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Economic Evaluation of Investment Project for Maintenance of Urban Forestry

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Abstract
The aim of this study is to provide economic evaluation of project for maintenance of the urban forestry undertaken by the Municipality of the City of Skopje in the Republic of Macedonia. The economic evaluation involves comparison of the present values of the estimated future benefits and costs of transplanting large trees. Therefore, here we employ economic benefit-cost analysis to compare the utilized tangible and intangible benefits and the cost of transplanting large trees and to assess whether the benefits to the society are higher rather than the costs and hence to evaluate whether this investment project is acceptable and justified for the society as a whole. Finally, the calculated ENPV and EIRR are presented to provide comprehensive measure for the justification of the project for the society.
Keywords: economic evaluation, cost-benefit analysis, urban forest, tree transplantation

1. Introduction

There are a growing number of countries that have developed a greater understanding of the role and importance of the natural ecology of the urban forests. The urban forests are the lungs of a modern urban city. In this context, there are growing awareness for undertaking activities to continuously enrich the number of trees and maintenance of existing ones. There are a plenty of projects underway in different countries around the world that have aim at restoration and preservation of ecosystems, ranging from simple eliminating leaf-raking and elimination of invasive plants to complete full-blown reintroduction of genuine and coastal ecosystems. In recent decades, communities in major cities continue to grow at an accelerated pace. The maintenance of the urban forest contributes to improving the quality of life of the people. The community today especially gives the importance of establishing a balance between economic growth and environmental quality and social wellbeing. This implies that urban forests to enhance the environment, increase community attractiveness and livability, and foster civic pride. In this respect, the social projects that are aimed at preserving and enriching the existing urban forest are of growing importance.

The City of Skopje in its program for the protection and development of greenery devotes significant attention to the increasing number of trees and protection and preservation of existing ones. Environmentalists are aware of the great benefits that carry large versus small trees and trees in this context is the project to the City of Skopje. In this direction, this is the main goal of this project for the purchase of machines for transplanting large trees. Tree transplantation or tree spading, as is commonly referred by professionals, is a common method for moving and transplanting large trees from one site to another. At least, the City of Skopje considers the following reasons for transplanting large trees vs. younger, smaller trees: 1) to prevent the loss of a tree due to building, roadway expansion or other construction; 2) to create space for a new building addition; 3) a particular mature tree has outgrown its present location; 4) to alter the design of a landscape; 5) to move a tree to a site better suited to its needs; 6) to create a mature landscape quickly.

This project of the City of Skopje will preserve the existing and increase the number of the small and large trees which appears to be excessive in certain location. For the communities in the City of Skopje, and wider, these trees will provide numerous and diverse environmental benefits. Urban forest has a large number of benefits for the local community. Commonly it is highlighted the effects of beautifying the city, reduce air pollution, saving electricity consumption in summer because of the shade of trees and in the winter by protecting from the wind, increased value of properties and real estate, the conservation of wild fauna etc. Also, urban forests provide local residents a range of social, recreational, psychological positive effects, through providing people to reduce everyday stress and thereby saves and improves health. These and many other benefits of transplanting large trees will be considered in this study.

The ultimate aim of this study is to provide economic evaluation of the project of the City of Skopje for acquiring a machine for transplantation of large trees. This is study for real project of the City of Skopje in the Republic of Macedonia that is undergoing to final realization. This study encompasses quantification of the benefits for open-grown trees on a per tree basis rather than on a canopy cover basis. In that order firstly we will provide identification of detailed benefits and costs for trees in residential yards as well as street/park trees, and afterwards we will quantify them in order to estimate the net benefits. At the end ENPV and EIRR are presented to provide justification of the project.

2. Framework and methodology of the economic evaluation analysis

The economic evaluation of this investment project of the City of Skopje in Macedonia involves comparison of the present values of the estimated future benefits and costs of transplanting large trees. The urban forestry in the parks and on the streets is a public good, providing benefits for the society as a whole. Also, this refers to the private yard trees which provide many benefits for the society as a whole. The initial investment cost for the purchasing of the machine and the subsequent operating costs associated with it and the cost to maintain these trees which are public good, represent today's known size that can be invested in any other alternative. These costs will mostly be beard by the municipality i.e. with spending community resources which could be spent elsewhere. The aim of this benefit-cost analysis is to compare the utilized intangible benefits and the cost of transplanting large trees and to assess whether the benefits to the society are higher rather than the costs and hence to evaluate whether this investment project is acceptable and justified for the society as a whole. Benefits were calculated using tree growth curves and numerical models that considered regional climate, building characteristics, air pollutant concentrations, and prices. Since we can count the number of trees transplanted by the machine, the benefits for open-grown trees are quantified on a per tree basis rather than on a canopy cover basis. The same is done for costs.

The approach in this type of evaluation requires to compare the situation "without the project" and "with the project" to determine the incremental or marginal effects which are basis for evaluation. In this analysis we take that in the situation "without the project" approximately 555 trees per year will not exist anymore in the community. Namely without possessing a transplanting machine these trees which exist somewhere in the City of Skopje are excess for some reason (widening boulevards, construction of buildings etc.) and will be cut and lost because they cannot be transplanted. By losing these trees the society loose the positive effect that those trees would produce otherwise. These lost benefits are cost for the society. Accordingly, if the benefits which are lost for the society by cutting the trees which could continue to live through transplantation, we add to the benefits in the situation "with the project", in fact they are the same benefits of the same trees that have been transplanted in the situation "with the project" instead of being devastated. That would mean double presentation of the same benefits. Therefore, in the situation "without the project" we assume zero situation or trees are lost forever and continue to live and to give benefits in the situation "with the project". On the other side, this also covers the situation of transplantation of trees from other regions, and with it comes to the creation of new benefits for the community in the City of Skopje that have not previously existed.

The benefits in the case "with the project" are derived from the estimated cost savings that come from multiple grounds of planned tree transplantation, but mainly derived from saving energy, reducing atmospheric carbon dioxide, improving air quality, reducing storm water runoff and hydrology, aesthetics and other benefits.

The economic evaluation of this kind of project is based on the time value of the future identified net-benefits, which are difference between the identified benefits and cost for each year. The relation among the future and the present is established by the discount rate. The project is justified for undertaking only if the cumulative of the future net-benefits is greater than the cumulative of investments. The difference between these two is called Economic Net-Present Value, which should be positive for the project to be socially justified for undertaking. Its calculation is based on the following formula:

$$\mathrm{ENPV} = \left(\sum_{t=1}^{n} \frac{NB_t}{(1+i)^t} + \frac{RV_n}{(1+i)^n} \right) - \sum_{j=1}^{m} \frac{I_j}{(1+i)^j} \qquad (1)$$

Here, we denote the Economic Net-Present Value with the abbreviation ENPV. The NB is the net-benefit in year t, (where $NB_t = Bt - C_t$) calculated as a difference between the sum of the benefits for the year (B_t) and the sum of the costs for the year (C_t), RV is the Residual Value at the end of the period, *I* is the investment in year *j*, and *i* is the social discount rate.

Also, we will calculate the Economic Internal Rate of Return, using the formula:

$$\left(\sum_{t=1}^{n} \frac{NB_t}{(1+EIRR)^t} + \frac{RV_n}{(1+EIRR)^n} \right) - \sum_{j=1}^{m} \frac{I_j}{(1+EIRR)^j} = 0 \qquad (2)$$

The formula (2) is the same as formula (1), instead of *i* in (1) which is known, in (2) we ask for the IRR. The Economic Internal Rate of Return is the "annualized effective compounded return rate" or rate of return that makes the Economic Net-Present Value of all net-benefits from the investment equal to zero. EIRR is the discount rate at which the present value of all future Net-Benefits is equal to the initial investment or in other words the rate at which an investment breaks even. EIRR should be higher than the cost of capital for the project to be justified for undertaking.

3. Literature review on identifying benefits from urban and community forest

3.1 Energy Savings

In the past decades have been conducted major researches of relevant authors in the world who have dedicated their papers and prove that there is a great positive relationship among planting of trees and reduction of energy costs. This is the curtail benefit for the society. Trees help to lower air temperatures in the summer and also to reduce the urban heat island effect in urban areas. Consequently, the reduction of temperature in the summer in the urban city not only lowers energy use, but it also improves air quality, as the formation of ozone is dependent on temperature. Generally, there are three principal ways in which trees modify climate and conserve building energy use: 1) *Shading* – this reduces the amount of radiant energy that is absorbed and stored by built surfaces McPherson at al. (1999a) found that annual energy saving in 15% of comes from the shade of the street trees and 85% from the climate effects ; 2) *Transpiration* – trees makes conversion of the liquid water into water vapor and consequently cools by using solar energy that would otherwise result in heating of the air; 3)*Reduction of wind speed* – Simpson (1998) founds that the trees reduces the infiltration of outside air into interior spaces and conductive heat loss, especially where thermal conductivity is relatively high (e.g., glass windows). Heisler (1986) observed that row of trees or a fence, provides shelter or protection from the wind and results in reduced wind speed, and infiltration of the air up to 50% and that, finally provides heating savings of 10-12%.

On average, trees and other green spaces within individual building sites may lower air temperatures by 3°C compared to outside the green spaces. Akbari et al. (1992) conformed that between urban city centers and the more vegetated suburban areas at the distance of 10km, have been observed temperature differences of more than 5°C. These so-called "hot spots" in urban cities are called urban heat islands. This is a typical problem for our this urban City of Skopje in Macedonia, where people, by individual observations, are aware that the temperature in the centre, especially in the sunny days is always higher by 5-6°C. Strategically located tree plantings could reduce annual heating and cooling costs by 20-25% for typical households. Strategically placed trees can increase energy efficiency in the summer and winter for individual buildings. In summer, the shade of the tree that protects the east, and especially west walls, helps keep buildings cool, and in winter, solar access on the southern side of buildings can warm interior spaces.

3.2 Reducing atmospheric carbon dioxide

The well known role of the urban forests is the reduction of the atmospheric CO_2, and that is provided in two ways: 1) trees directly sequester CO_2 as woody and foliar biomass while they grow; 2) by planting the trees near to the buildings, the demand for heating and air conditioning will be reduced as saw above, thereby reducing emissions associated with electric power production.

Regional variations in climate and the mix of fuels that produce energy to heat and cool buildings influence potential CO_2 emission reductions. Due to the large mix of fuels used to generate the heating for households, the large number of vehicles in the city traffic, and other pollutants, but mainly because of the landscape of the location of the City of Skopje, which is surrounded by mountains on all sides which hamper the smooth flow of air, in some periods of the year comes to strong concentrations of polluted air which is enormously over the permitted level and has a huge negative impact on life and health.

McPherson (1998) in his most comprehensive study of atmospheric CO_2 reduction by an urban forest found that 6 mil. trees in the case of Sacramento, California, removed approximately 304,000 metric tones of atmospheric CO_2 annually, with an implied value of $3.3 million. Avoided power plant emissions accounted for 32% of the amount reduced. The amount of CO_2 reduction by Sacramento's urban forest offset 1.8% of total CO_2 emitted annually as a byproduct of human consumption. This implies that the savings from new tree plantings could have been substantially increased through strategic planting and long-term stewardship that maximized future energy savings. Ramsay (2002) states that, since 1990, in the case of Iowa it has been planted trees for energy savings and atmospheric carbon dioxide reduction with utility sponsorships. These trees are estimated to offset CO_2 emissions by 50,000 tons (45,359 metric tonnes) annually.

3.3 Improving air quality

There are many ways in which urban trees provide air quality benefits, which we can synthesize in this four main ways: 1) by absorbing gaseous pollutants (e.g., ozone, nitrogen oxides, and sulfur dioxide) through the trees leaf surfaces; 2) by intercepting particulate matter (e.g., dust, ash, pollen, smoke); 3) by releasing oxygen through photosynthesis; 4) by transpiring water and shading surfaces, which lowers local air temperatures, thereby reducing ozone levels.

Since the urban forest produce the energy savings this further result in reduced emission of air pollutants from power plants and space hitting equipment. Here we consider Volatile organic hydrocarbons

(VOCs) and nitrogen dioxide (NO2) — both precursors of ozone formation — as well as sulfur dioxide (SO2) and particulate matter of <10 micron diameter (PM10). Where the cooling effects of trees is absent of the, than the higher air temperatures contribute to ozone formation. On the other side, most trees emit various biogenic volatile organic compounds (BVOCs) such as isoprenes and monoterpenes that can contribute to ozone formation. Different tree species has various potential in ozone-formation. Taha (1996) in his study, found that increased tree planting of low BVOC emitting tree species would reduce ozone concentrations and exposure to ozone, while planting of medium and high emitters would increase overall ozone concentrations.

In many studies it is proven that the trees were most effective in removing ozone (O_3), nitrogen dioxide (NO_2), and particulate matter (PM10). The level of PM10 in the City of Skopje many times exceeds the maximum allowed level. The study of American forest (2001) found that in the area of Colorado that the existing trees removed 1,080 tones of the air pollutants. Similarly, American forest (2001) report that in the case of Willamete the trees removed 80,740 tones of air pollutant. McPherson et al. (1999a, 2000) for the in coastal southern California estimated that the annual value of pollutant uptake by a typical medium-sized tree is 20$, and in the San Joaquin Valley is 12$. Scott et al. (1999) exploring the Davis, CA report that the trees in a parking lot benefit air quality by reducing air temperatures 0.5-1.5°C. Trees are shading the asphalt surfaces and the parked vehicles also, resulting in reduced hydrocarbon emissions from gasoline that evaporates out of leaky fuel tanks and worn hoses. These evaporative emissions are the main ingredient of smog, and parked vehicles are the primary source.

3.4. Reducing stormwater runoff and hydrology

This four are the main ways in which the healthy urban forest can reduce the amount of runoff and pollutant loading in receiving waters: 1) leaves and branch surfaces intercept and store rainfall, thereby reducing runoff volumes and delaying the onset of peak flows; 2) root growth and decomposition increase the capacity and rate of soil infiltration by rainfall and reduce overland flow; 3) tree canopies reduce soil erosion by diminishing the impact of raindrops on barren surfaces; 4) transpiration through tree leaves reduces soil moisture, increasing the soil's capacity to store rainfall.

In the studies it is by simulation is found that the runoff reductions by the urban trees is on average 2-7%. Xiao et al. (1998) in the case of Sacramento's urban forest, found that the annual interception of rainfall for the urbanized area was only about 2% due to the winter rainfall pattern and predominance of non-evergreen species. Also, the average interception on land with tree canopy cover ranged from 6-13% (20m^3per tree), and this values are close for rural forests. McPherson et al. (2000) in the case of the coastal southern California found that a typical medium-sized tree was estimated to intercept 2,380 gal (9m^3) annually. American Forests (2001) report that existing tree cover reduces runoff by 1.5 million m^3 in the Colorado Front Range. Similarly, American Forests (2001), existing canopy reduced runoff by 240.7 mill. m^3 in the region of Willamette/Lower Columbia.

McPherson et al. (1993) found that that coal-fired plants use about 2.3 liters of water per kWh of electricity provided. Since we have concluded above that the trees reduce the demand for electricity, this leads in reduction of water consumption by the power plants that consume water in the process of producing electricity.

3.5 Aesthetics and other benefits

One of the most important reasons for planting trees is because they beautify the environment in which people live. Therefore, in any cost-benefit analysis it must be measured and included the aesthetic, social, economic, and health benefits that the trees provide for the society. We can summarize these effects in a couple of points:

- *Beautification:* Schroeder and Cannon (1983) conform that street trees are the single strongest positive influence on scenic quality.
- *Retail settings:* Wolf (1999) in his consumer surveys have found that preference ratings increase with the presence of trees in the commercial streetscape. The results of the survey shows that the shoppers are willing to shop more often and longer in well-landscaped business districts, and also to pay more for goods and services, as opposed to the areas without trees.
- *Public safety:* Sullivan and Kuo (1996) in their research in public housing complexes found that outdoor spaces with trees were used significantly more often than spaces without trees. Through facilitating the interaction between residents, the areas with trees may contribute to reduce the level of domestic violence, as well as provide safer and more convivial neighborhood environment.
- *Property values:* The research that compares sales prices of residential properties with different forest resources suggests that people are willing to pay 3-7% more for properties with ample trees versus little or no trees. Anderson and Cordell (1988) found that each large front-yard tree was associated with about a 1% increase in sales price. Neely (1988) found that a much greater value of 9% was determined in for the loss of a large black oak on a property.
- *Social and psychological benefits:* Dwyer et al. (1992) and Lewis (1996) people got great pleasure from

trees, whether inspired by their beauty, spiritual connection, or a sense of meaning. Hull (1992) found that where some natural disasters happened, people report a sense of loss if their urban forest in their community has been damaged. Kaplan and Kaplan (1989) found that views of trees and nature from homes and offices ease mental fatigue and help people to concentrate. Furthermore, Kaplan (1992) states also those desk-workers that have view to the nature show lower rates of illness and greater satisfaction with their jobs compared to those without visual connection with nature. Trees provide important places for recreation and relaxation for the people in the urban cities.

- *Human health benefits:* Through the presence of trees in the cities it is providing better public health and improved well-being of the people who live, work and recreate in the cities. People who are exposed to physical and emotional stress suffer short and long term negative effects. Even more, exposure to prolonged stress can affect the immune system. Parsons et al. (1998) studying the human stress caused by general urban conditions and city driving confirm that the views of nature reduce stress response of both body and mind. Urban greenery also seems to have "the effect of immunization" by having people show less response on stress if they had a recent review of plants and trees. Ulrich (1985) hospitalized patients with views of nature and time spent outdoors need less medication, sleep better and have better prospects than those without contact with nature. Very importantly, Tretheway and Manthe (1999) found that trees reduce the people's exposure to ultraviolet light, which result in lower risk of skin cancer and cataracts.
- *Noise reduction:* The levels of noise in the cities can be as high as to a unhealthy levels. The movements of trucks, trains and planes can create noise that exceeds 100 decibels, twice the level at which noise becomes a health risk. Thick strips of vegetation combined with the landforms or solid barriers can reduce the noise from the highway 6-15 decibels. Miller (1997) proved that trees and other plants are able to commit more absorption of high-frequency noise than low frequency, which is advantageous for people because high frequencies are those that are most distressing to people.
- *Wildlife:* The rich assemblage of wildlife cosseting of older parks, cemeteries, and botanical gardens are provide high satisfaction for it residents. Platt et al. (1994) found that biodiversity can be protected and conserved in the wetlands, greenways (linear parks), and other green-space resources.
- *Jobs and environmental education:* Urban forestry can provide additional employment opportunities for both skilled and the unskilled labor force that further enhances the well-being of men in the city and its surroundings. Moreover, a number of volunteers will be provided with horticultural training through community forestry programs. Also, McPherson and Mathis (1999) found that there are educational opportunities for residents and researchers who want to learn about nature through firsthand experience.
- *Shade can defer street maintenance:* The shade of the trees provides lower damaging of the sidewalks and thus the lower the cost of their maintenance. The shadow of the trees lowers the temperature in the street and thus has a protective effect. Brusca (1998) proved that when the streets are unprotected with shadows, vehicles loosen the aggregate which is a constitutive element and much like sandpaper, the loose aggregate grinds down the pavement.

4. Literature review on identifying cost from urban and community forest

4.1. Planting and Maintaining Trees

Creation and maintenance of urban forests causes costs which generally consists of the purchase price of the trees if bought from another entity or cost of their production if produced by PE Parks and Greenery. In this study we focus on trees that are excessive and that would simply be destroyed if they would not have been transplanted. Therefore, in this study the trees have zero purchase prices. Given that transplantation by using this machine will be performed by PE Parks and Greenery, it must still be foreseen cost for salaries for workers who would have been involved in transplantation. Generally, the single largest expenditure was for tree pruning, followed by tree removal/disposal and tree planting.

Newly planted trees require irrigation in the first five years. It means that you need to install drip or bubbler irrigation which increases maintenance costs on average of 100$. After the planting, during the establishment period trees typically require 0.8-1.6m^3 per year. In the following years as trees mature, their water use can increase with an associated increase in annual costs. Nevertheless, the irrigation system may be not sufficient for trees planted in lawn areas and may require supplemental irrigation. Trees that are native to the City of Skopje region may not require supplemental irrigation after an establishment period.

4.2 Conflicts with urban infrastructure

With the growth and the development of trees in cities they cause damage to power lines, sidewalks, sewers, and other elements of urban infrastructure. Therefore the cities spend money on managing conflicts between trees and the public infrastructure. McPherson (2000) researching in the case of California, in his survey from 1998 showed that cities spent an average of $2.36 per capita on sidewalk, curb and gutter repair, tree removal and replacement, prevention methods, and legal/liability costs. Other cities spent less than that, on average $0.75 while others cities spent even $6.98 per resident. These amounts apply only to street trees and here are not included costs to repair damaged sewer lines, building foundations, parking lots, and various other hardscape elements. If we include these additional expenses, the total costs of the root-sidewalk conflicts are higher.

The old sewer lines that are cracked may be suffering damage from the roots of the trees. Utility companies that perform repairs of the sewerage network estimate that damages are small if the trees are young, but big trees older than 30 years, combined with the old sewer lead to significant costs to repair the damaged network. The damages are smaller on the streets, and are higher in private yards. This is due to the fact that sewers are closer to the root zone as they enter houses than at the street.

Cleaning and sweeping streets in cities are performed regularly to reduce the pollution. Street trees drop leaves, flowers, fruits and branches during the year which represent a significant part of the debris collected from the streets in the city. Even more, in the fall when the leaves fall and the winter rains begin, leaves from trees can clog drains, dry wells, as well as other elements of the control systems of flooding. Therefore additional costs arise due to hiring additional labor required to remove the leaves, and the material damage to property caused by localized flooding. Clearing costs also occur after windstorms. Although these natural crises are not so frequent they can result in high costs.

Trees can cause damage to the power lines. Therefore, large trees under power lines should be regularly pruned. On the one hand, their pruning reduces their positive effects that would have made, and on the other there are additional costs for hiring people and machinery for their pruning.

4.3 Wood salvage, recycling and disposal

The primary costs are related with hauling and recycling waste wood. It is estimated that wood disposal costs are less than 1% of the total cost for tree care. Cities and contractors intend to break-even (hauling and recycling costs are nearly offset by revenues from purchases of mulch, milled lumber, and firewood). In some cases, the net costs of waste wood disposal are less than 1% of total tree care costs as cities and contractors strive to break-even (hauling and recycling costs are nearly offset by revenues from purchases of mulch, milled lumber, and firewood). Here, costs primary are related with hauling waste wood and grinding. But, in many cities recycling waste wood is not economical. The costs of grinding wood into mulch can exceed the costs of hauling and burning.

4.4 Vehicle operating costs

In this project, the City of Skopje and PE Parks and Greenery will acquire new vehicles/machines for transplantation of large trees. These vehicles will be operated by PE Parks and Greenery and this enterprise will bear all cost associated with these vehicles in the future. The vehicle operating costs represents a cost of this project and this is why they have to be assessed and predict as deductible items in the construction of the cash flows of the project. These costs mainly relate to the cost of fuel, motor oil costs, costs for other services of the vehicle, changing tires and other major reparations that would eventually took place after a period of years.

5. Quantifying benefits and costs of community forests in the city arising by transplanted trees

5.1 The approach used in this analysis

In this study, the quantification of the benefits and cost arising from transplanted trees is based on the data provided by the Center for Urban Forest Research[1], a USDA Forest Service, Pacific Southwest Research Station, which is the world's largest forestry research organization.

This forestry research organization in their papers, studies and website, provides incredibly precise estimation for the annual benefits and costs for trees in three residential yard locations (east, south, and west of the dwelling unit) and a public streetside/park location over a 40-year planning horizon. Trees in these hypothetical locations are called “yard” and “public” trees, respectively. Prices were assigned to each cost (e.g., planting, pruning, removal, irrigation, infrastructure repair, liability) and benefit (e.g., heating/cooling energy savings, air pollution reduction, storm water runoff reduction) through direct estimation and implied valuation of benefits as environmental externalities. This approach made it possible to estimate the net benefits of plantings in “typical” locations and with “typical” tree species.

Mature tree height is frequently used to distinguish between large, medium, and small species because matching tree height to available overhead space is an important design consideration. However, in this analysis, leaf surface area (LSA) and crown diameter were also used to differentiate mature tree size. These additional measurements are useful indicators for many functional benefits of trees in relation to leaf-atmosphere processes (e.g. interception, transpiration, photosynthesis).

Estimated values for the quantity of the benefits and cost are reported by the Center for Urban Forest

[1] http://www.fs.fed.us/psw/about

Research in terms of annual values per tree planted. However, to make these calculations realistic, mortality rates are included. The estimated values include assumption that 40% of the hypothetical planted trees died over the 40-year period. Annual mortality rates were 3% for the first five years and 1% for the remaining 35 years.

Most benefits occur on an annual basis, but some costs are periodic. For instance, street trees may be pruned on regular cycles but are removed in a less regular fashion (e.g., when they pose a hazard or soon after they die). In this analysis most costs and benefits are reported for the year that they occur. However, periodic costs such as pruning, pest and disease control, and infrastructure repair are presented on an average annual basis

5.2 Assessment of demand

In order to prepare this study, we gathered the necessary data through survey which was sent to the PE Parks and Greenery. Through this survey were provided data on the number of trees that they will be transplanted annually, a description of the characteristics of the trees to be transplanted, where they will be transplanted (private or public areas), by type or by the height of growth (large, medium, small and coniferous) and assessment of size of the cost per tree. The data obtained from the survey is presented below.

In the most optimistic variant, the numbers of days in the year that is favorable for planting are 185 days. The average daily capacity of the machine is estimated at 3 trees per day, i.e. most likely this machine could transplant 555 trees annually. Out of this number 20% (or 111 trees per year) would be transplanted to private yards, and 80% (or 444 trees per year) would be transplanted in public areas (parks and streets). It is assumed that trees with different age will be transplanted.

Table 1. **Estimated transplanting capacity**

	Number of days	Trees per day	Total
Spring planting	45	3	135
Autumn planting	50	3	150
Infrastructure planting i.e. work in parks and infrastructure projects	90	3	270
Total:	185	3	555

Source: Public Enterprise Parks and Greenery of the City of Skopje of the Republic of Macedonia

Table 2. **Schedule of replanted trees according to their size**

SMALL TREE 7.3 m tall, 8m wide LSA=1.111 sf	MEDIUM TREE 11 m tall, 8.5 m wide LSA=2.434 sf	LARGE TREE 13.5 m tall, 9 m wide LSA=3.056 sf	CONIFER 9 m tall, 6.5 m wide LSA=1.646 sf
10%	**25%**	**50%**	**15%**

LSA=Leaf Surface Area

Source: Public Enterprise Parks and Greenery of the City of Skopje of the Republic of Macedonia

5.3 Quantification of benefits and costs

The benefits of this project for the society are the savings that transplanted trees will bring in different ways. In this analysis benefits and costs are measured and expressed per tree/year, and those figures are then multiplied by the number of trees to represent the total quantity of benefits. After the evaluation of the monetary value of per unit benefit/cost we derive their total monetary value per year. The quantity of benefits and costs per tree/year on various grounds is taken from the estimates provided by the Center for Urban Forest Research and are presented in the following table. They are expressed in appropriate units' quantitative measures.

Table 3. Estimated annual benefits and costs for a private tree (residential yard) and for a public tree[1]

BENEFITS / tree / year	SMALL TREE 7,3 m tall, 8m wide LSA=1,111 sf		MEDIUM TREE 11 m tall, 8,5 m wide LSA=2,434 sf		LARGE TREE 13,5 m tall, 9 m wide LSA=3,056 sf		CONIFER 9 m tall, 6,5 m wide LSA=1,646 sf	
	private tree	public tree	private tree	public tree	private tree	public tree	private tree	public tree
Electricity savings kWh	61	6	91	18	118	35	32	32
Natural gas Btu	-2.55	0.4	-2.06	1.14	-1.17	2.29	3.27	3.27
Carbon dioxide kg	59.42	19.05	99.34	40.37	143.00	77.00	55.34	55.34
Ozone O3 uptake kg	0.118	0.118	0.136	0.136	0.157	0.157	0.113	0.113
NO2 uptake + avoided kg	0.090	0.090	0.148	0.148	0.196	0.196	0.119	0.119
SO2 uptake + avoided kg	0.101	0.101	0.167	0.167	0.218	0.218	0.104	0.104
PM10 uptake + avoided kg	0.041	0.041	0.054	0.054	0.066	0.066	0.054	0.054
VOCs avoided kg	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
BVOCs released kg	-0.001	-0.001	-0.046	-0.046	-0.005	-0.005	-0.139	-0.139
Rainfall Interception liter	1643	1643	3660	3660	4225	4225	3808	3808
Other Benefits EUR	6.9	8.1	9.8	11.5	18.9	22.3	12.4	14.6
Total Benefits								
LSA=leaf surface area								

Source: Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station, Davis, CA

Table 4. Estimated annual benefits and costs for a private tree (residential yard) and for a public tree

COSTS / EUR / tree / year	SMALL TREE LSA=1,111 sf		MEDIUM TREE LSA=2,434 sf		LARGE TREE LSA=3,056 sf		CONIFER LSA=1,646 sf	
	private tree	public tree	private tree	public tree	private tree	public tree	private tree	public tree
Tree and planting	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Pruning	1.59	9.60	1.59	9.60	3.65	12.80	3.65	9.60
Remove & Dispose	3.11	2.29	3.20	2.36	3.44	2.53	3.41	2.51
Pest & Disease	0.02	0.22	0.02	0.22	0.02	0.24	0.02	0.24
Infrastructure	0.07	0.54	0.07	0.55	0.07	0.60	0.07	0.59
Irrigation	0.08	0.08	0.18	0.18	0.23	0.23	0.13	0.13
Clean-up	0.02	0.21	0.02	0.21	0.02	0.22	0.02	0.22
Liability & Legal	0.01	0.06	0.01	0.08	0.01	0.10	0.01	0.07
Administartive & Other	0.01	3.07	0.06	3.16	0.07	3.41	0.07	3.30

Source: Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station, Davis, CA

The price of individual items is given in the following table. Price is given in EUR per unit, estimated for certain years. Prices for 2015 are the current prices. For the next years prices are predicted to grow at an average rate of inflation of 3%. This growth rate is also applied for costs.

The price of electricity: The current price of electricity, according to the Statistical Office of the Republic of Macedonia and the EUROSTAT data is 0.081 Euro/kWh. According to the EUROSTAT data, Macedonia has the lowest price of electricity in Europe. The highest has Denmark of 0.3 Euro/kWh which is 3.7 times higher than in Macedonia. The reason for such a low price is lack of liberalization of the electricity market. Liberalization that was supposed to happen in 2014 was postponed to 2020 and should take place gradually. The reason was that it was estimated that the price will increase by 17% to 20% immediately after liberalization. Therefore, in our analysis we take that the price of electricity will rise by 2018 with a normal rate of 3%, and in 2019-2024 will grow at a rate of 10%, after what it will continue to grow with a normal rate of 3%, reaching a level of 0.147 Euro/kWh in 2024, which is still well below the current average of the EU-28 of 0.199 Euro/kWh, and the EA-17 of 0.211 Euro/kWh. The price of electricity is not the key factor, and lower or higher growth rate reflects insignificantly at the ultimate size of ENPV.

[1] Center for Urban Forest Research, USDA Forest Service, Pacific Southwest Research Station, Davis, CA

Table 5. Individual prices of the benefits

Year	Electricity price eur/kWh	Natural gas eur/therm	Carbon dioxide eur/kg	Ozone eur/kg	NO2 eur/kg	SO2 eur/kg	PM10 eur/kg	VOCs eur/kg	BVOCs eur/kg	Rainfall Interception eur/l	Other Benefits EUR/yr
2015	0.081	1.19	0.0154	6.29	6.29	14.62	10.52	9.94	9.94	0.0027	9,167
2016	0.083	1.23	0.0171	6.48	6.48	15.06	10.83	10.24	10.24	0.0027	9,442
2017	0.086	1.27	0.0187	6.68	6.68	15.51	11.16	10.55	10.55	0.0028	9,725
2018	0.089	1.30	0.0204	6.88	6.88	15.97	11.49	10.87	10.87	0.0029	10,017
2019	0.097	1.34	0.0221	7.08	7.08	16.45	11.84	11.19	11.19	0.0030	10,318
2020	0.107	1.38	0.0237	7.30	7.30	16.95	12.19	11.53	11.53	0.0031	10,627
2021	0.118	1.42	0.0254	7.52	7.52	17.46	12.56	11.87	11.87	0.0032	10,946
2022	0.130	1.47	0.0270	7.74	7.74	17.98	12.94	12.23	12.23	0.0033	11,274
2023	0.143	1.51	0.0287	7.97	7.97	18.52	13.32	12.60	12.60	0.0034	11,612
2024	0.147	1.56	0.0303	8.21	8.21	19.07	13.72	12.97	12.97	0.0035	11,961

Source: author's calculations

Natural gas price: The current price of natural gas, according to Statistical Office of the Republic of Macedonia is 11.3 Euro/GJ. This is the purchase price stated by importers, free of all additional charges. The price per GJ is converted to price per therm, because amounts of quantities above are expressed in this measurement unit. The price of natural gas currently is pretty low, compared with the prices in the recent history. Also, it can be seen that historical prices show great volatility, and there is no legitimacy in their movement. Price in VII-XII in 2012 was about 21% higher than today's. Also, it is unreasonable to expect that these prices will remain at the current level (from April 2015). Therefore, conservatively, we take moderate average growth rate of 3% per year.

Table 6. **Purchase price of natural gas (Euro/GJ)**

VII-XII 2011	I - VI 2012	VII-XII 2012	I - VI 2013	VII-XII 2013	I-VI 2014	VII-XII 2014
10.83	12.89	13.67	11.30	10.20	10.43	11.30

Source: Statistical Office of the Republic of Macedonia

Carbon dioxide price: European Union Emissions Trading System (EU ETS), also known as the European Union Emissions Trading Scheme was the first large greenhouse gas emissions trading scheme in the world, and remains the biggest. The current price (as of 30/3/2015) is 0.02 Euro/kg. In this study we use Synapse Energy Economics Inc. forecast of the CO_2 prices, shown in the table above[1]. We are using their latest report of Synapse 2015 CO_2 price projections (2014 dollars per short ton CO_2). We decide to use this data because they produce price forecasts, which are prices for use in policy making to be an estimate of the social cost of carbon. On page 27 the report they provides comparison with 50 other forecasts, and theirs are in the middle. They also provide low, middle and high case. In this analysis it is used the middle case forecast. All other prices for Ozone, NO_2, SO_2, PM10, VOCs, BVOCs, rainfall interception and the value for other benefits are taken from estimates provided by the Center for Urban Forest Research, USDA Forest Service. These are social prices estimated by using a comprehensive methodology. Also, it is assumed that they grow annually with average rate of 3%.

Investment expenditure. The total investment amounts to 361,000 Euro including VAT. Excluding VAT, the total investment expenditure figure is 305,932 Euro.

Table 7. **Estimated investment costs**

Description	Value (EUR)
Truck with mounted machine for uprooting trees	**280,000**
Tractor	**48,000**
Mounted crane with mower	**15,000**
Side brush for mounted crane with mower	**6,000**
Canal cleaner for mounted crane with mower	**6,000**
Branch cutter for mounted crane with mower	**6,000**
	361,000

Source: author's calculations

This investment will be financed by loan, which will be repaid in 6 years including 1 year of grace period (no installment in 2016). The amortization plan of the loan is presented below.

[1] http://www.synapse-energy.com/sites/default/files/2015%20Carbon%20Dioxide%20Price%20Report.pdf

Table 8. **Repayment schedule**

	Principal amount (eoy)	Interest (5%)	Annual payment	Annual reimbursement
2015	361,000			0
2016	361,000	18,351		18,351
2017	288,800	17,393	72,200	89,593
2018	216,600	13,733	72,200	85,933
2019	144,400	10,073	72,200	82,273
2020	72,200	6,428	72,200	78,628
2021	0	2,753	72,200	74,953

Source: author's calculations

Quantification of costs: The size of costs is derived from nine separate items and is shown in the above table, expressed in Euro/yr/tree. It is assumed that trees are not actually paid. These are trees that are excess to a specific location, and instead to be cut they will be transplanted. The cost of planting is derived from the cost of hired worker. The average cost of labor in Macedonia is 3.02 Euro/h, and this price is spread over the entire operating period of 10 years. Therefore, the price of Euro/h is divides by 5 because some trees will be planted in the first, some in the second, the third year, etc. and some in the tenth year. In order to provide an average for the entire period we divide it with five.

Other costs are taken from Center for Urban Forest Research, USDA Forest Service. Given that their deriving requires too complex analyzes, data and assumptions that we cannot provide we can assume that those applied by the Center for Urban Forest Research are fully relevant to our case. Moreover, the amounts of benefits measured by the Center for Urban Forest Research are for average tree anywhere around the world, and we will make the corrections by applying more appropriate price which is relevant to Macedonia. Thus, we obtained correct monetary amounts of benefits and costs.

Operating costs for the vehicle: In a survey sent to PE Parks and Greenery of the City of Skopje, it has been requested data about the operating costs of the vehicles. According to those data (presented in the table above in the financial analysis), we made appropriate calculations that are shown in the following tables, separately for the transplanting machine and for the tractor.

Table 9. Assumptions for calculation of the operating costs for the transplanting machine

Working hours per year (185 days * 8 h/day)	**1,480 *hours***
Average consumption of fuel per working hour (l/hour)	**3 *l/hour***
Average price of fuel (Euro diesel per l)	**0.696 *EUR/l***
Average annual fuel cost (in EUR)	3,090 *EUR/yr*
Motor oil (on every 500 working hours)	**500 hours**
Times per year (1,480 hours/500)	**2.96 times**
Motor oil in liters needed	**20 l**
Motor oil piece Euro/l	**2 *EUR/l***
Motor oil costs per year EUR/yr	118.4 *EUR/yr*
Other services EUR/year	300 *EUR/year*
Pneumatics from 315/80 to 365/80 R20 (change in 2020)	1,659 *EUR*
Large reparations after 8 years (if needed) (EUR)	10,000 *EUR*

Source: Public Enterprise Parks *and Greenery of the City of Skopje*

Based on these assumptions the annual average vehicle operating costs were calculated.

Table 10. **Annual Average Vehicle Operating Costs (EUR/year) for the transplanting machine (EUR/year)**

Year	Fuel cost	Motor oil costs	Other services	Pneumatics	Large reparations	AAVOC
2015	3,090	118	300			5,524
2016	3,183	122	309			5,631
2017	3,278	126	318			5,740
2018	3,376	129	328			5,853
2019	3,478	133	338			5,969
2020	3,582	137	348	1,659		7,747
2021	3,690	141	358			6,211
2022	3,800	146	369		10,000	16,338
2023	3,914	150	380			6,468
2024	4,032	154	391			6,603

Source: author's calculations

Table 11. **Assumptions for calculation of the operating costs for the tractor**

Working hours per year (264 days * 8 h/day)	**2,112**
Average consumption of fuel per working hour l/hour	**7**
Average price of fuel (Euro diesel per l)	**0.696**
Average annual fuel cost EUR	10,289
Liters per year	**52**
Price per liter	**6.2**
Motor oil costs per year	322.1
on every 3,000 working hours	**0.704**
price per filter	**86.18**
Hydraulic filter	60.7
Other services EUR/year	300
Pneumatics	1,659
Large reparations after 8 years	10

Source: Public Enterprise Parks and Greenery of the City of Skopje

Table 12. **Annual Average Vehicle Operating Costs (EUR/year) for the tractor (EUR/year)**

Year	Fuel costs	Motor oil costs	Other services	Pneumatics	Large reparations	AAVOC
2015	10,289	383	300			12,987
2016	10,597	394	309			13,317
2017	10,915	406	318			13,657
2018	11,243	418	328			14,007
2019	11,580	431	338			14,368
2020	11,927	444	348	1,659		16,398
2021	12,285	457	358			15,122
2022	12,654	471	369		10,000	25,516
2023	13,033	485	380			15,921
2024	13,424	499	391			16,339

Source: author's calculations

Total VOC are the sum for both vehicles.

6. Operational (exploration) period

Operating period in this analysis is 10 years, according to the length of the accounting period of the machines. It starts in 2015 (investment year) and last until 2024.

7. Discount rate

Discount rate represents the opportunity cost of capital. For the purpose of this study its size is estimated of 10%

required by the World Bank, stated in Project Operational Manual: Municipal Services Improvement Project[1]. Although previous studies of other projects undertaken by the City of Skopje, financed by EBRD, estimated the size of the discount rate in the range between 5-6%, though we will discount at a rate of 10%.

8. Residual value

Given that the trees will continue to live after the expiration of the operating period it is necessary to assess the residual value. These trees that will be planted in the first ten years will provide their benefits to the society indefinitely into the future. Therefore, in assessing the residual value of the project it will be used the method of continuous value, and we carry out capitalization of the last net benefit derived from the trees in the last year of the operating period by applying the rate of capitalization in accordance with the Gordon Growth Model.

$$Residual\ value\ (usingGGM) = \frac{Terminal\ year\ net - benefit\ x\ (1 + Growth\ rate)}{Discount\ rate - Growth\ rate} \quad (3)$$

Here, the growth rate is 9%. Namely, net benefits increase at an average rate of 3% per year. But given that the trees that will be transplanted are on average 20 years old, and the net benefits of the older trees grow on average by 6% between age 20 and 40 years of age of the trees, we take an additional 6% growth in continuity. Thus, the overall growth rate of net benefits is 9%.

9. Results of the cost benefit analysis

9.1. Calculation of the monetary value of total benefits, total costs and net-benefits

Based on the quantitative size of benefits and costs shown in the table above as the number of units per tree per year, the economic value was calculated of the total benefits and total costs arising from all 555 trees planted annually. Each of the above identified benefits is expressed in their total amount of Euros annually, by multiplying their quantitative units with their prices in Euro per unit of quantity that are estimated for the respective year and the number of trees according to their category. The other benefits are expressed in Euro value per tree/year, so that size is multiplied by the number of trees in the appropriate category to calculate the total annual value for other benefits. Also, the total costs arising only from the trees are calculated so that the identified size Euro/tree per year is multiplied by the number of trees in the appropriate category. In this way are calculated the total benefits and total costs resulting from transplantation of average 555 trees per year. From their difference it is obtained the net benefits of transplanting 555 trees for the respective year. Thus, in the first year it will be transplanted 555 trees, and the net benefits that would enjoy the society of these trees account for 12,221 Euros. In the second year it will be transplanted 555 new trees, and the net benefits that would enjoy the society in the second year amount to 12,634 Euros, while the greater value arises from the higher prices envisaged, although there is no change in the quantity of benefits and costs. But the trees that are planted in the first year will exist in the second year. So, in the second year the society will enjoy the net benefits of the trees transplanted in the first and in the second year, that is, will enjoying the benefits of 1,110 trees. The benefits and costs of the trees planted in the first year are valued in the second year according to the prices from the second year. Or, the amount of net benefits in the second year is obtained when the value of net benefits arising from newly transplanted trees 555 in the second year will be multiplied by 2 and so will amount to 25,267 Euros. Furthermore, in the third year the society will enjoy the net benefits arising from the trees transplanted in the first year, in the second year and from the newly transplanted trees of the third years or from the net benefits from 1,665 transplanted trees, and their overall benefits and costs are measured at prices provided for the third year. Since we valued the net benefits only for the newly transplanted 555 trees in the third year, the total net benefits for the third year is obtained when the net benefits for the third year is multiplied by three. In the coming years, fourth, fifth, until the tenth year, the total net benefits for the respective year are obtained in the same way, so we include net benefits for the society arising from the trees which were transplanted in previous years. Therefore, in the spreadsheet used for calculation of the net benefits the column weight is introduced which serves for weighting of net benefits. In this way are calculated the values in the column weighted net benefits in EUR/year which actually show the total net benefits from all the trees that are transplanted from the first until the current year.

The initial investment is assumed to occur in late 2015 and that the machine will be immediately put into use. In the same year are realized the net benefits for the society.

From the amount of the weighted net benefits are deducted the initial investment and the annual average vehicle operating costs, and thus is obtained the category Total Net Benefits which represents the undiscounted

[1] http://www.finance.gov.mk/files/u5/MSIP_Project_operational_manual.pdf

expected future annual values. The last net benefit is the residual value of the project which is calculated with the Gordon Growth Model by discounting the net benefit from the last year as perpetuity.

We should point out that it is normal that some trees will not survive or will be lost. The loss of trees that occur in the following years is already expressed in the initial inputs. As pointed out above, the estimated values per tree/year include assumption that 40% of the hypothetical planted trees died over the 40-year period. Annual mortality rates were 3% for the first five years and 1% for the remaining 35 years. Therefore, there is no need to predict a reduction of net benefits due to losses of trees.

The economic appraisal based on the above assumptions and data provides positive ENPV of 768,961 Euro and EIRR of 34%. These results clearly imply that the project is economically justified.

Table 13. Results of the Cost-Benefit analysis (*in EUR*)

	Benefits arising from:											Total benefits	Total costs	Net benefits	Weight	Weighted net benefits	Initial investment	AAVOC	Total net benefits
	Electricity savings	Natural gas savings	Carbon dioxide	Ozone	NO2	SO2	PM10	VOCs	BVOCs	Rainfall Interception	Other Benefits								
2015	1,818	924	592	1,098	567	1,430	342	6.2	-193	5,541	9,167	21,293	9,072	12,221	1	12,221		18,510	-6,289
2016	1,873	952	656	1,131	584	1,473	353	6.3	-199	5,708	9,442	21,978	9,344	12,634	2	25,267		18,946	6,321
2017	1,929	980	719	1,165	601	1,518	363	6.5	-205	5,879	9,725	22,681	9,625	13,056	3	39,169	61,186	19,396	-41,413
2018	1,987	1,009	783	1,200	619	1,563	374	6.7	-211	6,055	10,017	23,403	9,913	13,490	4	53,960	61,186	19,859	-27,085
2019	2,186	1,040	846	1,236	638	1,610	385	6.9	-218	6,237	10,318	24,284	10,211	14,074	5	70,368	61,186	20,335	-11,153
2020	2,404	1,071	910	1,273	657	1,658	397	7.1	-224	6,424	10,627	25,204	10,517	14,687	6	88,122	61,186	24,143	2,792
2021	2,645	1,103	973	1,311	677	1,708	409	7.4	-231	6,617	10,946	26,165	10,833	15,332	7	107,325	61,186	21,332	24,806
2022	2,909	1,136	1,037	1,350	697	1,759	421	7.6	-238	6,815	11,274	27,169	11,158	16,011	8	128,092		41,852	86,239
2023	3,200	1,170	1,100	1,391	718	1,812	434	7.8	-245	7,020	11,612	28,220	11,492	16,728	9	150,550		22,389	128,162
2024	3,296	1,205	1,164	1,433	739	1,866	447	8.0	-252	7,230	11,961	29,097	11,837	17,260	10	172,601		22,941	149,660
																1,881,354			1,881,354
																		ENPV:	**768,961**
																		EIRR:	**34%**

Source: author's calculations

10. Sensitivity analysis

In this section we test sensitivity of the project to changes in the key variables. The movement of the variables is taken into range of ± 20% from the base value. As key variables we consider all those which, according to their size would cause a significant change in the ENPV and EIRR. Such would be the number of trees and the size of the initial investment. Given that none of the individual benefits and costs is not significant variable, we test for their change as a whole. The results of the analysis are presented below.

Table 14. **Sensitivity analysis: ENPV and EIRR in different scenarios**

	Number of trees	Investment value
Baseline	768,961 -34%	
+20%	988,349 64%	730,623 23%
-20%	549,574 14%	807,299 50%

Source: author's calculations

In none of tested scenarios ENPV becomes negative. It provides additional arguments in favor of project implementation that will provide the society with large scale benefits.

11. Conclusion

In the modern societies in many countries significantly grew the awareness of the great role and importance of the natural ecosystems. In this regard, the state and especially municipal authorities have taken a series of activities through various projects to preserve biodiversity. In fact, in order to achieve sustainable development, it is necessary to balance the economic growth with simultaneously protection of the living and working environment of man. The urban forest is of great importance and gives a number of positive benefits and this is considered a lung of the major cities. Not only through the beautification of the city, but its preservation and maintenance allows the community reduction of air pollution, saving in electricity consumption in summer because of the shade of trees and in winter by protecting from the wind, greater value of properties and the real estate, the conservation of wild fauna etc. Also, urban forests provide local residents a range of social, recreational, psychological positive effects, through providing people to reduce everyday stress and thereby saves and improves health. These and many other benefits of transplanting large trees will be considered in this study.

The City of Skopje in the Republic of Macedonia is faced with constantly losing older large and small trees, which for many reasons (mostly expansion and construction of boulevards and other buildings) must be cut. Thus the people of the city lose the positive effects that brought big trees. In order to offset this negative effect, the Municipality of the City of Skopje undertakes a project for procurement of machine for transplantation of trees and their relocation from one place to another in order to further consume their positive effects. The investment amounts to 361,000 Eur and will be funded entirely from long-term loan provided by the World Bank for these purposes. The project will be implemented by the Public Enterprise Parks and Greenery of the City of Skopje. The repayment of the loan will be conducted with money from public revenues. That is why it is necessary to assess whether it is justified to use this public money from the perspective of the community.

We conducted this study to evaluate the economic feasibility of the proposed project. To that end, we applied the methodology of cost-benefit analysis through its three stages: identification of benefits and costs, their quantification and finally we performed calculation of future net-effects for a period of 10 years. The residual value of the project was computed by applying the Gordon Drowth Model. By applying a discount rate of 10% we estimate ENPV of 768,961 Euro and EIRR of 34%. These results clearly imply that the project is economically justified. Finally, we conducted sensitivity analysis and founf that the project remains with a positive ENPV and there is no risk for failure to realize of the expected net benefits.

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