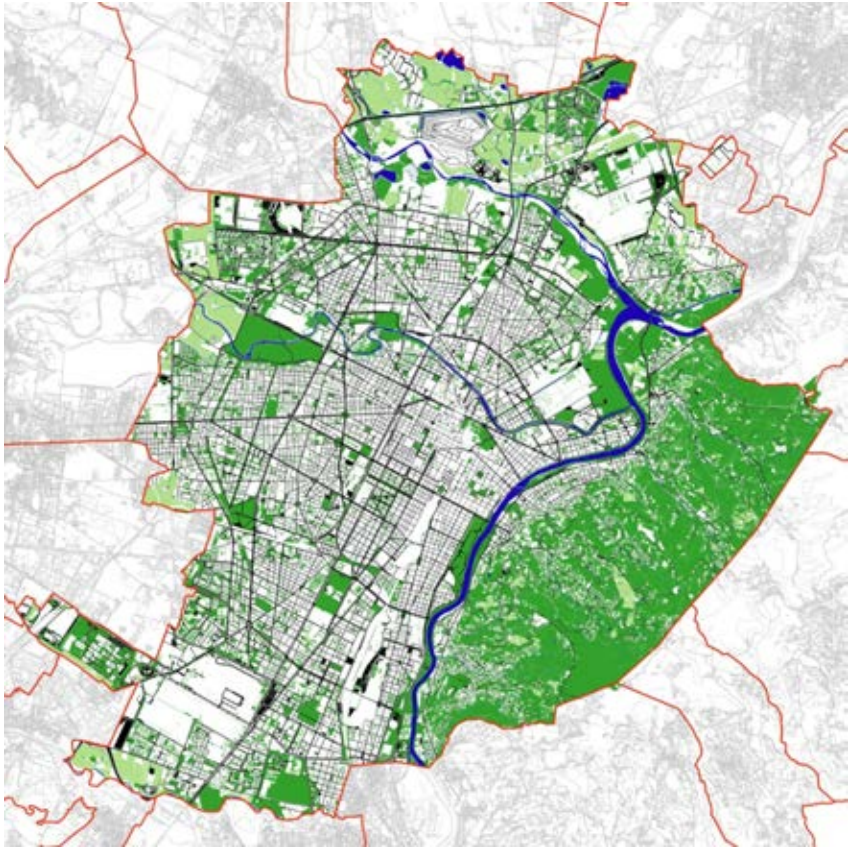




*THE ROLE OF TREES IN THE FACE OF CLIMATE CHANGE: CURRENT
MANAGEMENT AND FUTURE STRATEGIES*

National Tree Officers Conference 2019 – Reading 6th November

Turin's Green and Open Space System



URBAN SURFACE : 130.17 km²

INHABITANTS: 898.714

GREEN SPACE/INHABITANT : 52.56 m²

TOTAL PUBLIC GREEN AREAS: 21.429.000 m² (23,84 m²/in. – 16,46% urban surface)

HILLSIDE FOREST: 7.925.186 m²



More than 160.000 public trees:

- 110.000 trees in parks, gardens, riverbanks, boulevards (60.000), school gardens and sporting facilities
- more than 50.000 trees in hill forests

1817: the first tree-lined boulevard established

A system of tree-lined boulevards over km 450 long

An heritage with an incredible value in environmental and economic terms





ORGANIZATION

- 1 tree manager (coordinator):
general and technical codes,
relationships w/all stakeholders
(politicians, associations, citizens..)
- 2 community groups



ACTIVITIES

- Tree-maintenance planning
- Issuing public tenders: planting, pruning, risk assessment, etc.
- Daily works managements and territorial control

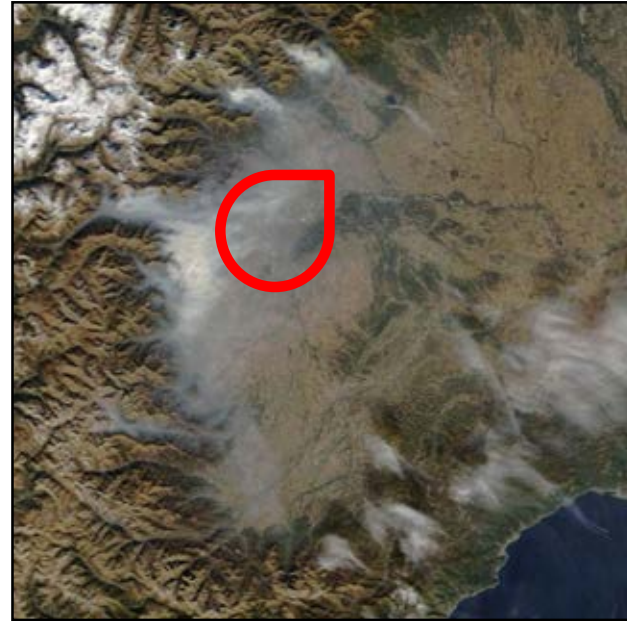


The Alpine Arch and the Po River plain



Turin is in a unique natural location: surrounded by the Alps, with hills to the east and is crossed by four rivers

Unfavourable Natural Conditions



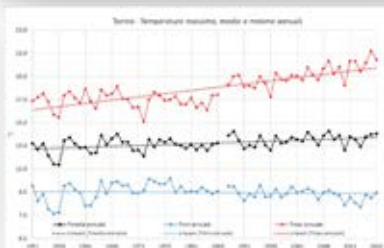
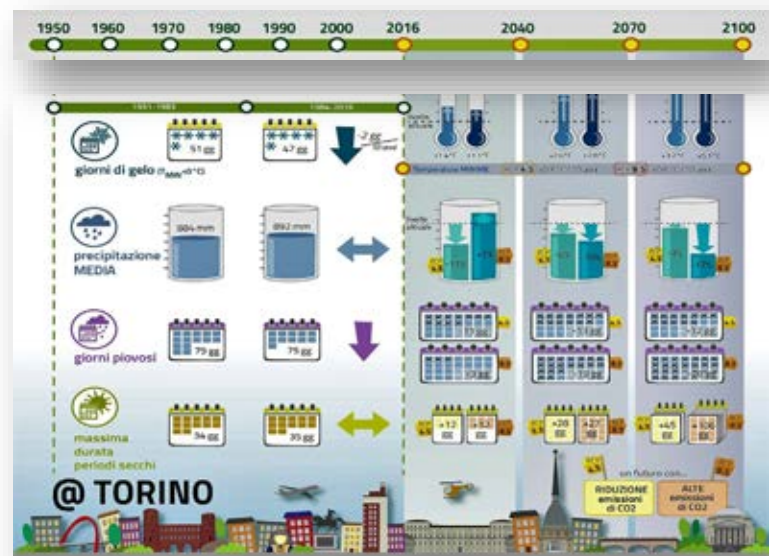
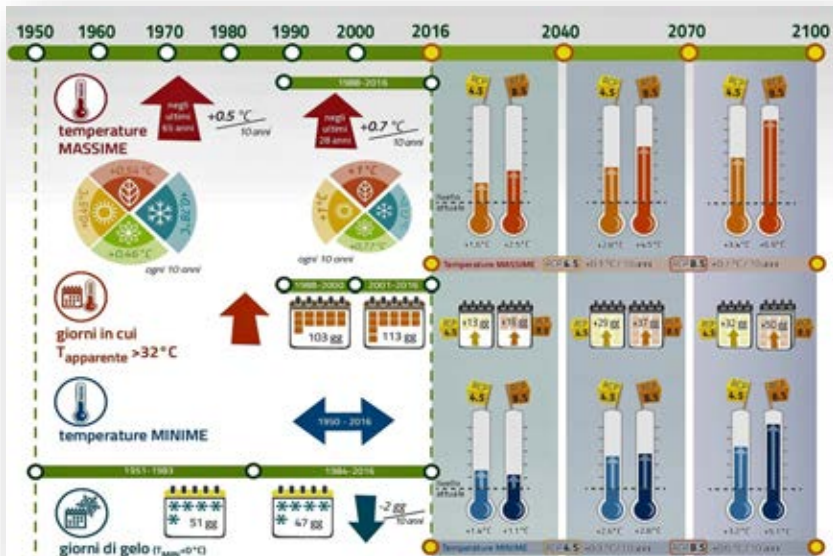
Negative effects of poor air circulation in a densely populated and highly agricultural landscape

Climate Change

- Climate change may exacerbate regional and local air quality problems
- Summer heat waves can impact the production of ozone
- Longer dry spells and less frequent winter precipitation mean more stagnant air
- Impacts of climate change may be cumulative and indirect
- Heat and drought can cause forest fires that exacerbate air quality



Climate Vulnerabilities in Turin



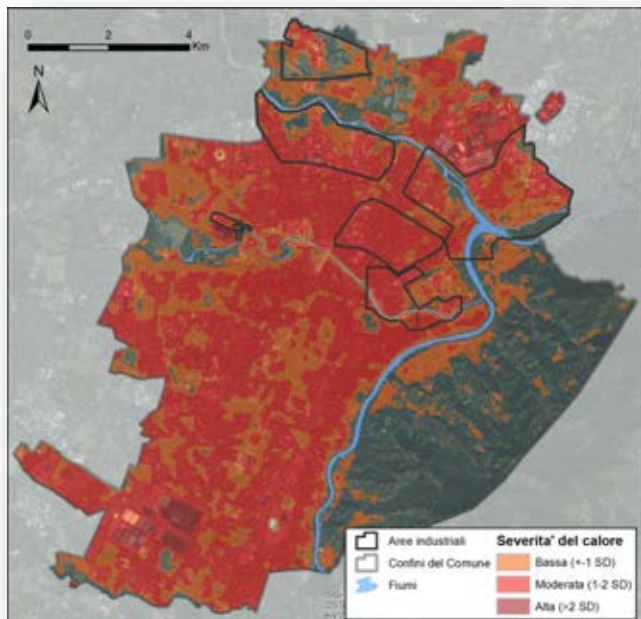
Source: Regional Agency for the Protection of the Environment



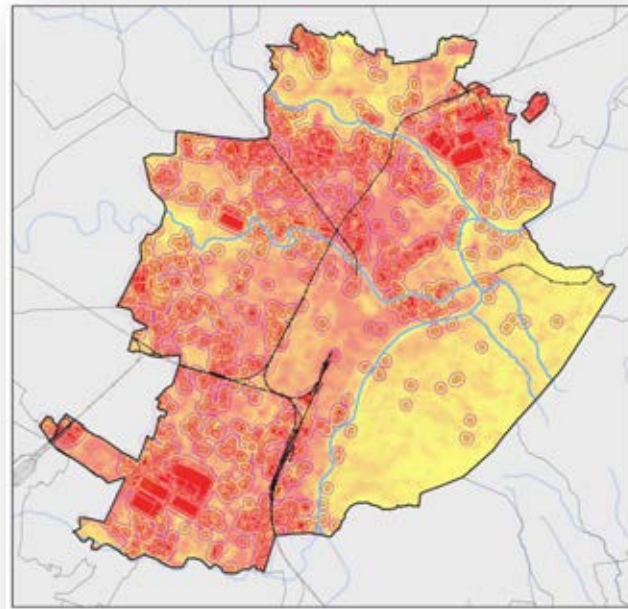
Climate Vulnerabilities in Turin – Heat Waves



Distribution of the three hazard classes related to heat waves



Effect of industrial buildings on heat waves



Increase in temperatures of **+ 3 ° C to m 50** from industrial areas,
+ 1°C between m 50 and m 100 from industrial areas

Climate Vulnerabilities in Turin - Flooding



River flooding and localized flooding



Mitigation: towards an energy transition

2009 Turin signs the Covenant of Mayors for Energy - 7481 signatory cities agree to implement EU energy policy

2010 Turin adopts an Action Plan for Energy (TAPE) to *reduce greenhouse gas emissions by 30% below 1991 levels by 2020*

Planning for adaptation



- Mayors Adapt – the Covenant of Mayors Initiative on Climate Change Adaptation, set up by the European Commission to engage cities in taking action to adapt to climate change
- Adapting to climate change is a way of making the city a safer, healthier, greener, and more liveable place for its citizens and visitors. Turin adheres in 2015.



Planning for adaptation – EU Life DERRIS Project

Partnership between public administration and SMEs to reduce the risks from extreme weather in industrial districts



Implement a climate risk management plan with an integrated approach that fosters coordination between PA and SMEs for the definition of a series of measures to prevent economic, environmental and human health damage caused by climate change.



Planning for adaptation

Formalizing the process

- Municipal resolution launching interdepartmental working group across the administration
- Comprehensive vulnerability analysis including all risk factors: wind, heat, air quality, soil stability, food security, flooding, pollen outbreaks, etc
- Epidemiological assessment of climatic events on local and regional populations
- Development of a Climate Action Strategy with Local Administrations, Regional Environmental Agency, Local Universities and Strategic partners



- Survey adaptation actions already being implemented
- Assess the planning and regulatory frameworks that require revision
- **Engage stakeholders across the board** to develop a comprehensive climate strategy
- **Continue exchanging and sharing** best practices
- Periodic monitoring and evaluation of the implementation of climate actions, and **correct the strategy** as necessary
- Develop and implement ongoing **communication strategies** to raise awareness in the general public



THE TIMING IS RIGHT

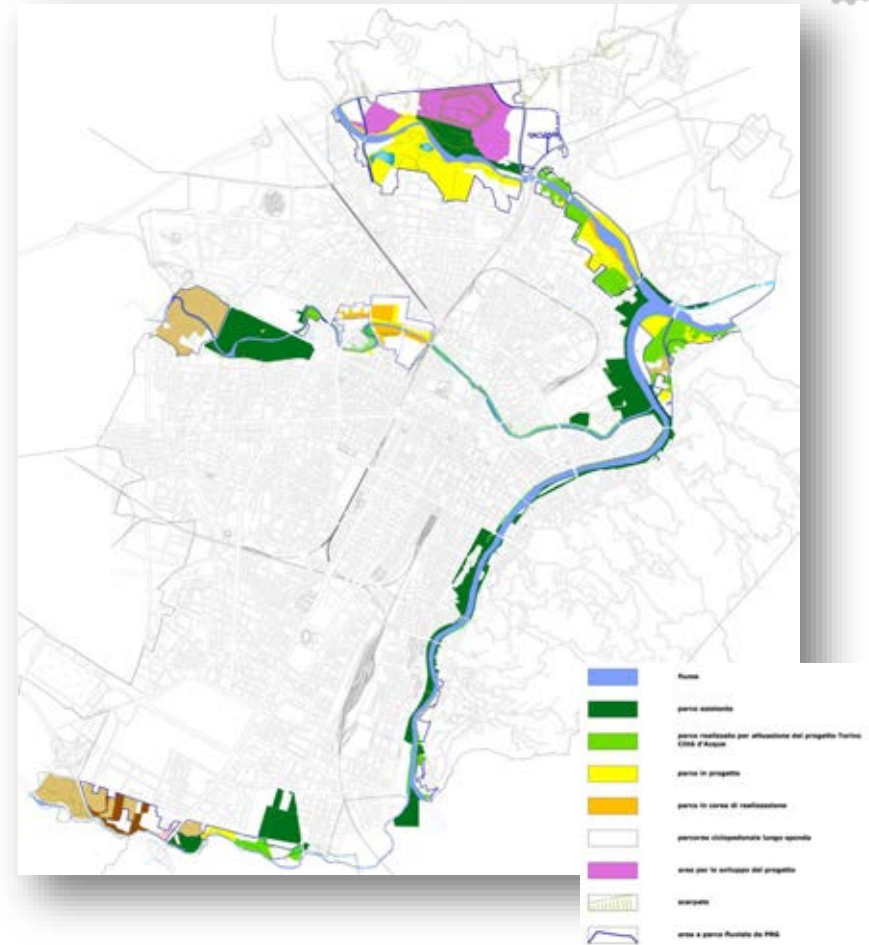
An enormous opportunity to integrate the Climate Strategy into existing and new plan

- Update of the Urban Master Plan *in process*
- Update of the Sustainable Urban Mobility Plan *to begin*
- Civil Protection Plan *will be updated*
- Turin Action Plan for Energy *to be reviewed*
- Strategic Green Infrastructure Plan (*new plan*)
- Air quality plan (*new plan*)
- Zero waste strategy (*new plan*)



Updating the City Masterplan by 2021

- Greenfield and soil conservation
- Integrated metropolitan mobility
- Hydrological balance and surface permeability
- Green infrastructure conservation/development

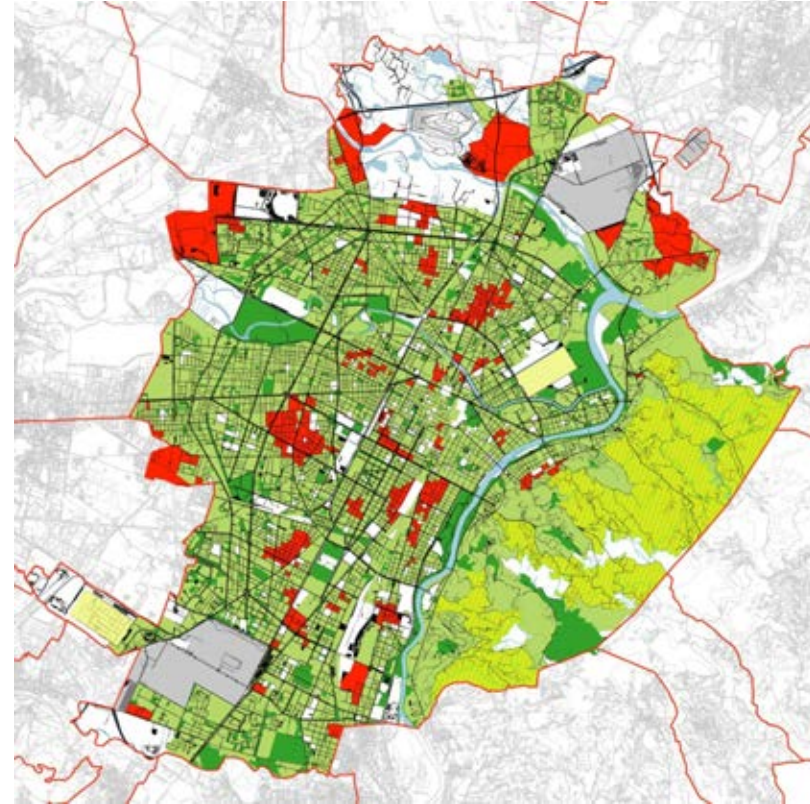


Integrating the strategy



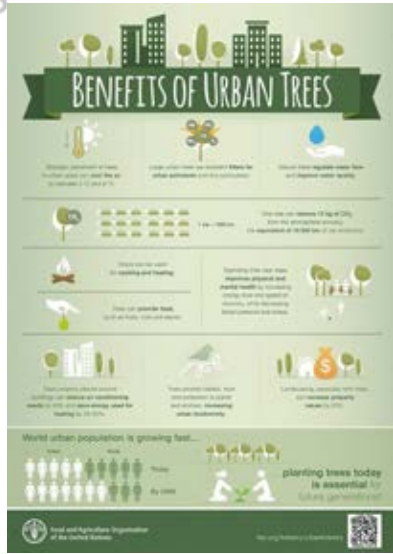
Green Infrastructure Plan

- Quantitative and qualitative analysis of recreational green infrastructure
- Ecological assessment: Biodiversity and habitat connectivity
- Ecosystem services: Risk mitigation and management assessment: land stabilization, soil conservation, shading/cooling and ventilation, CO₂ capture, stormwater management
- Urban agriculture and food security



Target: 25 square meters per resident

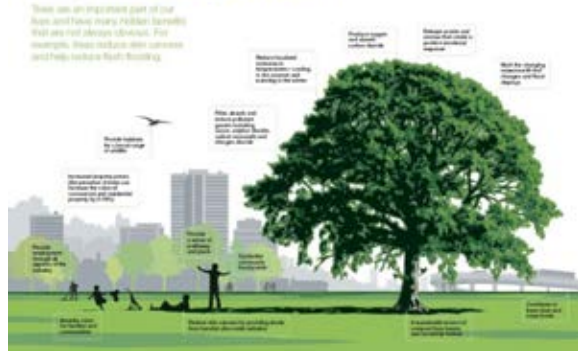
Awareness of the Multiple Benefits of Urban Trees



Planting trees in cities is particularly effective both for direct CO₂ sequestration and for microclimate improvement

Urban trees have a direct impact on human health
New N.U. «Urban Agenda to 2030» considers green spaces one of key points for sustainable cities

Why trees are good for us



According to the European Commission Green Infrastructures themes will be strategic

The cities of the future should have more trees



Our tree stock is ageing and feeling the effects of a complicated coexistence with human activities

History full of mistakes, wrong choices also from arborists and municipal ones and the result is....

Reduction of life expectancy and structural stability factors

Problems related to tree stability in cities



Extreme weather events are more frequent and show structural instability of our public and private tree stock



Tree failures: Causes and Frequency



| TREE FAILURES & REMOVAL | 2013 (WIND > 100 km/h) | 2014 | 2015 | 2016 | 2017 | 2018 |
|-------------------------|------------------------------|------|------|------|------|------|
| GLOBAL | 253 | 43 | 65 | 70 | 100 | 103 |
| TRUNK | 30 | 9 | 13 | 7 | 38 | 5 |
| COLLAR | 25 | 4 | 0 | 1 | 2 | 6 |
| ROOT PLATE | 83 | 18 | 36 | 30 | 24 | 60 |
| CANOPY | 115 | 10 | 16 | 32 | 36 | 32 |

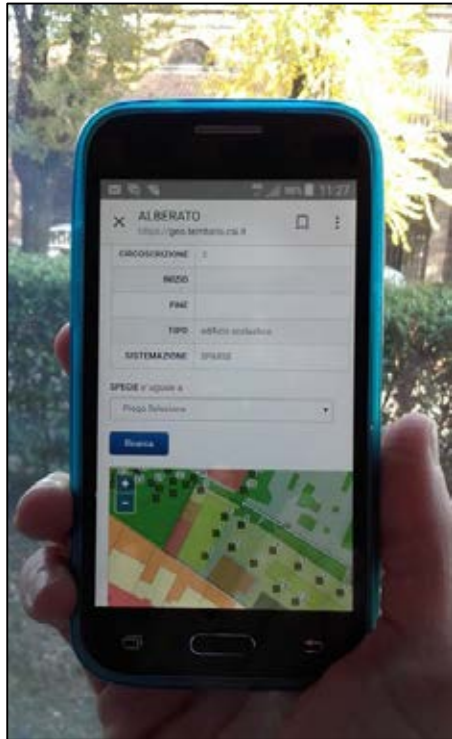
- Importance of analysing data and trends over the years
- Failures could help us better understand tree history and vulnerability to improve our management
- It's key to point out critical issues and analyse causes and errors

Trees normally fail in Turin as well



| TREE FAILURES & REMOVAL | 2013 (venti > 100 km/h) | 2014 | 2015 | 2016 | 2017 | 2018 (30/10/18) |
|----------------------------------|-------------------------------|------|------|------|------|--------------------|
| GLOBAL | 253 | 43 | 65 | 70 | 100 | 103 |
| WITH ORDINARY WEATHER CONDITIONS | 3 | 2 | 5 | 1 | 9 | 3 |

- Despite risk assessment activities trees fall down, also ones with lower failure risk
- 43-100 trees x year on 160.000 represents 0,02%-0,06% of the total, it's neither a lot nor a little... it depends on how many are avoidable failures and the extent of the damages.....
- Avoid alibi of extreme weather conditions and focus on climate change *as the new normal*



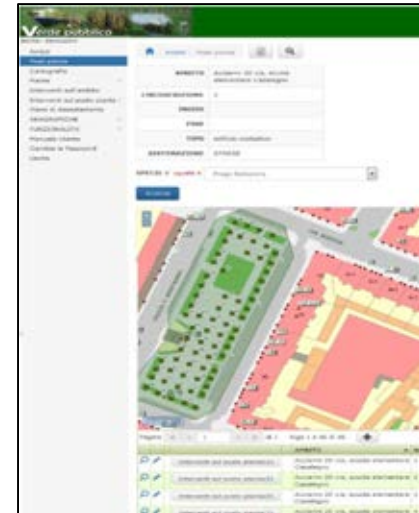
Web application to plan and manage public tree stock

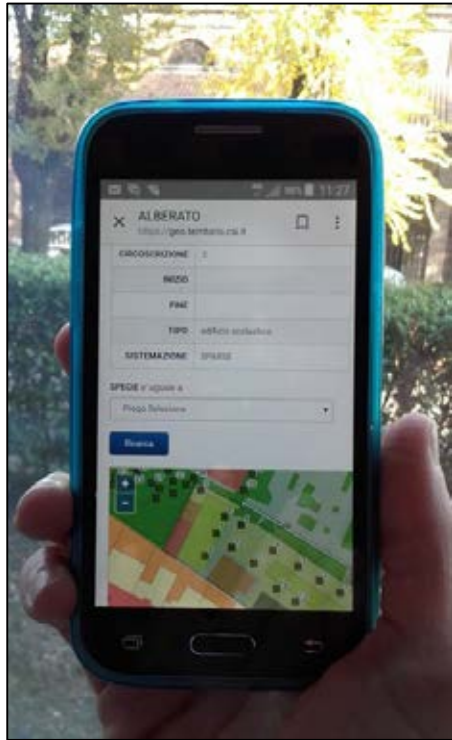
Open to the tree-technicians and consultants

Easy to use and web interface (pc, laptop, smartphone)

Privileges are set according to different users (*municipal technicians and arborists, consultants, citizens...*)

Flexibility: system administrators can customize data sheets





Web-gis to ensure an easy and sure access to all users

Preserve historical info, know-how and experience

Decision-making based on historical data

Planning maintenance activities

Reporting and statistical analysis

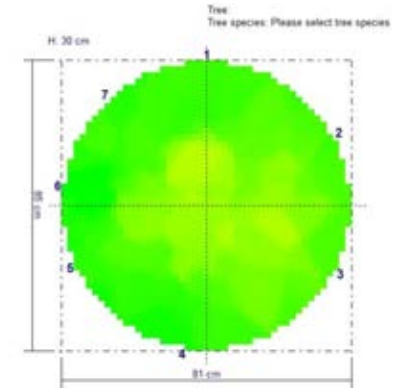
Support quality process activities (ISO 9001 standards)



ALBERA.TO & Tree Assessment



| | | |
|---|--|----------|
| Facebook | ANSA.it | ALBERATO |
| https://geo.territorio.cs.it/alberato/vvo_v_interv_ppianta_vsaview.php?showdetail=&id_interv_ppianta=115691 | | |
| SPECIE | PLATANUS HYBRIDA | |
| ALTEZZA [m] | 23.00 | |
| DIAMETRO FUSTO [cm] | 88.00 | |
| ALTEZZA FUSTO LIBERO [m] | 3.50 | |
| DIAMETRO CHIODA [m] | 12.00 | |
| CARATTERI GENERALI | ADULTO | |
| STATO POSTO PIANTA | PIANTA | |
| BERSAGLIO | area verde | |
| TSPOL. PRIVILEGIATAZIONE | COBERTURA VEGETALE | |
| COLLETTO | AZZAMBITURA, CONTRAPPORTE DI REAZIONE | |
| FUSTO | FUSTO ARCUATO - SCIBOLATO, RIGONFIAMENTO ANGULARE, TORSIONE DEL FUSTO | |
| CASTELLO | [nessun difetto] | |
| CHIODA | SECURE | |
| ALLEGATE | valentino_parco_121_r1.pdf valentino_parco_121_r2.pdf valentino_parco_121_r3.pdf valentino_parco_121_r4.pdf 121_1_3PO 121_2_3PO | |
| CLASSE | C/D | |
| ANNO PROSSIMO INTERV. | 2017 | |
| MESE PROSSIMO INTERV. | Agosto | |
| NOTE | Al colletto legno residuo al limite della sufficienza per ampia carne occulta. Intervento: riduzione in altezza di 5 m e riconformazione del cimale. | |
| STATO INVIO | validato | |
| INVIABILE | | |
| DATA INVIO | 21/12/2016 | |
| DATA VALIDAZIONE | 09/01/2017 | |



> 70.000 assessment reports loaded

All data related to tree inventory and assessments is available for all stakeholders

Useful in case of accidents with damages and injuries

Indispensable tools to improve management: safety for trees and citizens

ALBERA.TO & Tree Assessment



Possibility to store and analyze accidents and damages related to tree failures

The screenshot displays the ALBERA.TO web application interface. The main content area shows a table of tree accidents (sinistri) with the following data:

| AMBITO | TIPO | DESCRIZIONE | IMPRESA ESEC. | DATA FINE | DATA PROG. MESE | DATA PROG. ANNO | DESCR. APPALTO | TOTALE/PAZIALE |
|---------------------------------------|----------|------------------------------|---------------|------------|-----------------|-----------------|----------------|----------------|
| BOTTICELLO VIA JAQUERO G.RO | SENISTRO | | (altro) | 05/07/2017 | | | | Totale |
| XI FERRARIO CORSO | SENISTRO | CADUTA ALBERO | (altro) | 04/03/2017 | | | | Totale |
| MARCONNE Guglielmo CORSO | SENISTRO | | (altro) | 13/07/2018 | | | | Totale |
| DOGALI VIALE | SENISTRO | CADUTA RAMO SU AUTO | (altro) | 07/01/2018 | | | | Totale |
| NOVARA CORSO | SENISTRO | CADUTA RAMO SU ALTO IN SOSTA | (altro) | 20/05/2018 | | | | Totale |
| VALENTINO PARCO - VIALE VORGELIO | SENISTRO | CADUTA RAMO SU TETTO CHALET | (altro) | 14/05/2018 | | | | Totale |
| CORO VIA - PARK SERVIZIO GRANDI OPERE | SENISTRO | CONTROLO U.S.A. | SEACOP | 18/02/2018 | | | U.S.A. 2015 | Totale |

The screenshot shows a detailed view of a tree accident record. The data is as follows:

| | |
|--------------------|----------------------------------|
| AMBITO | VALENTINO PARCO - VIALE VORGELIO |
| TIPO | SENISTRO |
| DESCRIZIONE | CADUTA RAMO SU TETTO CHALET |
| IMPRESA ESEC. | (altro) |
| DATA FINE | 14/05/2018 |
| DATA PROG. MESE | |
| DATA PROG. ANNO | |
| DESCR. APPALTO | |
| DATA INNEVERIMENTO | 01/10/2018 |
| TOTALE/PAZIALE | Totale |
| POSTO PIANTA | |
| NOTE | CAD T21 - TEMPORALE CON VENTO |

After an event once the emergencies have been resolved, it's normal to go back to routine management, with a risk of losing valuable info
Need to analyze data to evaluate critical issues in a sort of troubleshooting process

Tree Risk Assessment & International Context

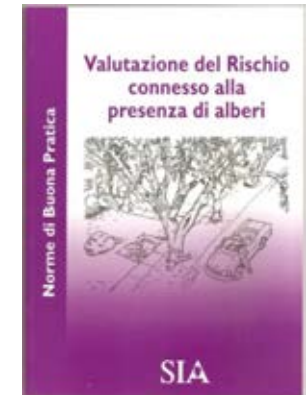
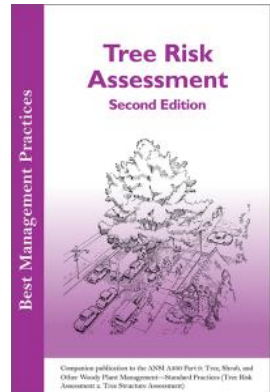
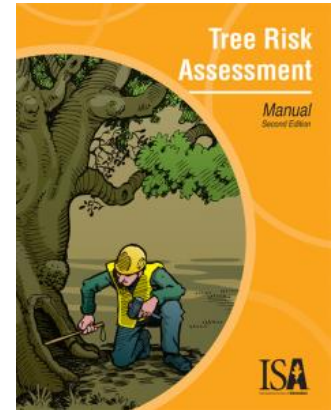


In Italy V.T.A. has been used for more 20 years

The professional landscape is very sophisticated

There's a national protocol processed/drawned by ISA Italy Chapter with different interpretations and approaches

In Italy the first TRAQ and QTRA certifications were established in 2016





T.R.A. FORMS

ISA Basic Tree Risk Assessment Form

Client: _____ Date: 19 Nov 2015 Time: 10:41
 Address/Tree location: Antinori road, Castello di Serravalle, Via Fieschi 2000, _____
 Tree species: Five oaks _____ Tree age: 75 _____
 Tree species: Five oaks _____ Tree height: 15m _____ Crown spread: 8m _____
 Assessment: Jm Tm _____ Time taken: _____ Task used: _____

Target Assessment

| Target | Target description | Target area | Exposure | Consequence | Number of trees | Number of people |
|--------|--------------------------|-------------|----------|-------------|-----------------|------------------|
| 1 | Vehicles on highway Road | ✓ | ✓ | ✓ | 4 | 1 |
| 2 | Powerlines | ✓ | ✓ | ✓ | 3 | 1 |
| 3 | | | | | | |
| 4 | | | | | | |

Site Factors

History of failure: _____ Topography Flat □ Slope □ _____ Aspect _____
 Site changes: Trees: Shade change □ Site clearing □ Changed soil conditions □ Root cuts □ Describe: _____
 Soil conditions: Limited volume □ Saturated □ Shaded □ Compacted □ Rooted over roots □ _____ Describe: _____
 Prevailing wind direction: _____ Common weather: Strong winds □ Ice □ Snow □ Heavy rain □ Describe: _____

Tree Health and Specific Profile

Vigor: Low □ Normal □ High □ Foliage: None (season) □ None (year) □ Normal □ Abnormal □ _____
 Pruning: _____
 Specific failure profile: Branches □ Trunk □ Roots □ Describe: _____

Load Factors

Wind exposure: Protected □ Partial □ Full □ Wind forming □ _____ Relative crown size: Small □ Medium □ Large □
 Clean density: Sparse □ Normal □ Dense □ Winter branches: Few □ Normal □ Dense □ Vines/Mistletoe/ Moss □
 Recent or planned change in load factors: _____

Tree Defects and Conditions Affecting the Likelihood of Failure

— Crown and Branches —

Undeveloped crown □ LCA: % _____ % _____
 Dead large branches: _____ Number: _____ Max. dia: _____ lightning damage □
 Broken/changed: Number: _____ Max. dia: _____ Callus/Healed bark □
 Over extended branches □
 Pruning history: Crown retained □ Pruned □ Ripped □ Dead/missing bark □ Carcass/limbs/bark □ Spongy damage/decay □
 Reduced □ Topped □ Clean-tailed □
 Flush cuts □ Other: _____
 Regrowth growth: _____
 Main comments: _____

— Trunk —

Dead/missing bark □
 Callus/Healed bark □
 Spongy damage/decay □ Carcass/limbs/bark □ Sap ooze □
 Lightning damage □ Heartwood decay □ Cork/Multicoma □
 Early/late hole: _____ % dia: _____ Depth: _____ Year: _____
 User: _____
 Regrowth growth: _____
 Main comments: _____

— Roots and Root Collar —

Soil buried/over visible □ Depth: _____ Stem girdling □
 Dead □ Decay □ Carcass/Multicoma □
 Decay □ Early □ Late □
 Cracks □ Gird/Damaged roots □ Distance from trunk: _____
 Root plate lifting □ Soil weakness □
 Regrowth growth: _____
 Main comments: _____

— Likelihood of Failure —

Leaf as defect: N/A □ Minor □ Moderate □ Significant □
 Likelihood of failure: Insignificant □ Possible □ Probable □ Inevitable □

Risk Categorization

| Condition number | Tree size | Conditions of concern | Tree size | Leaf damage | Target number | Target protection | Likelihood | | | | Consequences | | | | Risk rating (of 16) |
|------------------|-----------|-----------------------|-----------|-------------|---------------|-------------------|------------|--------|------------------|--------------|--------------|--------|------------------|--------------|---------------------|
| | | | | | | | Failure | Injury | Failure & Injury | Compensation | Failure | Injury | Failure & Injury | Compensation | |
| 1 | Root | White tree failure | 80% | 1 | 10 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 16 |
| 2 | | | 80% | 1 | 10 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 100 | 16 |
| 3 | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | |

Matrix 1: Likelihood matrix

| Likelihood of failure | Very low | Low | Medium | High |
|-----------------------|---------------|---------------|---------------|---------------|
| Consequence | Insignificant | Insignificant | Insignificant | Insignificant |
| Failure & Injury | Insignificant | Insignificant | Insignificant | Insignificant |
| Compensation | Insignificant | Insignificant | Insignificant | Insignificant |

Matrix 2: Risk rating matrix

| Likelihood of failure & injury | Very likely | Low | Medium | High | Severe |
|--------------------------------|-------------|--------|--------|--------|--------|
| Very likely | Low | Medium | High | Severe | Severe |
| Low | Low | Low | Low | Low | Low |
| Medium | Low | Low | Low | Low | Low |
| High | Low | Low | Low | Low | Low |

Notes, explanations, descriptions: _____

Mitigation options _____

Residual risk: _____
 Residual risk: _____
 Residual risk: _____

Overall tree risk rating: Low □ Moderate □ High □ Extreme □
 Overall residual risk: Low □ Moderate □ High □ Extreme □
 Recommended inspection interval: Annually

Date: □ Final □ Preliminary Advanced assessment needed: □ No □ Yes (Type/Reason: _____)
 Inspection locations: □ Crown □ Limbs □ Decay □ Moss □ Root collar □ Buried □ Describe: _____

This document was produced by the Department of Agriculture (D&A) and is available to use by the Tree Risk Assessment Qualified (TRAQ) persons. 2012

Risk Assessment is a process based on matrix that consider

- *hazard*
- *target*
- *consequences*

With a qualitative (T.R.A.Q.) or quantitative (Q.T.R.A.) approach



Clarify difference between hazard and risk, in Italy there's still too much confusion

Hazard is the possibility of a negative event (failure) occurring. It is in a sense related to the nature of the object

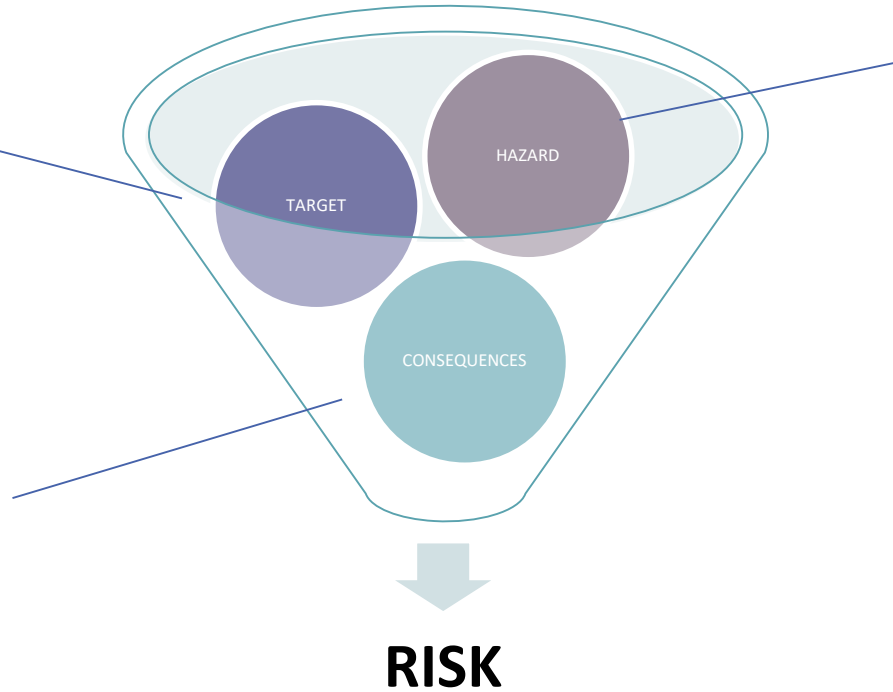
Risk is the potential impact of the hazard based on the vulnerability of the site. It is related to the nature and extent of the damage that a failure can cause on the surrounding environment





Likelyhood of impact related to occupancy rate

Damages to infrastructures or people, depending on gravity



Likelihood of failure according as per V.T.A. Growing accuracy depending on zoning and exposure

Risk Assessment and Risk Management



Transition from likelihood of tree failure to potential risk pose by considering context (history, characteristics, occupancy rate) and consequences

Likelihood of tree failure is a part of risk assessment

Zero risk doesn't exist!

Risk mitigation depending on target, risk level, site restriction

Defining acceptable risk level





Risk assessment/management are connected to acceptable risk level which is influenced by different factors (political, technical, economical, insurance and emotional)

According to Italian criminal law ***acceptable risk threshold must be determined by the tree owner***/manager, not the consultant

An acceptable risk level evaluation is about ***balancing citizens safety with tree stewardship***

In the face of a failure event ***a Judge generally weighs safety over tree stewardship***



Need to clarify roles and responsibilities in the Italian context

Clear up the mandate

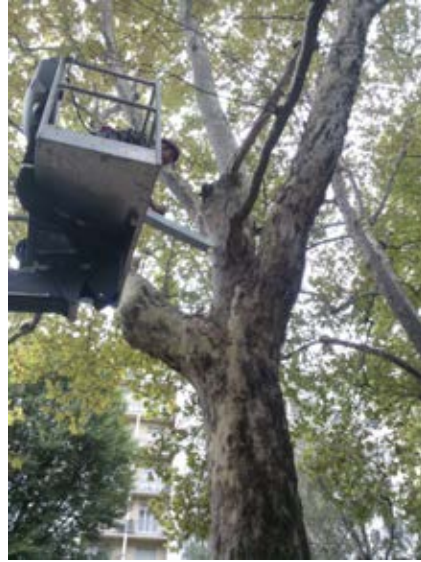
- Tree inventory
- Tree stability assessment
- Tree risk assessment

Clear up the roles

- Arborists
- Analyst
- Tree risk assessor
- Tree risk manager

When a tree analysis is commissioned the real question is **«Is that tree healthy?» «Could it fall?»...**

Tree Inspections in Turin



Activities entrusted to external consultants selected with call for tenders

Consultants decide if visual or instrumental inspection, tree failure categorization and how to mitigate it...**City arborists evaluate risk!**



In Turin tree stability controls are focused on evaluating the likelihood of failure.

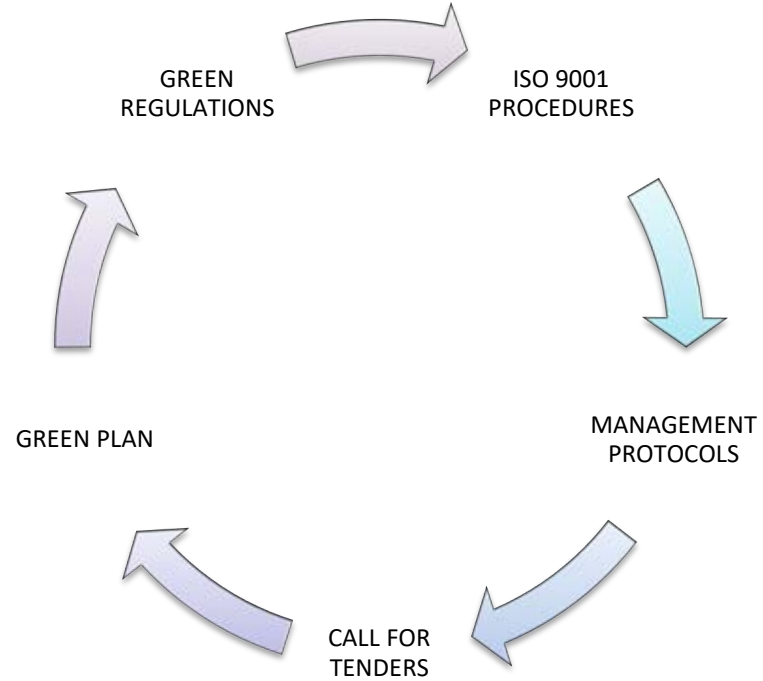
It's not necessary to evaluate every trees in the same way: it's technically uncorrect and not sustenaible

We're in a transition phase, risk assessment will be a mixed process:

- territory zoning decided by manager to determinate time frame and tipology of control
- likelihood of tree failure determinated by consultants
- risk mitigation through a shared decision



Importance of having a multi-year tree stock management plan based on census and monitoring information



and that connects different aspects



Are our existing urban trees able to face this challenge?

- With a different approach based on life expectancy that introduces planned tree renewal but not forgetting tree risk assessment on existing trees
- Tree risk assessment is a part in tree management process
- Maximum effort to reduce and minimize risk, but since a zero risk scenario doesn't exist and we need to accept a certain amount of risk as the price for the multiple benefits of trees

Tree Planting campaign to Mitigate Climate Change



Trees are considered as one of the most effective and affordable solutions to mitigate climate change effects

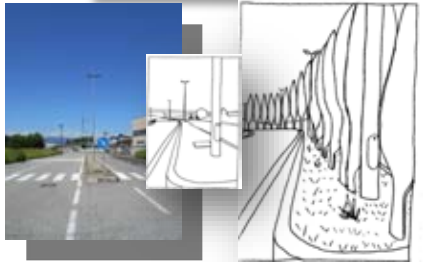
How do we maintain the existing tree stock and grow it in numbers?

- reforestation of former industrial sites
- micro-interventions of NBS within the existing urban fabric
- extending the benefits of tree to areas where it is not possible to create new green space

What Are We Doing Already?



Green roof



Strategies to reduce heat island effect and better manage stormwater runoff
Use pilot projects to demonstrate best practices for public and private projects

What Are We Doing Already?



Project to create multi-functional micro green areas at the block and street level (heat islands and stormwater runoff) repurposing areas dedicated to streetside rubbish collection which are currently being eliminated. Micro areas could provide co-benefits by supporting more equitable and sustainable lifestyles

What Are We Doing Already?



- Twice annual initiatives to plant trees with citizens
- Over 2000 trees planted since 2016
- 20.000 trees will be planted by end 2019, 10.000 by 21/11 our National Arbor Day

Urban tree planting campaigns with residents, community groups, local organizations and political representatives

What Are We Doing Already?



Urban reforestation with private sponsors and institutional partners



First experiences with private enterprises investment

Collaboration protocols with no profit org. expertise in urban forestry activities to engage private partners

Forestry certifications process of public hillside forest (more than 250 ha.) according to ecosystem services benefits





- Engage this challenge to **save our historical tree stocks from climate change effects** and both demonstrate how **trees can mitigate climate change effects**
- The future of trees in our cities requires a **paradigm shift** from trees as an ornamental feature of the **urban landscape** to trees as an integral part of the **urban ecosystem** providing multiple ecosystem services and benefits to contrast climate change
- Approach tree management **not forgetting our roots and introducing a new vision**, new solutions
- Zero risk scenario doesn't exist **we need to accept a certain amount of risk** as the price for the multiple benefits of trees
- Engage all stakeholders because **trees is a public good**



make the world a better place, one tree at time!



**THANKS FOR YOUR PATIENCE AND
ATTENTION**

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