate all the costs connected with the development of the transmission system therefore the owners of the forests always get all the costs back and they have no financial harm[15]. It may occur that the owner of the forest has no interest in changing the trace of the transmission system because in fact he has no financial harm and also because by this decision he will protect the forest because in connection with a longer trace of the transmission lines goes a bigger destroyed part of a forest. Nevertheless developer of the transmission system can find out a different trace which can be more efficient in order of development costs and therefore he himself will try to persuade the owner of the forest to let him develop the transmission system in a

[15]Financial harm connected with development of the transmission system.

longer option. The persuasive tools are financial resources. If there is a better financial optimum a new optimum will be set.

7.1. Example

ČEZ distribution Ltd is a firm that develops transmission systems in Czech Republic. On their website is a document that list the future projects[16]. I have looked on them and I have chosen the project which affects the forest the most. Connection of the cities Nový Bor and Varnsdorf. A village Rousínov is the last village that is on the line between Nový Bor and Varnsdorf therefore I started calculating from this point (see picture Straight line). Transmission system is 110kW and therefore the wideness of the buffer zones is 32,1m.



Picture 2. Pillar

To calculate the most precise amount I will make a few adjustments and that is that all the trees are mature therefore there is no need for compensation for premature tolling of the trees and the owner of the forest can sell all the trees for their real market value and that there are not connected the costs and revenues for using the land under the power lines for production of Christmas trees.

[16] http://www.cezdistribuce.cz/edee/content/file-other/distribuce/technicke-informace/rozvoj-ds/20150129_rozvojove_zamery_komplet.pdf

For the easement (land where are the pillars) and for the tenancy of the land (under the power lines) I will use the same equation S1 = r*(1 - K)[17] for the period of 50 years.
Average cost of development of 1km of power lines is 6.6 mil. CZK[18].

7.1.2. Straight line

The straight line is 7 779 meters long and goes through SLT 5A, 6S, 7G, 6K, 5N, 5K, 5B, 6O, 6B, 6N, 4D (see picture *Straight Line*).

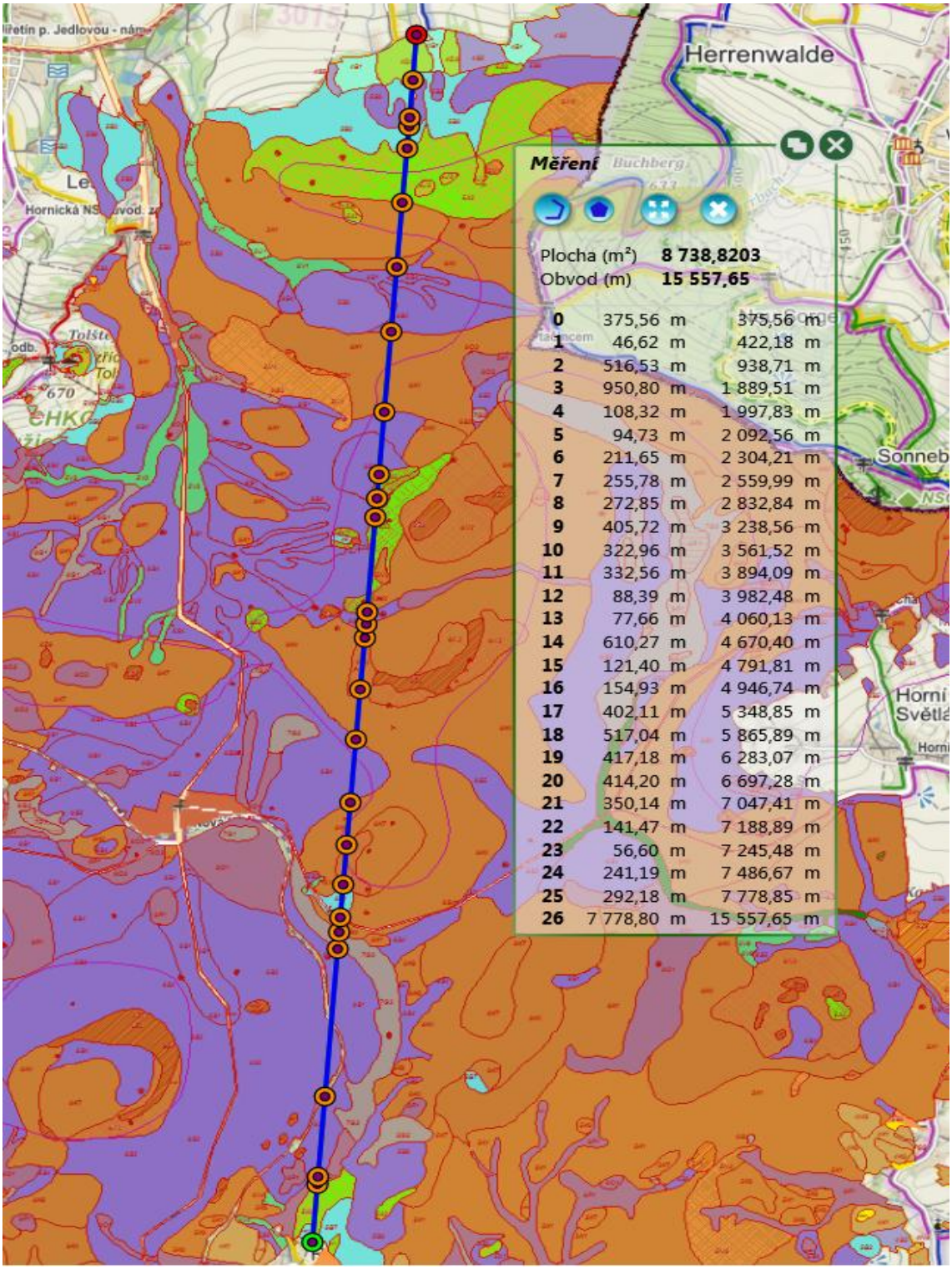
For each particular SLT I calculated the total compensation using the equation
S1 = r × (1 – K) where r is rent calculated as
particular SLT value × affected area (length of a line and wideness of a buffer zone) × 50 (period 50 years) and then I added together all parts.
For example first part is calculated as: 375 × 6,46 × 32,1 × 50=3 888 112,5

Total sum of all parts is (S1)= 79 211 276 CZK.

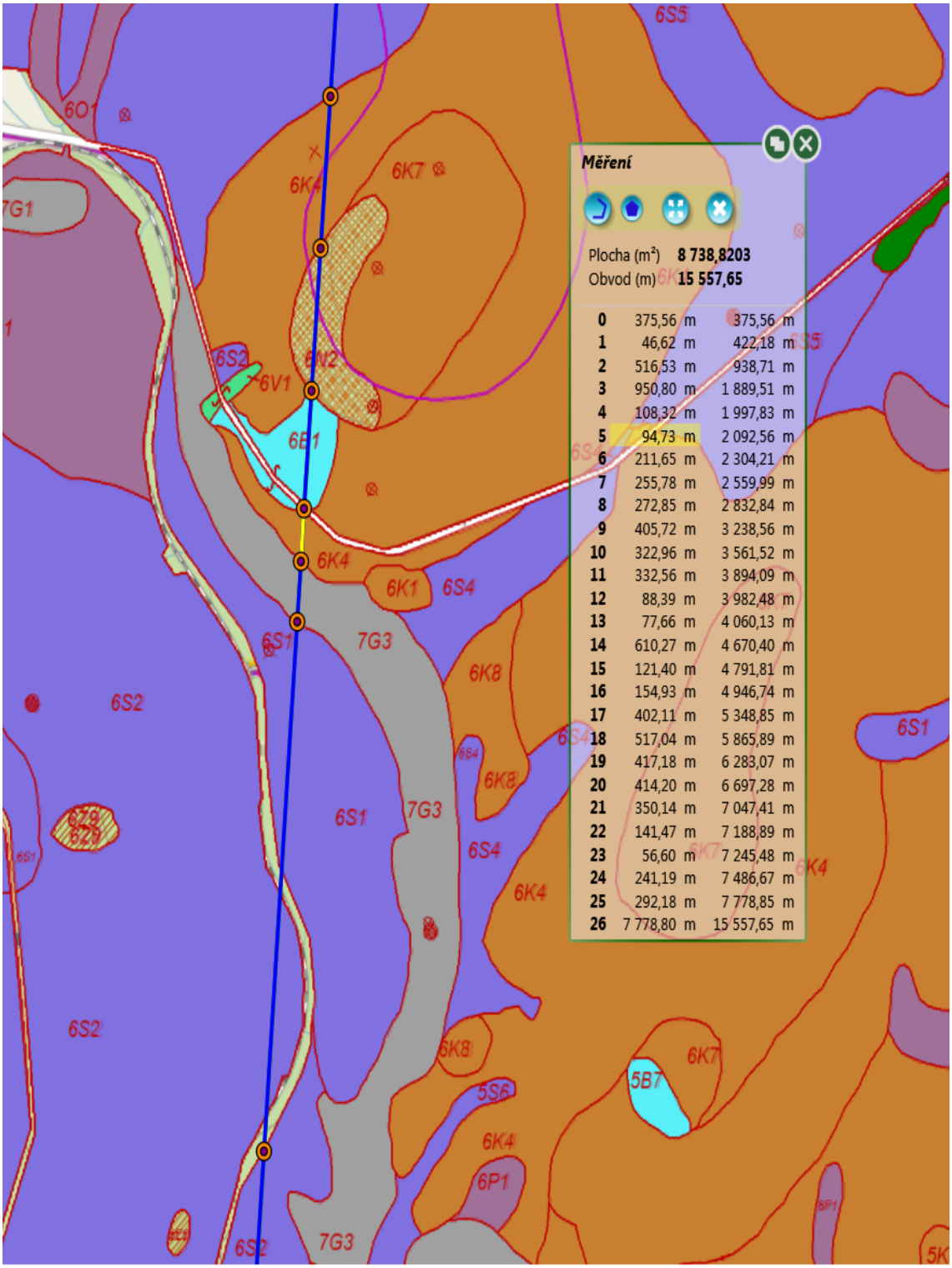
In the picture *Zoomed Straight Line* is obvious how was I working with the measuring tool on the map. Yellow part on the line comes with yellow number 94,73m in the table next to the line. With this tool I was able to calculate very precise values[19].

[17] S1 is total cost, r is a rent calculated from SLT table as an arithmetic mean. K is the rate of the forest which lost its function, zero means that all function was lost. Also r is multiplied by the
[18] Information by CEZ Distribution, JaroslavSoukup.
[19] This map is available on http://eagri.cz/public/app/uhul/ds_lho/

Case study Example



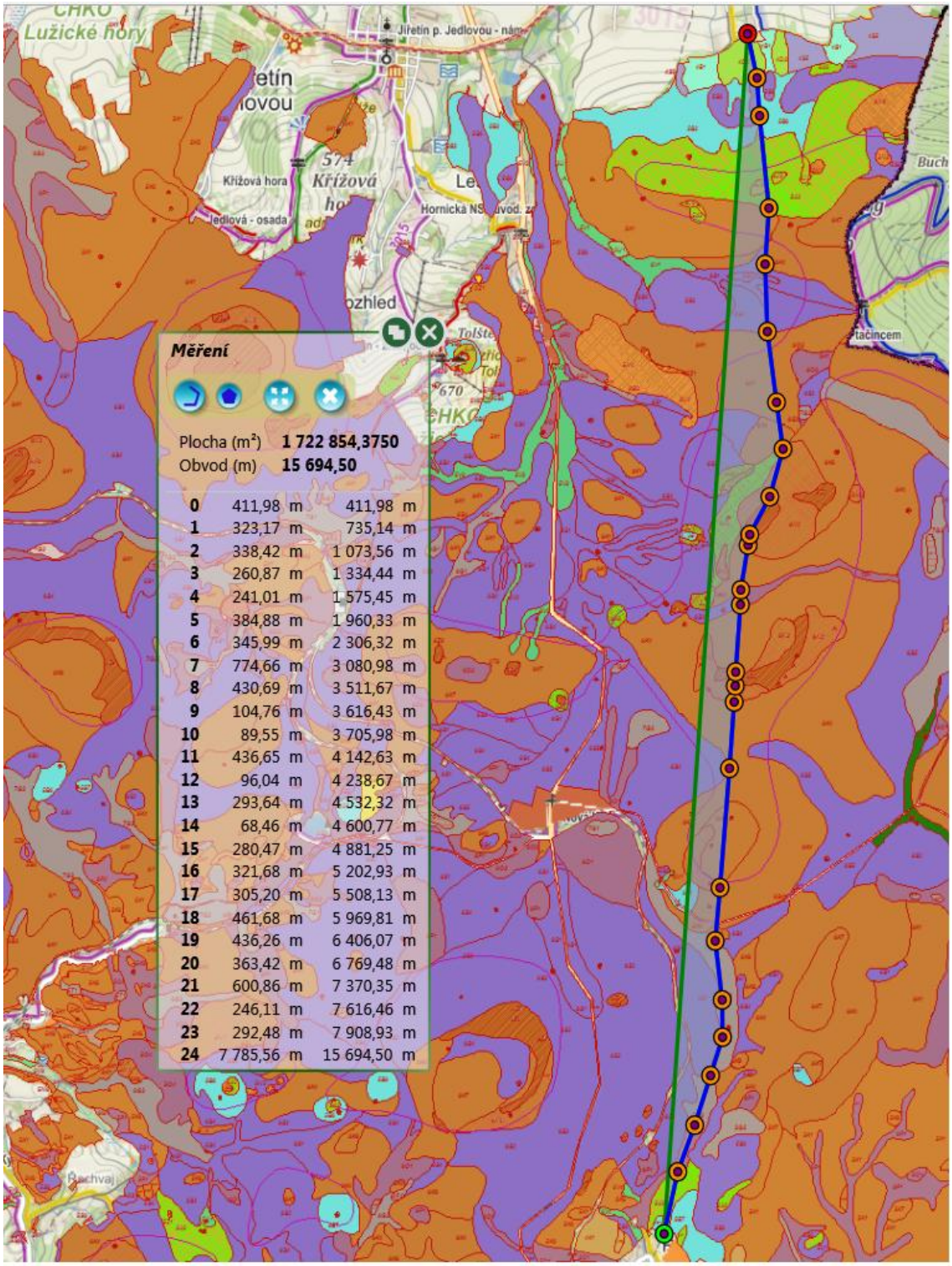
Picture 3. Straight line



Picture 4. Zoomed Straight line

7.1.3. Changed line

For the trace of the Changed line I have chosen the cheaper parts of the forest.
The line goes through SLT types: 5A, 6O, 7G, 6K, 6N, 6Z, 7P, 5S and 4D. The length of the line is 7910 meters (see picture Changed Line).
I calculated the total sum of all part the same way as in previous case. The total sum (S1) is 68 837 278,5 CZK.
Total compensation is by 10 373 997,5 CZK cheaper! By prolonging the line by 131 meters the development cost of the power lines rises by 864 600 CZK. If I subtract this amount from 10 373 997,5 CZK I get 9 509 397,5 CZK. The provider of the transmission system can save 9 509 397,5 CZK by developing the transmission system on this newly proposed trace.

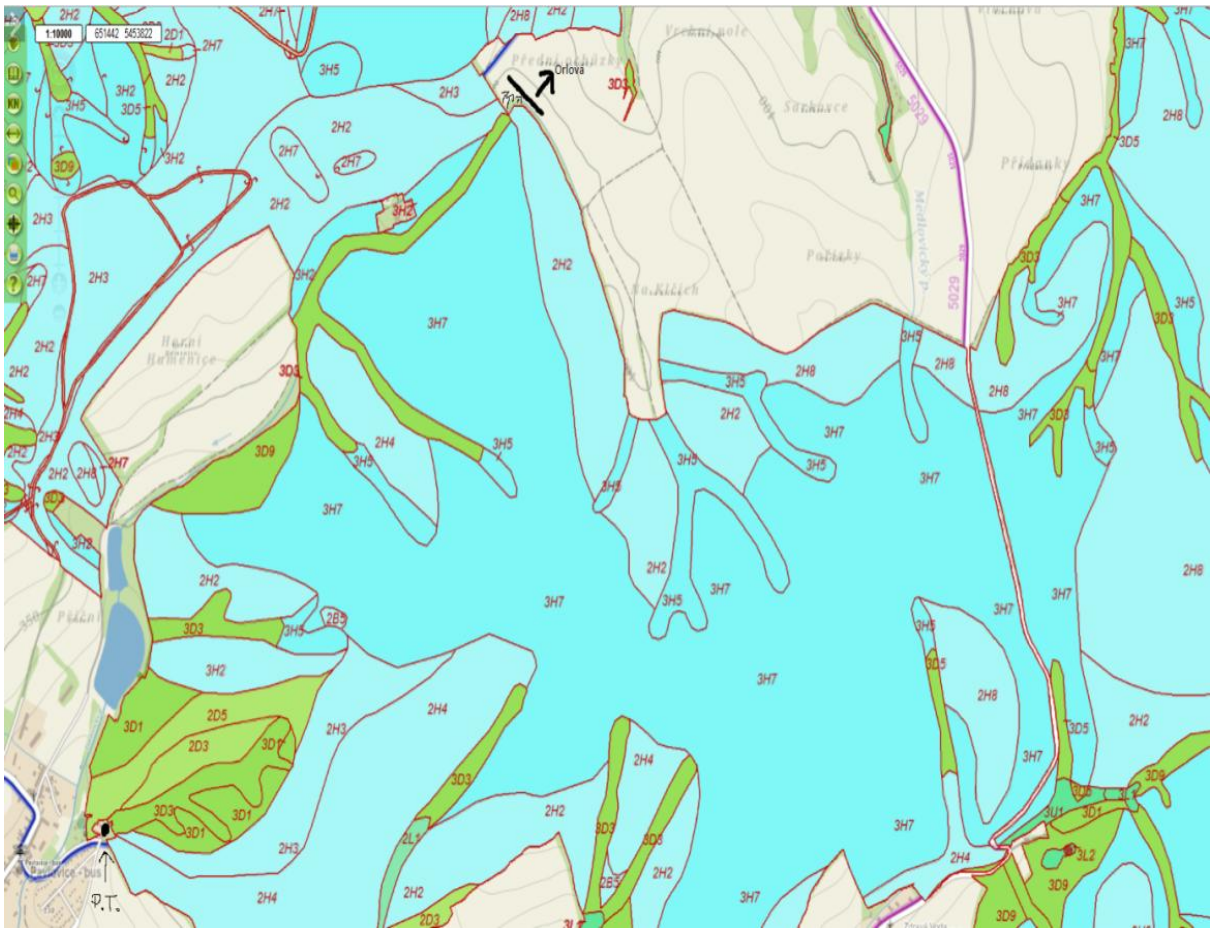


Picture 5. Changed line

7.2. Example

In previous examples the case was ideal. Diversity and quite high contrast between the price of the different types of the forest made possible to use my idea. In this example I show that not always is possible to change the trace and the prolonging of the trace can be more expensive and therefore not suitable for development.

Aim is to connect two villages named Pavlovice and Orlové with power lines. The beginning of the planned trace is in point P.T. End of the line going through the forest is where the abscissa is painted.

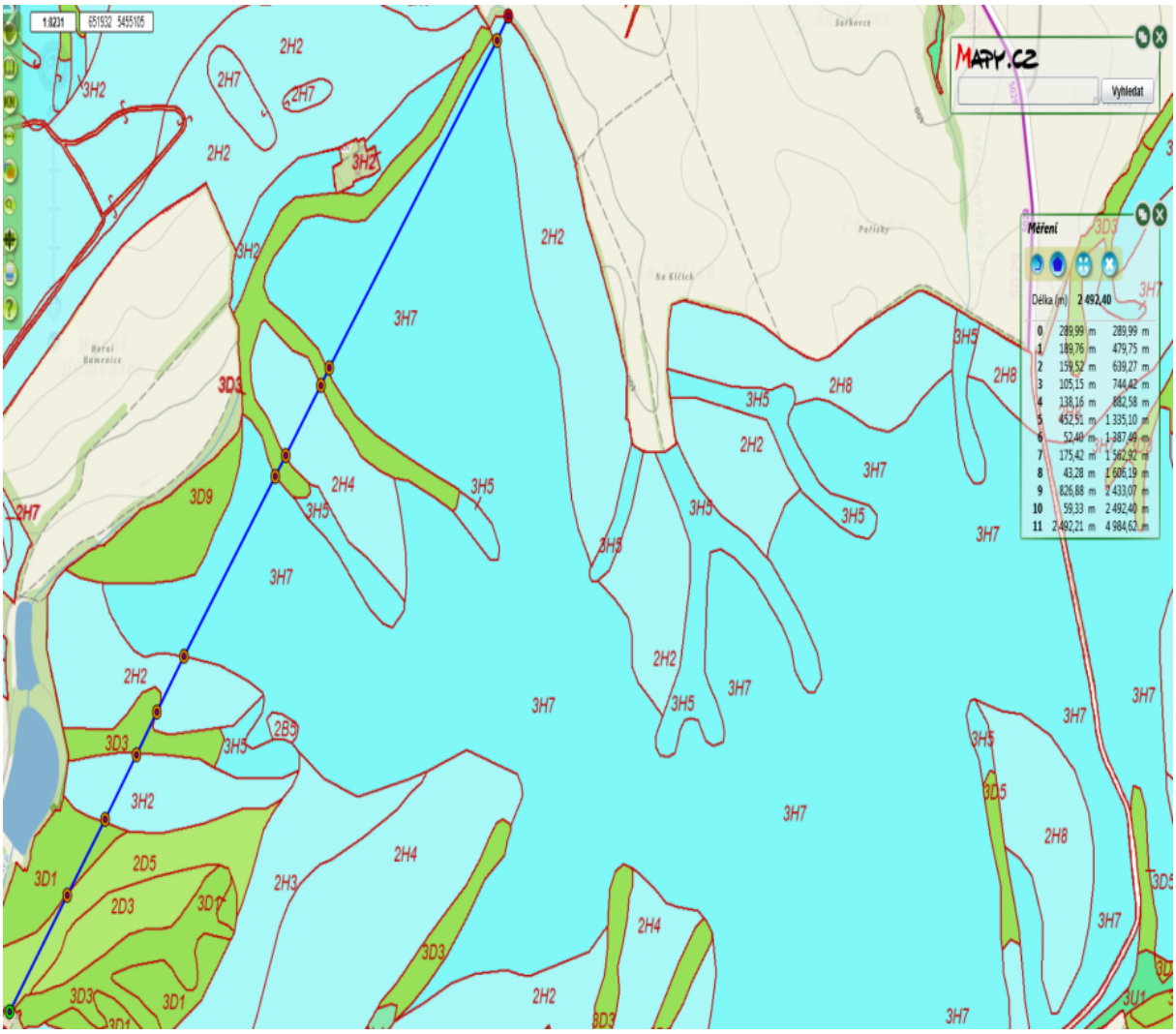


Picture 6. New Example

7.2.1. Example

First and the most simple variant is to lead the line directly. Line goes through the types of SLT : 3D3-2D5-3D1-3H2-3D3-2H2-3H7-3D3-2H4-3D3-3H7-2H2 and its length is 2 493 meters.

Harm is calculated as in previous example. Total harm is 26 319 159 CZK.

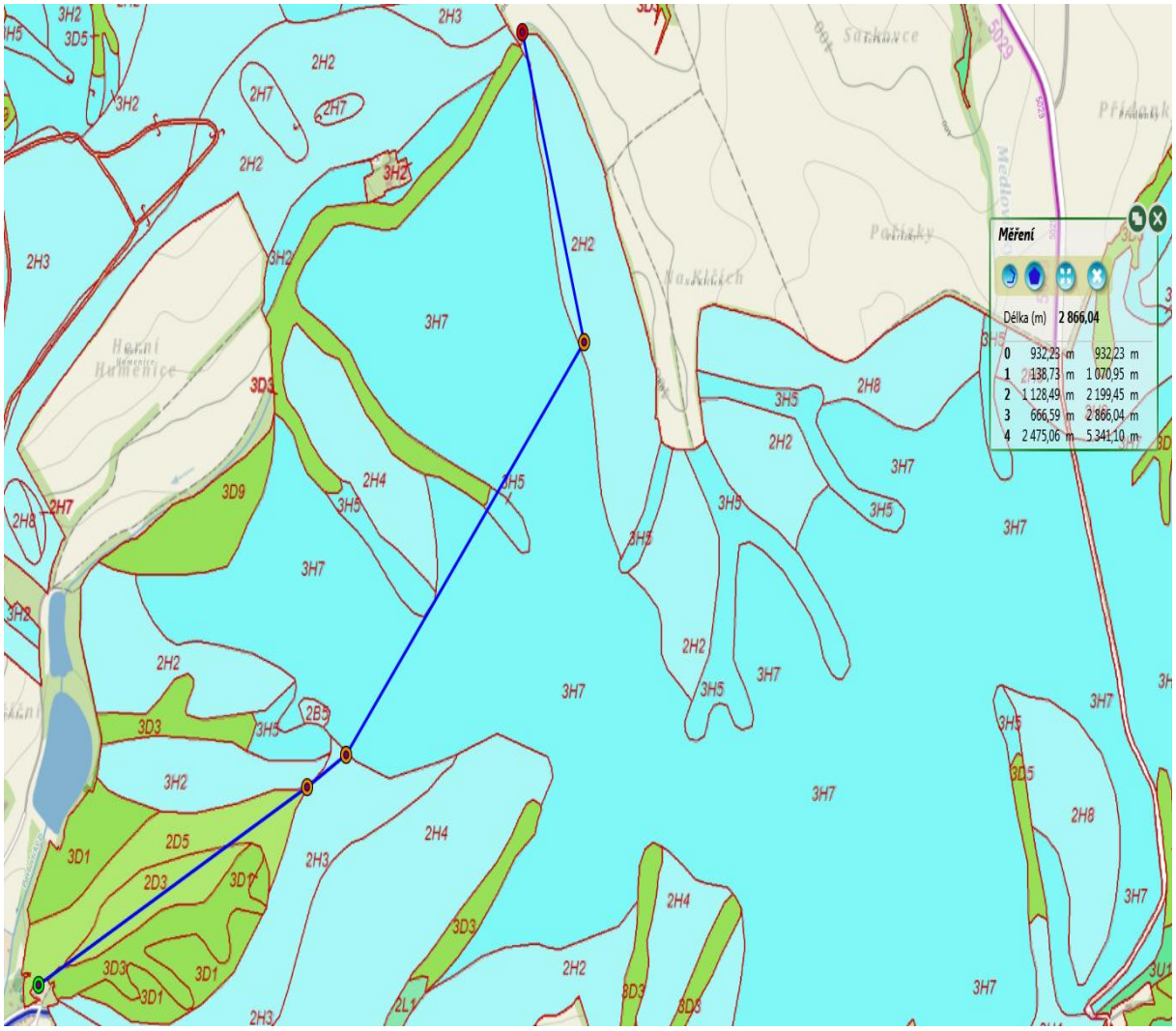


Picture 7. Straight line

7.2.2. Example

Second option. I avoid SLT 3D. It is the most expensive one and also the forest of the best quality. Planned trace of the power lines can be seen on the picture below. Total Harm is 29 382 077 CZK.

The distance length is by 400 meters longer and the compensation much higher. Although the 3D are is in safe this variant is not better than the first one.

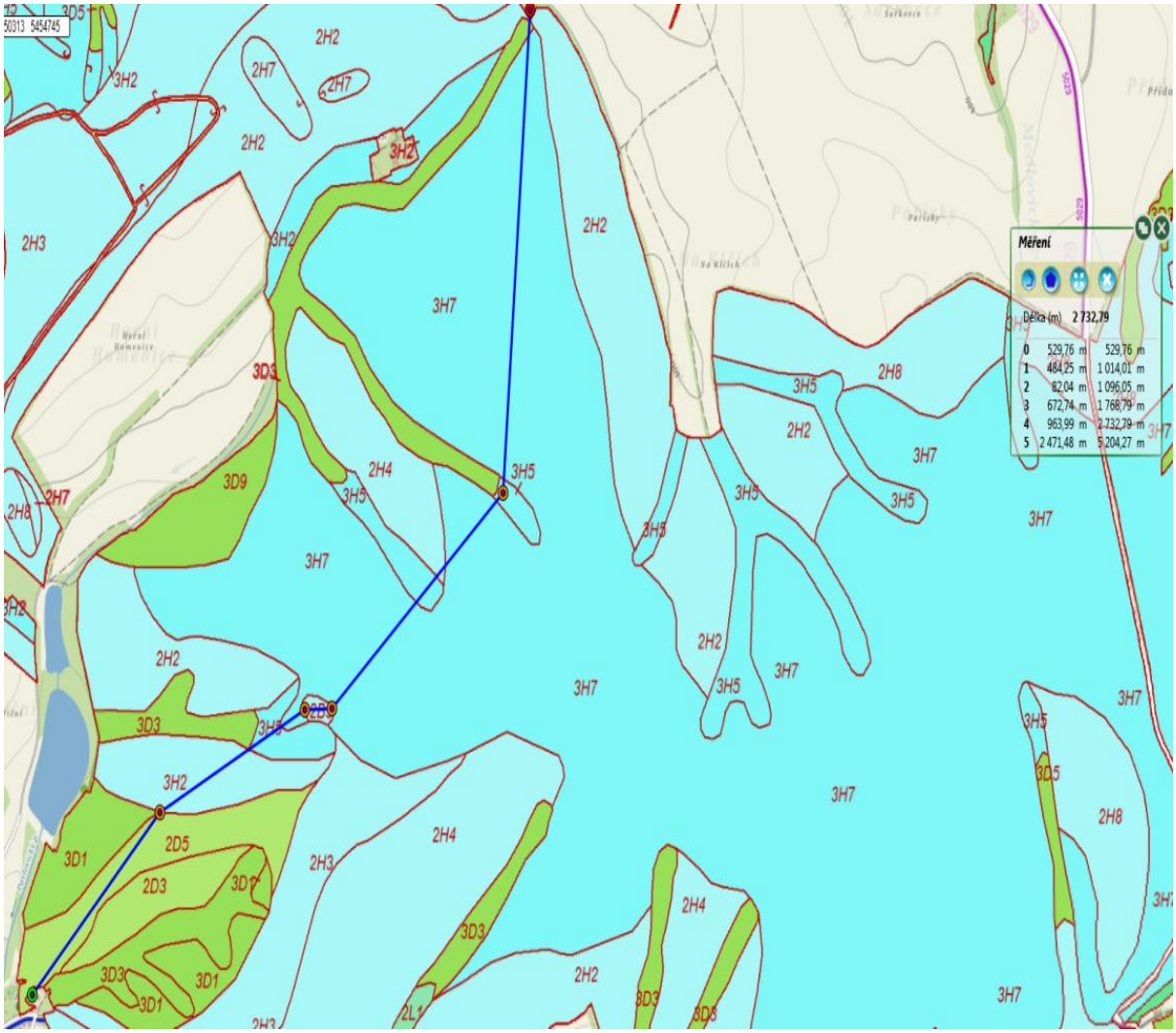


Picture 8. Changed line

7.2.3. Example

Total Harm is 29 734 984 CZK.

In this case, even though the length of the line is smaller than in the previous case the total harm is higher and that is because of passing through an area with a higher level of SLT.



Picture 9. Changed line n. 2

8. Application of the Coase theorem

In second example of the first case I calculated that the changed line can save up to 9 509 397,5 CZK. In this case additional 4 205 square meters of forest will be destroyed. Aim of the provider is to persuade the owner of the forest to let him develop the transmission system. Owner of the forest is an economic-rational person and even though the additionally destroyed forest is fully compensated because there are the same rules for compensation, he wants some profit from letting the provider develop the cheaper variation or because he wants to invest additionally earned money in the forest to even out the loss on number of trees. If the provider would give him 500 CZK for one square meter of additionally destroyed forest the owner of the forest would accept this offer and would earn 500*4205=2 102 500CZK. Provider of the transmission system would save 7 406 897,5CZK. Negotiation can continue with higher prices for square meter of additionally destroyed forest until breaking point which is the point where the price for square meter is so high that the provider would have no savings at all therefore he would not be willing to pay more (see in graph). In the graph below is obvious how the savings of the provider are decreasing and the earnings of the owner of the forest are increasing with every rise of the price for square meter of the forest.

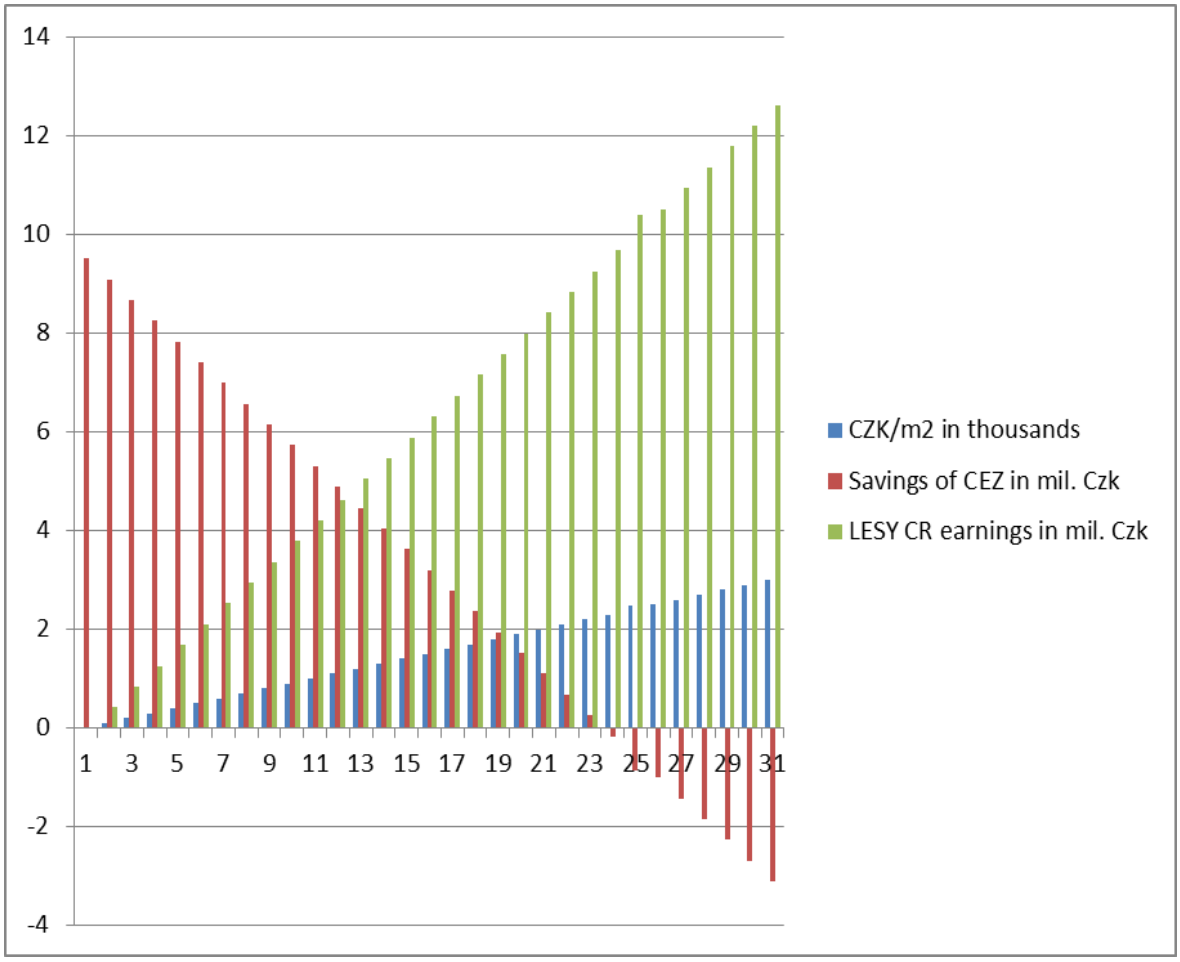
If I change the point of view and now the owner of the forest would try to persuade the provider of the transmission system in order to save the higher level forest or because he want to earn some profit than the same thing will happen. The provider will develop the cheaper variation of the transmission system but why should he pay to the owner of the forest some additional revenues if all the costs are covered in the total compensation? There is no logical reason for the provider to pay more. In fact there is no missing money because the destruction of the lower level forest is fully compensated and the higher level forest is saved which means that also its price remains the same.

The Coase theorem cannot be used.

In the first option (provider is persuading the owner of the forest) is possible to negotiate which is something similar to the Coase theorem but there is no possibility to strictly specify the optimum because every additional revenue is a net profit for the owner of the forest and even if they would agree on a "friendly" optimum (they would split the total saved money into half) it is not a real optimum because it would be not valid if we swap the point of view. There is only possibility to specify the minimum and maximum of the price for square meter of the forest. In the second option (owner of the forest is trying to persuade the provider) on the other hand is no reason to not develop the cheaper transmission system. But the owner of the forest will get no additional revenues because there is no reason to.

Nevertheless it is correct that by changing the trace of the line both sides can achieve a better position. Provider can save money and the owner of the forest will protect the higher level forest.

The reason why the Coase theorem cannot be used in this particular case is that those two bodies are do not interacting in their production and they are do not transmitting their liabilities to one and other and that all the costs connected with development of the transmission system are fully compensated.



Picture 10. Graph of Savings/Earnings/Price

The graph above show us particular cases of „agreed" compensation between ČEZ and LESY Čr and potential savings of ČEZ. Red lines are the savings which depends on the level of price for one m^2 of additionally destroyed forest which represent the blue lines. Green lines represent the potential earnings of LESY ČR. On the axes Y is the price both for saving/earnings and for cost of square meter of a land (in thousands of CZK). On axes X are the particular cases. Between the points 12 and 13 on axes X is the breaking point for the „friendly" optimum. In point 24 on the axes X is the breaking point where the compensation for additionally destroyed forest is so high that the ČEZ would not be willing to negotiate or develop the changed trace because it would be even more expensive

than the firstly planned trace and also it show us the maximum price for the compensation for additionally destroyed forest.

9. Comparison of agricultural land and forest land

In general agricultural land is more expensive than a forest land. Ing. Jan Sebera, Ph.D. wrote in his work *Oceňování lesních, zemědělských a jiných pozemků* that general attitude of expelling forest on the land which is not so good for agricultural purposes made the forest land cheaper (Oceňování lesních, zemědělských a jiných pozemků, Jan Sebera, page 2).

Biggest disadvantage of developing transmission system through the forest is the fact that the buffer zones destroying the forest. On the other hand on the field is it still possible to produce grain under the power lines because the buffer zone does not affect the grain production (grain is not so high). Therefore only place where is not possible to continue with the field function is on the place where are the pillar. This fact makes much cheaper for providers of transmission system to develop the transmission system across the fields instead of across the forest.

9.1. Example

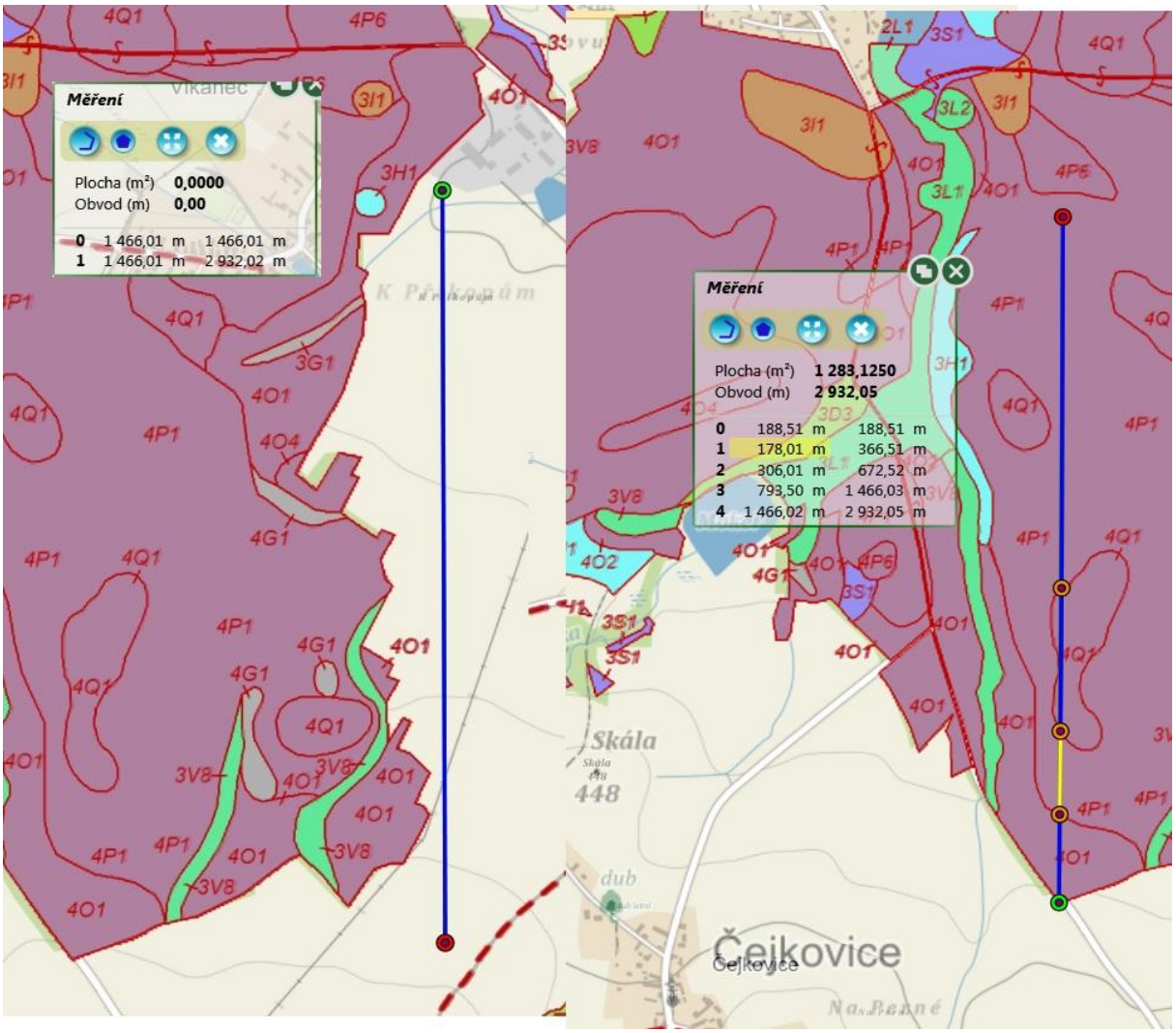
At picture below you can see a map with a forest and a field. I find out in a cadastre the BPEJ[20] of the field and also the SLT of the forest.

The total compensation S1 in the forest area is 9 842 967 CZK.

For the calculation of the compensation of the field I used contractual agreement. The easement is also for 50 years. It is common to set the rent as a 4% from the value of the land. By BPEJ in that area[21] the cost of a land is 8, 94 CZK per square meter. Affected area under the pillar is 12, 25 m2[22]. Line is 1466 meters long=>6 pillars in total. Therefore total affected area is 73, 5 m2. On 73, 5m2 can be annually produced 68kg of grain. Price for one t of grain is 4000 CZK[23]. Generous provider of the transmission system offered to the field owner that he will pay him annual loss on profit. The total compensation is 14965 CZK!

[20] BPEJ is an ecological unit used for determining the price of an agricultural land
[21] BPEJ is54600.
[22] Area of pillar. Pillar is 3,5 meters wide.
[23] http://www.agdmorkovice.cz/rostl.htm

By comparison of these two results it is obvious that it is much more advantageous to lead the transmission system across the fields.



Picture 11. Agricultural land vs. Forest

The possibility of change of the trace of the transmission system in order to find a cheaper option and the fact that agricultural land is much more advantageous for development of the transmission system showing us that the best way how to develop the transmission system and save as much forest as possible and also decrease the cost for development is to build the transmission system on agricultural land near to the forest and in particular places (cases) when it is

effective lead the system through the forest and try to find the cheapest and the most safe[24] trace with the use of the SLT maps.

[24] in order of to safe the higher order of the forest

10. Conclusion

Theoretical part introduced me the rights of both sides. Most important is the fact that both sides are well protected. Legislation gives the possibility for using the Coase Theorem. Especially Energy act supports private negotiation. This condition is stipulated in the act itself and also stipulates that the easement must be done. Forestry act sets the equations for calculation of the compensations and describing the forestry typology which comes with SLT. Energy act gives possibility to develop the transmission system on other property and to create the buffer zones. Building act is than linking all affected bodies to one place and give them the option to raise an objection against the development.

The development of the transmission system has to obey several conditions and be in compliance with Czech and EU law. Especially the Civil code, Forestry act, Energy act and The Conservation of Nature and Landscape act. This also comprise the Natura 2000 where are the Sites of Community Importance and Special Protection Areas. Those areas have a higher protection.

Compensations connected with development of the transmission system are in most cases total therefore there are no loses. This means there are no externalities connected with the development itself and this fact affected my case study. However other externalities may occur, after the transmission system is developed.

Another option how to protect the owner of the forest was to build a Stand Alone grid system. That would protect the forest the best because no transmission system would be developed. Unfortunately this is not feasible for my case mainly because the conditions in Czech Republic are not good and the size of such SA grid system would have to be enormously big which correlates with very high costs of development.

Comparison with the Slovakia showed me that the situation of the owner of the forest from the compensations for restriction of the ownership right point of view is quite similar.

Conclusion

In the case study I successfully calculated that the change of the trace lead to saving on costs on development if the conditions are suitable. The cheaper part of the forest must not be very far from the proposed trace of the transmission system because the prolonging of the line would be too big. The difference in prices for one square meter must be significant. In the second case of the transmission line system example I showed that not always the change of the trace can lead to a better end. This is mainly caused because of the low diversity of the forest, to big prolonging, small price differences among particular SLT types.

The Coase theorem unfortunately cannot be used in that way how the theorem is defined. It is true that in case, where the provider of the transmission system is trying to persuade the owner of the forest to let him develop the transmission system in a longer way and destroy additional forest, is a negotiation and the provider can save money and the owner of the forest can earn money but the new "optimum" is not precisely settled.

In a case study I successfully calculated that the higher level forest can be saved if the trace is changed which comes also with the development cost improvement and this is a new ecological-economic (owner of the forest-provider of the transmission system) optimum.

I also find out that for the development of the transmission system is much more feasible to build it on the agricultural lands. Development is much more cheaper and the production function of the agricultural land is not so affected.

I would recommend as the best option for the development to combine the agricultural land and the forest land in cases which are feasible which means that not the straight lines are the cheaper and more ecological variation but the lines crossing through the lower orders of the forest. Also I would recommend for the owners of the forest to be very precise in calculating of the compensations or to hide an expert not to make a mistake and lose money.

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