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Parco Ottavi: the design of the green areas

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The project consist in the transformation of a large green area of around 36 hectares, to be created out of a formerly agricultural area of the territory, this site is, at the, moment mostly covered by grass and trees and surrounded by existing buildings. The project of almost 23 hectares will be designated to public green space and the remaining will be articulated as private green.
Such an extended green area, intensely planted with trees, will highly improve the microclimate and the environmental quality of the entire territory. The benefits directly connected to this new green lung will have effect on the whole community.
The planning and layout of the Parco Ottavi's green system will fulfil, not only the desire for a more beautiful landscape, as is normally associated with the addition of plants and trees to an area, but also respond to specific environmental needs. The choice and quantity of the species, their exact location, planting and care are all factors aimed at the improvement of the overall environmental quality and the areas liveability.
Plants effect the environment of cities: they filter and purify the air from dust and pollution, they help reduce the use of energy, and play an irreplaceable role in the water cycle.
Plants offer an ecological continuity between countryside and urban development allowing the diffusion and protection of a many species of Flora and Fauna.
The planning of the large park and of the green areas assigned to social, commercial and sports purposes, parking lots and of the green zones surrounding the school and the crèches, have all been carefully integrated. If on one hand the benefits of plants on the environment are quite well-know, it is not yet as acknowledged as those effects that plants have on human well-being. Much research made during the last 20 years, explains the rapport between the presence of plants and stress reduction: the mere sight of plants is enough to bring people to a state of relaxation which is physiologically measurable (Honeyman, 1991); periods in hospital spent in rooms facing vegetation are about 20% shorter than those spent, on the same terms, in rooms without a view on a green area (Ulrich, 1984); school and pre-school aged children show a higher capability in paying attention when schools are surrounded by green spaces (Mancuso and others et al., 2006).
Parco Ottavi's site will shelter more than 2000 trees together with some 3000 shrubs. All together these plants will create benefits on environmental quality, some of the most important ones are described below.

Effect on air temperature and on energy saving

The fast growing urbanization of cities during the last 50 years has resulted in the constant increase in air temperature in the city's centres which varies from 0.1 to 1.1 °C each decade. It has been estimated that a quota from 3% to 8% of the use of electric energy during the summer period is required in order to balance this effect, which is usually known as 'heat island' (Akbari et al., 1990). The rise in urban temperature entails further implications such as the increase in the carbon dioxide due to this high demand for energy, as to the use of water, the concentration of pollutants in the atmosphere and, finally, in the increase of many human pathologies.
Vegetation can reduce the 'heat island' directly, by shading the surfaces which absorb the heat, and indirectly through evo transpiration (Chandler, 1965; Herrington and others et al., 1972, Oke, 1989).
The selection and the location of those species which will form the green system of parco Ottavi, have been planned in order to assure a significant reduction in summer temperatures and therefore subsequent energy saving. The plants' positions, near houses, parking lots and buildings with surfaces absorbing heat, will help guarantee a relevant decrease in temperature of this area, especially in the hottest hours of the day.
A preliminary computer-based simulation of the cooling effects of trees on buildings located in the area (Usda 1998), allows us to estimate that about a 10-15% of annual energy saving, which could be attributed to a shrewd utilization of the plants. It's interesting to outline that the expected 36 hectares of green space will absorb, through the perspiration process, energy amounting to 80-120 billion of Kcal, which otherwise would be transferred to the environment.
A proper layout of the trees within the parking lots, to obtain the most shade possible during the summer period, will allow us to considerably influence the local microclimate by preventing the creation of those little 'heat islands', that are usual in the parking lots.
The 2000 or more trees, once grown, will assure within the climatic environment of Reggio, an overall energy saving calculated within the range of 120,000 to 250,000 kwh per year, assuming the utilization of those species recommended by the environmental council for Public Green Space of the Muncipality of Reggio Emilia (Pellini, 2002).

Effects on the quality of the air

Plants can purify the air from a number of air pollutants. The most important primary pollutants, that is to say those that are directly released in the air, are emitted during combustion by carbon monoxide and dioxide (CO e CO2), azote oxides (mainly in the form of azote monoxide, NO), together with dust and unburnt hydrocarbons. Furthermore, when fuels contain sulphur, there's an emission of carbon dioxide (SO2).
Among the secondary pollutants, ozone (O3), which comes from the primary pollutants, and therefore, broadly speaking, from the vehicular traffic, from combustion, etc. has also to be mentioned.
Plants develop their effect towards gaseous pollutants (CO2, NO, CO, SO2, O3), on the basis of separate mechanisms, both through the leaves and, generally, through the different plant tissues.
This effect achieved in four steps: i) direct absorption of pollutant substances such as ozone, azote and sulphur oxides, through the surface of leaves, ii) interception of the atmospheric particulate (dust, ash, fume and pollen), iii) oxygen released through photosynthesis, iiii) evapo transpiration and shading of surfaces, which decrease the temperatures of the air and, therefore, the level of the ozone (Nowak, 1995, 2002).
During the last years the adverse link between the concentration of particulate (PM10) existing in the air has become increasingly more evident and the number of many serious human pathologies, most of them concerning the respiratory apparatus has grown. A large number of research has confirmed that pollution deriving from

particulate is far worst found in our cities. Without magnifying the problem, it should however be outlined that on the basis of a survey made by the World health organization, each year in Europe more people die for particulate pollution than for car accidents (Seaton and others et al., 1995; Epaqs, 1996).
It is common knowledge that trees represent the only possible defence against the particulate because they act as filter (Freer-Smith and others et al., 1997). The deposition of pollutants both gaseous and solid (particulate), like those existing at the moment in Parco Ottavi's area, is larger on trees than on grass (Mc-Pherson et al., 1997). The capacity of trees to filter large quantity of air and to purify it from particulate, which settles both on leaves and on the bark, it is significant. Therefore, also in this occasion, a shrewd choice of the species and their layout will guarantee an excellent effect on the improvement of the quality of the air. We can believe that the trees, when grown up, could get rid of around 300-800 kg of particulate per year, on the basis of the species of trees and of their layout. Just to give an idea, let's think that one m3 of air in Reggio contains, on the average, around 50 _g of PM10 (Arpa, 2002), so assuming, as a theoretical target, the reduction to a half of such a quantity, then parco Ottavi's trees, when matured, could work on 15-30 billion of mc of air.
Such a large number of trees and shrubs will highly contribute to the improvement in the air quality in a large area of Reggio Emilia, as too with respect to others environmental pollutants. Special measures will be adopted in planning green spaces, in choosing the species and in the plant setting in order to assure the most efficient environmental effect. For example, the execution of parking lots shaded by trees will assure, through the change of the micro-climate, a large reduction on the azote oxides, carbon oxides and hydrocarbons produced by the cars especially during engines' ignition and turning off (Scott and others et al., 1999).
On the whole, taking into consideration matured plants, it could be reasonably expected the elimination from the atmosphere of some 200-450 kg/year of ozone, 70-130 kg/year of ozone dioxide, 50-110 kg/year of carbon dioxide and of 25-50 kg/year of carbon monoxide thanks to the new vegetation planned for the Parco Ottavi area.

Effects on water cycle
Trees play a frequently underestimated role in the retention of waters, effectively helping the reduction of water flow through the earth (Larsen and others et al., 2001). The choice of the species and their correct cultivation seems fundamental for the improvement of the water cycle: leafless plants also have far minor effect than plants with luxuriant foliage. Furthermore the evergreen are more effective than the plants that seasonally loose their leaves, since as they keep the leaves also during the winter periods they are more subject to rain discharge (Xiao and others et al., 2000).
A careful planning and design of the green area for parco Ottavi will allow a relevant reduction in the level of the water flow through the whole area. It is difficult however, under present conditions, to give figures regarding the actual quantity of water intercepted by the plants. However, some information could already help in giving an idea of magnitude: For example, only one medium-sized adult tree, such as a hackberry can reduce the quantity of water dispersion after relevant meteoric events of at least 15-20.000 litres per year. Therefore, also in this case, the planned vegetation will create significant benefits for the whole Reggio Emilia district.