ECOLOGICAL AIRPORT URBANISM

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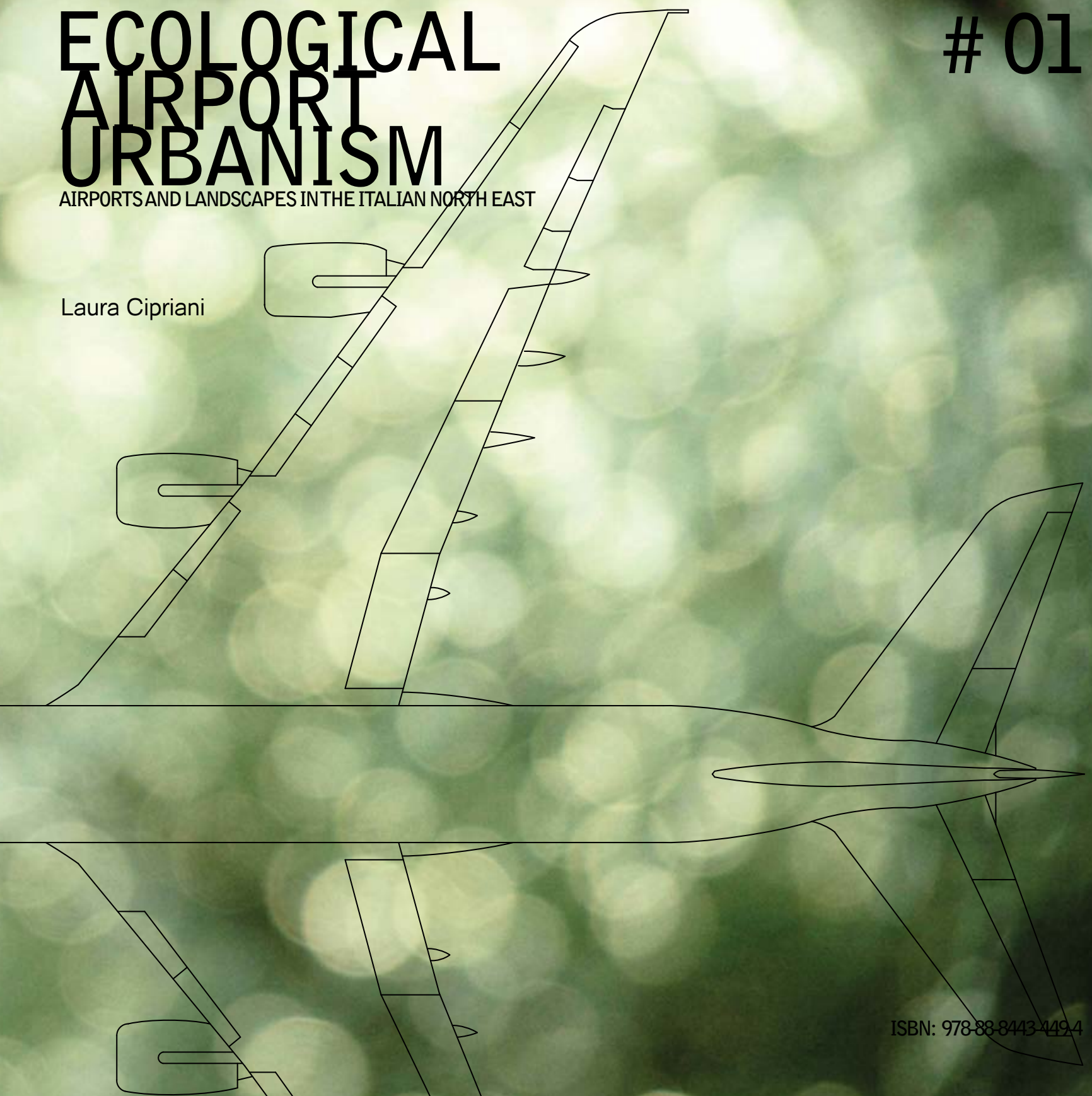
AIRPORTS AND LANDSCAPES IN THE ITALIAN NORTH EAST

Laura Cipriani



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ECOLOGICAL AIRPORT URBANISM
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Airports are playing an ever more important role in regional and local development. Infrastructure on this scale benefits society as a whole, but the environmental effects are a particularly heavy burden on the communities directly involved. How is the landscape modified by air transportation? Can the landscape and airport infrastructure be integrated following ecological criteria?

Laura Cipriani, Marie Curie researcher at Trento University, works in urban and landscape research and design. Over the years, she has specialised in the relationship between infrastructure and landscape, with a constant commitment to research and university teaching.
After graduating with honours in architecture at the IUAV University of Venice in 2001, she won a study grant which enabled her to graduate with honours in urban and landscape studies at Harvard University Graduate School of Design in 2004. Finally, in 2008 she was awarded a doctorate at IUAV University of Venice.

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Laura Cipriani

This volume presents a number of reflections on the airport landscape theme, fruit of a series of meetings between the researcher and the Veneto Region Department of Regional and Strategic Planning on Venice airport-city and the data collected and considerations matured by the researcher during the Marie Curie COFUND-PAT programme at Trento University.

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CONTENTS

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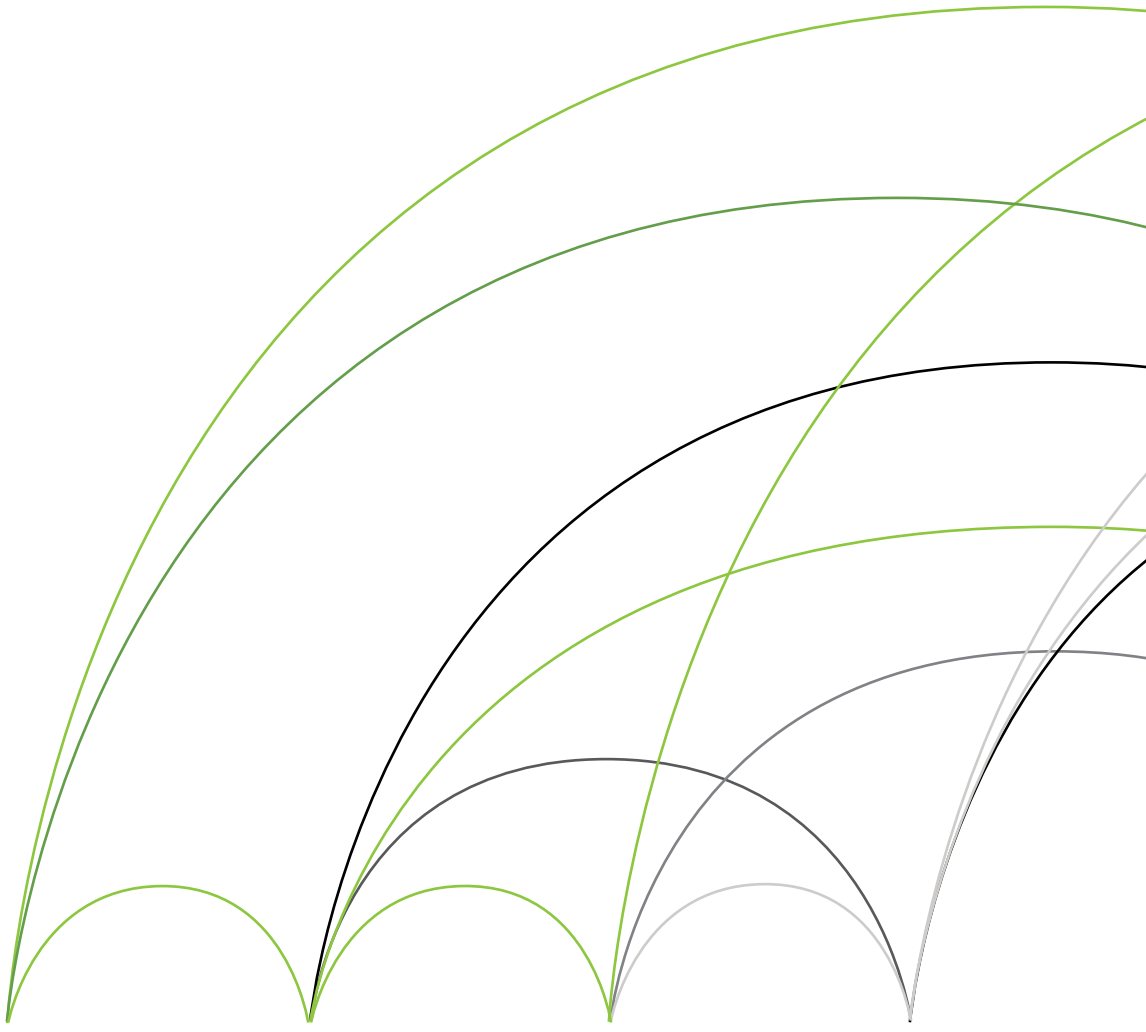

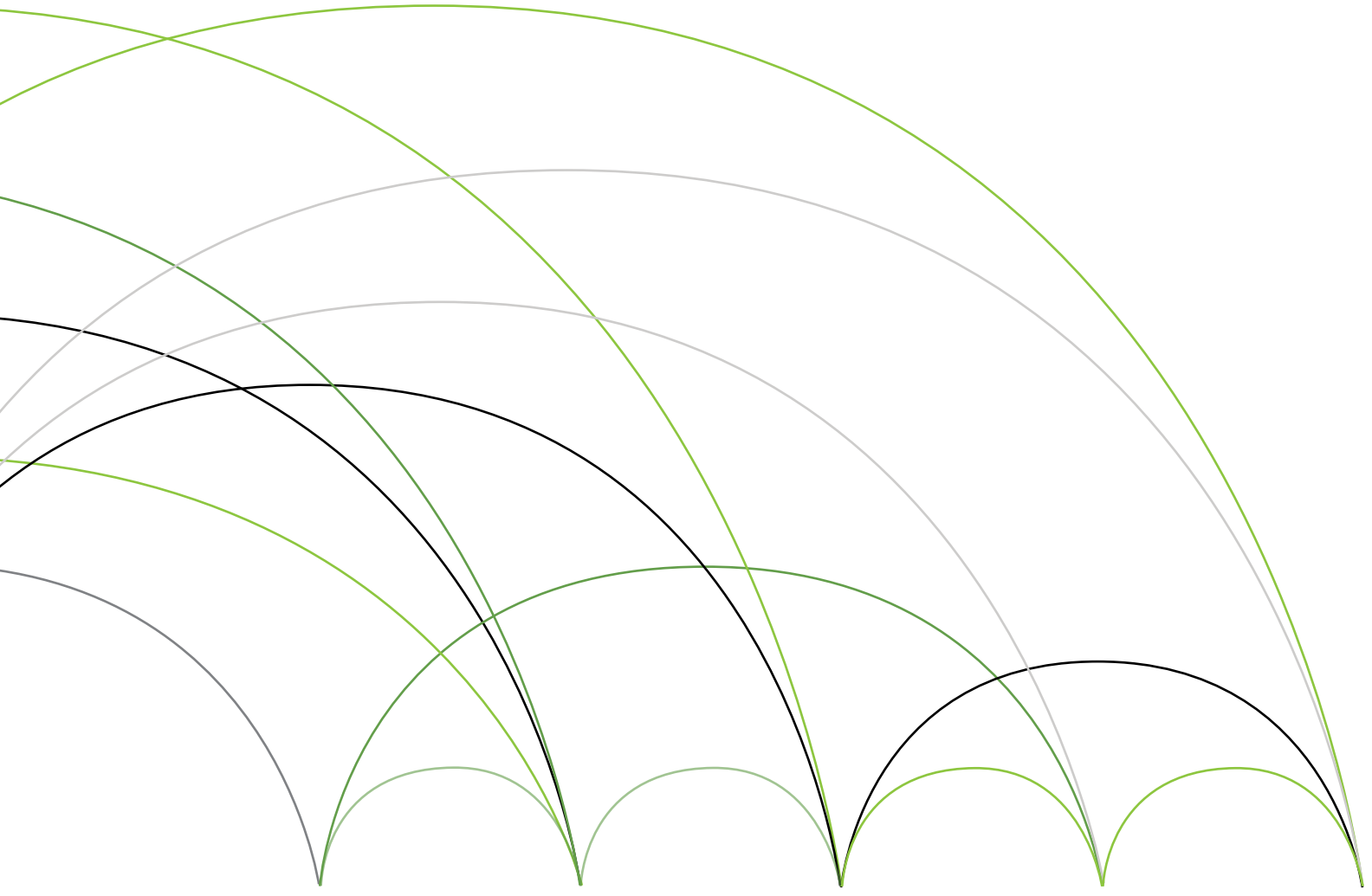

INTRODUCTION

INTRODUCTION

By their nature, use, form and size, airports are often considered as spaces extraneous to the landscape and difficult to integrate into the local context. Yet airport infrastructure is playing an ever more important role in local development, modifying not just the aspect, but also the social structure, economy and environmental quality of the surrounding area. Infrastructure on this scale benefits society as a whole, but the environmental effects are a particularly heavy burden on the communities directly involved.

How is the landscape modified by air transportation? What is meant by "ecological airport urbanism"? Can the landscape and airport infrastructure be integrated following ecological criteria? How can an airport be integrated into the local context? What design devices can be used? How can we combine today's technological requirements with the need for unforeseen new functions in the future? In the future, how might disused airport infrastructure possibly be "recycled"?

This study aims to make an initial contribution to research on the airport system in North East Italy in relation to current landscape transformation dynamics.

The first part provides a theoretical background to the theme of airports, cities and the landscape. The intention is to provide an overview of contemporary scientific literature in order to open a dialogue on the hitherto little explored theme of airports in relation to the landscape.

The second part examines the particular characteristics of Italy's national airport system, then goes on to consider airports in North East Italy through original data and documents.

Particular attention is given to the study of Venice airport, identifying the environmental risks and scenarios deriving from the urgent effects of climate change. Historical documents and accurate themed maps highlight the conflicts emerging around the airport and the possible short, medium and

long term scenarios for the future.
The study aims to develop a method to orient planning and design of an "ecological" airport system, identifying possible alternative development scenarios on multiple scales. The final section of the study therefore presents a series of designed projects proposing targeted design devices able to guide definition of the strategies and decisions to be taken today for the future.
In an era dominated by uncertainty about tomorrow and by a race towards real or presumed sustainability, infrastructure must be re-planned, not just to accommodate today's technological functions or contingent needs, but also with a view to possible future re-cycle, generating a method for re-inventing the landscape and thus becoming fertile ground for the unexpected.

AIRPORTS, CITIES AND THE LANDSCAPE

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AIRPORT-CITY

AVIOPOLIS

AIRPORT CORRIDOR

AIRPORT REGION

AEROTROPOLIS

AEROPOLIS

AIRPORT URBANISM

”

AIRPORTS, CITIES AND THE LANDSCAPE

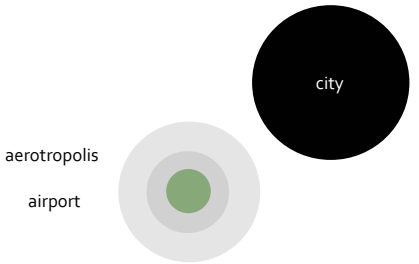
The theme of the relationship between airports and the landscape has so far been little studied. In the past, urban and landscape planning disciplines have been concerned more with studying the social effects of airports, than with exploring the complex airport-machine and its effects on the territory.
The airport intended as a "non-place", according to Marc Augé's anthropological concept some ten or so years ago, has become a repetitive cliché.
Until now, the airport has remained detached from both the city and the landscape. It is not an integral part of either. Moreover, the usual sector studies (environmental impact assessments for example) are not sufficient to establish a relationship between airports and cities. Although they recognise the need to manage and monitor the airport-machine from an environmental, economic and legislative point of view, often they do not attribute adequate importance to regional planning. There are no integrated plans, but rather numerous sector studies which aim at resolving specific, rather than general, issues.
The "airport and landscape" relationship is usually interpreted in economic geographical terms. Numerous studies[1] have been carried out on this subject, but the geographical aspects of the phenomenon are largely limited to a strictly economic analysis. The airport is described as a production catalyst. Employment, added value, profit and income are adopted as the parameters for defining the impact of the airport as a business activity. Statistics, data and financial equations do not, however, reflect the quality of places or record changes in the landscape and the practices taking place within it.
Abundant literature on the theme confirms the "multiplier effect" generated by the activity of an airport on the local and national economy. In technical terms, an airport produces value for the local area, both in terms of large firms able to attract investment and create employment, and as transport infrastructure able to increase the national, international and intercontinental

accessibility of the area.
The interdependent relationship between the airport and the local area is synergic, biunique and complex. The economic impacts attributable to the presence of an airport can be graphically represented by a series of concentric circles, a "cascade" of benefits ("ripple effect") propagating out from the airport to the local area. The nucleus is the airport operator, followed by on-site services, then the activities associated with air transportation and finally the entire regional economy.
The process is two directional – outwards from the centre, in other words, from the airport to its hinterland, but also from the outside inwards, through a process of feedback from local companies which in turn generates activity for the airport itself[2].
Direct[3], indirect[4], induced[5], dynamic or catalytic[6] impact are the economist's reference vocabulary.
Within this dictionary of economics and land-use, the most interesting contributions from a strictly spatial point of view come from what are known as dynamic or catalytic impacts.
These focus on an airport's role as "magnet", in other words, its ability to attract production activities and trigger a chain of multiplier mechanisms.
Given that they have repercussions on the global economy of the region, these dynamic effects are difficult to delimit and quantify and therefore to analyse and estimate. Often it is impossible to isolate what is produced by the airport and what depends on "other" factors, not dependent on the presence of air traffic flows in the local area.
However, there is no doubt that the presence of an airport is a decisive factor for regional development[7]. Numerous production activities spring up and grow around these places which gradually develop into genuine cities. In some ways, development of these urban organisms, also known in economic terms as "aerovilles" or "airport cities", resembles that of the Victorian railway towns which sprang up around railway stations at the end of the 1800s. A series of industrial and commercial activities largely associated with airport infrastructure spring up – conference centres, service companies, distribution and storage facilities[8].
The notion of airport city is in fact just one of numerous neologisms. Airport city, city airport, air city, aerotropolis, aeropolis, aeropark, aviopolis, avioport,

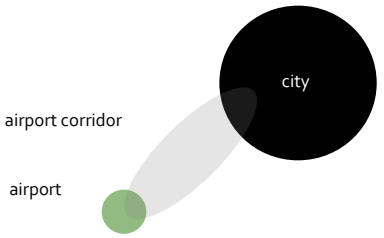
The illustrations represent four theoretical urbanisation models for areas characterised by the presence of an airport.
Source data: Johanna Schlaack. Diagrams by Laura Cipriani.

CITY-AIRPORT

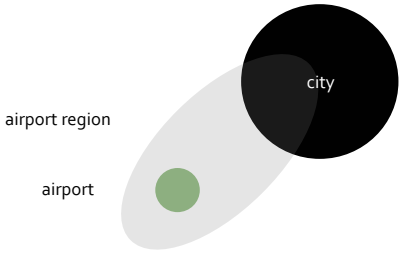
AEROTROPOLIS
(John Kasarda)



AIRPORT CORRIDOR
(Maurits Schaafsma)



AIRPORT REGION



sky city and airpark are just some of the terms coined to express the image of this phenomenon.

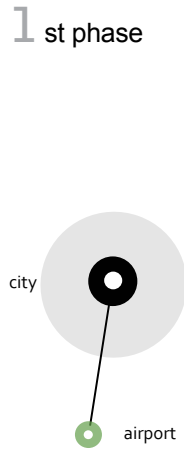
Broadly speaking, five main conceptual and spatial models can be distinguished[9]: airport city, aerotropolis, airport corridor, airport region and airport metropolis. The hackneyed concept of airport city is applied to large airports whose scale, size and functions have transformed them into genuine cities. The second concept of aerotropolis as proposed by John Kasarda extends the concept of airport city to a new spatial form no longer (or at least not only) located near the airport itself: "*The emerging corridors, districts and production activities associated with the airport generate a new urban form – the aerotropolis - which extends over an area at least 15 miles (20 km) from the entrances to the airport. The airport functions as a multi-modal convergent nucleus and a commercial link in the associated diffuse urban system, playing a role similar to central business districts (CBD) in a traditional metropolis.*"[10]

An aerotropolis is not a city airport. But neither is it an airport city. It is not therefore limited to the immediate vicinity of the airport, but also extends for several miles from the airport itself, including external areas not closely associated with aviation activities. Districts, offices, research parks, commercial areas, conference centres, entertainment, even residential housing may all be anchored to and dependent on the airport in some way.

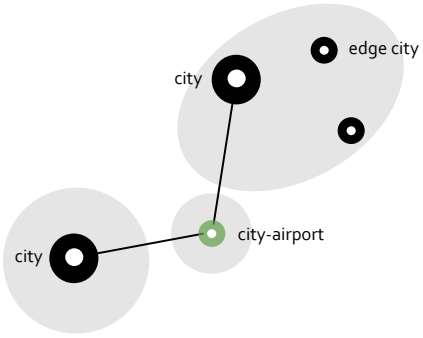
"*In response to the new economy's demands for speed and reliability, the aerotropolis is based on low density, wide lanes, and fast movements. In other words, form is following function. Although aerotropoli have so far evolved largely spontaneously – with previous development creating arterial bottlenecks – in the future they will be improved through strategic infrastructure planning.*"[11]

As Kasarda himself admits, many aerotropolis have been spontaneous and dangerous, mainly because planning and governance have been absent, fragmentary and unable either to resolve the issues, or exploit the possible potentials.

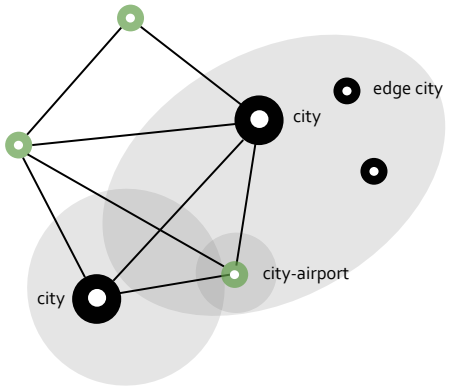
The third definition is that of airport corridor, as defined by Mauritz Schaafsma on the basis of his personal experience with Amsterdam Schipol Airport. This spatial concept derives from the observation that the airport and associated areas are progressively extending towards the centre of the city, creating a genuine airport corridor. This corridor extending towards the city centre is characterised by the presence of an infrastructural spine (rail or road) which



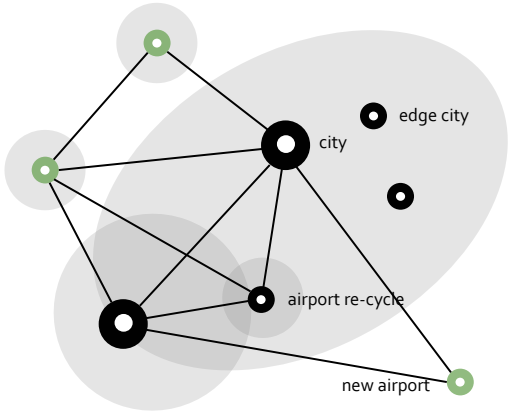
2 nd phase



3 rd phase



4 th phase



The evolution of the city-airport. During the first phase, the airport is built outside the city in open country. During the second phase, as the city expands, the airport serves a number of urban centres. During the third phase, the airport is incorporated within the urban fabric. During the fourth phase, the airport is replaced by another airport located further from the residential areas. No longer in use, a practical reconversion project enables the airport to perform new functions.
Diagrams by Laura Cipriani.

spawns a series of urban developments distributed longitudinally and often fruit of joint ventures between private interests and public institutions.
The fourth term, airport region, has no founding father and the concept is therefore perhaps more vague and generic, with public governance of the issues arising from the presence of an airport apparently predominating.
Finally, the last concept of airport metropolis has been defined by the Australian school led by Robert Freestone. The theoretical-practical framework developed by the group is based on an awareness of the urgent need for integration between airports and the surrounding urban contexts. The changed nature of airports in their metropolitan context and the emergence of new social, environmental and economic issues necessitate the introduction of a new conceptual framework to help understand these complex relationships and the spatial interactions between the various elements. The airport metropolis thus becomes both a theoretical and a practical solution, with four main constituent sectors: economic development, land use, infrastructure and governance. The intention is to break down interdisciplinary barriers and adopt an integrated approach to resolving the interdependence relationships which develop between airports and the surrounding regions.
To the concepts of airport city, aerotropolis, airport corridor and airport metropolis, I would like to add that of "ecological airport urbanism". In the past, I have done a great deal of work on the theme of airport urbanism, in particular in relation to low-cost travel. My aim was to study changes in the local area in the presence of the external forces of air transportation, what mechanisms were behind the phenomenon, recording the consequences on local and global scale.
The study showed not only that new centralities and urban forms were developing from the airport node, but also that the effect of the airport extended beyond its geographical boundaries. Airport infrastructure in fact not just became the engine of urban evolution/devolution for the neighbouring regions immediately involved in the transformation process, it also stimulated the spread of transnational urbanisation and landscape contamination models, generating genuine "airport urbanism".
Flows structure geographical spaces, activating and deactivating the potentials of places, allowing a biunique relationship between mutually distant regions and sometimes generating a genuine displacement of spatial

and environmental processes. Contamination between regions, hybridisation of landscapes and the migration of urban models may often be traced back to the variable geometry of communication flows.
I believe that the concept of "ecological" must be added to that of airport (landscape) urbanism.
The word "ecological" aims to describe not the current situation (which airports are truly "ecological"?), but rather what the goal should be. "Ecological" contains a series of unresolved issues of how (and if) we can rethink airport infrastructure in terms of urbanism and, above all, of the landscape and environment. This is why I wanted this study to include a section on projects centred around the concept of the airport in relation to the landscape and local area, rethinking from an ecological perspective a series of design strategies able to look towards the future.

NOTES

1 See: Baccelli, O & Zucchetti, R 2001, *Aeroporti e territorio: conflitti e opportunità di sviluppo* (*Airports and their environs: conflicts and growth opportunities*, in Italian), EGEA, Milan.
2 On one hand, an airport is able to develop and boost the economy of the region in which it is located, increasing the area's competitiveness and attraction and becoming an effective tool for marketing the local area; on the other, the existence of a local economic system, in other words, of industrial and tertiary activities competitive on an international scale, represents a crucial factor in determining the competitiveness of the airport itself.
3 The direct economic impact, according to the Federal Aviation Administration (FAA) definition, subsequently adopted by the Airport Council International (ACI Europe), is generated by activities directly associated with air transportation (cargo and people). This category may include the functions of the airport operators, airlines, handling providers and others directly involved in aviation services.
In general, the employment generated within an airport and in its immediate vicinity is the type of impact easiest to identify. The economic impact may be produced by airlines, the airport and airport services.
4 The indirect economic impact is generated by activities located outside the airport, but associated with it as they are at the service of airport users. This definition includes spending in the region surrounding the airport by passengers, crew and air cargo operators (at travel agencies, tour operators, businesses, etc). In the same way as direct impact, indirect impact is analysed by upstream study of salaries, spending, investments and fiscal income.
5 Induced impacts are the multiplied effects of direct and indirect impacts. An airport does not in fact generate employment on the actual site alone, but also beyond its boundaries. According to a Keynesian effect, companies located within the airport boundaries grow in close relationship with the airport, generating local income, spending cycles and a growth in employment.
According to the brief ACI Europe description: "*The induced impact is an estimate of the subsequent spending of all those with direct or indirect economic benefits.*"
6 Dynamic or "catalytic" impact, by its nature difficult to delimit and quantify, is usually analysed in terms of quality. It represents the economic value produced by the airport not as an activity in itself, but as transport infrastructure. This impact therefore considers the force of attraction and expansion of business activities generated by an airport in a defined area.
The dynamic impact of an airport differs from the other types of impact in two characteristics:
1. firstly, it concerns activities "downstream" of the airport-company, in other words it involves the industrial and tertiary companies using the air transportation service;
2. secondly, the dynamic effects bring benefits to the local area on condition that they occur in a local economic system ready to benefit from them.
7 Today, companies are ever more air transportation related, in other words, they are ever more dependent on air transportation services. In the era of contemporary globalisation, innovations in production processes (just-in-time or delocalising phenomena) ever more frequently necessitate long distance mobility, thus attributing a key role to air transportation.
In location decisions, the accessibility of air transportation services becomes pre-eminent, par-

ticularly for certain businesses. Economic studies show that industries with a high technological content (electronics, precision instruments, information technology, pharmaceuticals, professional consultancy services, etc.) perceive the airport as an essential means of transport.
The location of this type of business also tends to encourage the concentration of similar professions in the same area. In technical terms, this is known as the follow-my-leader effect, in which competitors decide to locate near market leaders.
The airport is also able to generate two further dynamic effects. In the first, known as the innovation effect, the airport acts as a stimulus to innovation for two reasons: firstly because airports, airlines and the aviation sector require constant innovation from goods and services providers; secondly, because the most innovative companies tend to act in an international context and therefore tend to choose a location near airports.
In the second effect, known as the skill effect, the airport increases the skills in the region, as the aviation sector in general calls for a high level of professionalism.
8 Examples of this are the Barcelona Logistic Centre, the Schipol Area Development Company, Amsterdam, and Carrefour des Entreprises, Paris. Of the 1100 companies locating in the Netherlands, 45% are in the area surrounding Amsterdam airport. Also located in that area are a number of important European distribution centres, including Canon and Yamaha, together with numerous international leaders such as Boeing, Unilever and Glaxo-Wellcome.
9 See: Schlaack, J 2010, 'Defining the Airea. Evaluating urban output and forms of interaction between airport and region', in Knippenberger, U & Wall A (eds.), *Airports in Cities and Regions. Research and Practice. 1st International Colloquium on Airports and Spatial Development*, KIT Scientific Publishing, Karlsruhe, pp. 113-125.
10 Kasarda, J 2001, 'From Airport City to Aerotropolis', *Airport World Magazine*, August-September, p. 44.
11 Kasarda, J 2000-2001, 'Logistics and the rise of Aerotropolis', *Real Estate Issue*, winter, p. 46.

THE AIRPORT LANDSCAPE OF ITALY

THE AIRPORT LANDSCAPE OF ITALY

The airport landscape of Italy is an anomaly on the European scene. Observing the position of civilian airports on an atlas of Italy in fact reveals a schizophrenic and irrational logic. There are 101 civilian airports in Italy, 45 open to commercial traffic. Of these, only 21 exceed one million passengers per year, the threshold considered as a minimum for the airport not to make a loss. There is an enormous proliferation of airports, or in economic terms, fragmentation of the offer. Five airports operate between Rimini and Parma: Rimini, Forlì, Bologna, Reggio Emilia and Parma. If the analysis is extended to the section of motorway between Milan and Ancona, there are eight, with traffic (with the exception of Bologna) in the order of hundreds of thousands of passengers per year.

While on one hand the large number of airports is a direct consequence of Italy's specific morphological and historical characteristics, on the other this dispersion represents a major obstacle to development of the main national airports.

Since 1997, the year in which the European market was fully liberalised, Italian airport traffic has grown continuously. In 2011 there were about 148 million transit passengers, the majority flying from the five main airports: Milan (Malpensa, Linate and Orio al Serio) with 36.7 million transits, Rome (Fiumicino and Ciampino) with 42.3 million, Venice (Venice and Treviso) with 9.6 million, Catania with 6.7 and Naples with about 5.7 million each[1]. While Rome Fiumicino, Milan Malpensa and Venice are established as peninsular Italy's three most important airports, the development of low-cost airlines has also led to the birth of a number of secondary airports, in particular, Orio al Serio and Treviso.

In Italy regulatory organisation has been characterised by an excessive offer of capacity, a lack of strict revenue and financial constraints due to the public ownership of infrastructure, a virtual lack of competition on both home and international routes and privileged relationships between airport operators and the national airline. The resulting forms of regulation are inadequate for a context which ever more lends itself to transformation into a business activity. Above all, Italy still has no national airport infrastructure plan. Despite the fact that the first study on Italian airports was presented in 2011, no national plan has so far been approved. The absence of top down planning makes a long term vision impossible, creating a state of permanent uncertainty not just concerning airports, airport operators, airlines, local authorities and financers, but above all in the local area from a social, economic and urban point of view. This fragmentation concerns not just the geographical location of the airports, but also their management. On its website, Assaeroporti, a confederation representing 35 Italian airports, publishes a map congested with names and symbols, an eloquent illustration of the numerous airport operators located throughout the peninsula. While airports were originally state owned authorities managed directly by the Ministry of Transport or publically owned companies, laws number 537 of 24 December 1993[2] and 351 of 3 August 1995 [3] initiated the regularisation and privatisation of Italy's airport industry, a process which is still underway today. On one hand, a number of companies with full operational control under the special laws were set up: SAVE for Venice Tessera Airport, SACBO for Orio al Serio airport, AdR for Rome Fiumicino and Ciampino airports, SEA for Milan Linate and Malpensa airports, Aeroporto di Genova for Genoa Airport, SAGAT for Turin Caselle Airport, GESAC for Naples Capodichino Airport and Aeroporti di Puglia for the airports of Bari, Brindisi, Foggia and Taranto in Puglia. On the other, other companies were demoted from the status of full concessionary due to their partial management role: Verona, Brescia, Palermo, Lamezia Terme, Olbia, Cagliari, Bologna, Reggio Emilia, Trieste, Pisa, Pescara, Ancona and Perugia.

It is not just a national airports plan which is lacking. There is also no clear framework legislation for the issue and renewal of airport concessions. This would allow airports to be fully privatised and therefore the development of healthy competition between airports.

Neither is there an adequate investment policy either by the State, owner of

On right, the main, secondary and military airports in Italy in relation to the road and rail infrastructure network.
Source data: Assaeroporti, 2010; ENAC, 2010.
Map by Laura Cipriani.


> 10 million passengers
5-10 million passengers
1-5 million passengers
200.000-1 million passengers
1.000-200.000 passengers
secondary airports
military airports
highways
high speed rail line
high speed rail line under construction
main rail line
secondary rail line
0
100
200
300
400
500
600
700
800
900
1000 Km


> 10 million passengers
5-10 million passengers
1-5 million passengers
200.000-1 million passengers
1.000-200.000 passengers
0
100
200
300
400
500
600
700
800
900
1000 Km

the land and until just a few years ago directly responsible for managing airside infrastructure, or by the airport operators. The provision of public funding is inadequate and insufficient compared to that of other European countries[4], moreover the model of distribution among the airports is indiscriminate, non-transparent, discretional and beyond any form of planning framework. This is one of the reasons for the proliferation of airports, way above the European average. The majority of the 101 civilian airports in Italy have just a few hundred passengers per year, precisely because of the ongoing state funding received largely as a result of political pressures.

In short, there is no serious, clear, transparent process of reform and liberalisation in the sector. The first laws passed (laws no. 537/93 and 351/95) modified the airport ownership and concession system, conditions of entry into the handling services market and tariff schedule for airport access, but they did not include effective measures to control airport management efficiency. The European Union directive was introduced in order to open up the landside services sector to the market with the aim of improving efficiency and reducing costs, but when this directive was taken on board by Italian legislation and partially applied, the results were unexpected.

There is no efficient tariff schedule for airport services. Airport fees for passengers and carriers continue to be defined on a discretional basis, distorting competition between airlines using the same airport and between the airports themselves. An efficient regulatory system is fundamental to prevent abuse of a dominant position by airport operators or service providers in a position of monopoly or oligopoly and to prevent the risk that citizens pay airport costs twice, once through the tax system which allocates vast sums for the construction of infrastructure, then again through airport fees.

Although the latest Interministerial Committee for Economic Planning (Comitato Interministeriale per la Programmazione Economica) resolution no. 86/2000[5] aimed to create more efficient control systems, in fact, for many years the opposition of many airport operators[6], strict constraints and poor profitability prevented implementation of this resolution until approval of new regulatory criteria as part of the 2005 Financial Law. The result was fossilisation of the tariff system which now appears to lack economic logic. Tariffs are heterogeneous, even among airports with similar technical characteristics and traffic flows, in some cases they appear arbitrarily high and the actual

On left, the main airports in Italy.
Source data: Assaeroporti, 2010; ENAC, 2010.
Map by Laura Cipriani.

orientation of production costs cannot be verified.
The infrastructure and airport management sectors are therefore still characterised by extreme legal uncertainty and a failure to apply regulations. The direct consequence is a weak and undersized airport system, characterised by unfair competition.
Reorganisation of the entire sector according to a transparent and unitary legislative framework is therefore indispensable. If carried out in an appropriate fashion, completing privatisation of airport operators, regularising the issue of airport concessions and time band management and providing appropriate control mechanisms and sanction procedures, reorganisation could significantly improve competition and the quality of the services offered.
The aim of an effective regulatory policy – ever more complex, given that the sector includes both companies operating competitively and companies operating as monopolies – is to avoid unfair competition between the airlines using the airport or between the airports themselves. This aspect is important as numerous airport operators now offer packages in support of the development of new air links, including incentives to airlines, discounts on handling charges and subsidies for promotional campaigns or marketing initiatives which in many cases are financed by regional tourist promotion funds. Competition between airports is also a war between regions, landscapes and places.
This is why a clear and transparent system regulating the relationship between carriers and airports (in part initiated with law number 248/2005[7]) should improve efficiency throughout the sector's entire production chain.
The first step in this change is the project, still in the study phase, to reform air transportation in Italy. Initiated in December 2006 by a Council of Ministers' bill, the programme provides on the one hand for definition of a national airports plan to guarantee orderly coordinated development of Italy's airport system which "*is today in fragile conditions*"[8], and on the other, for regulation of control systems, airport concession issue and management of time bands and airspace.
Planning at national level, particularly as part of a general transport programme, would allow development of the system to be rationalised and the "airport urbanism" generated by the airport infrastructure to be calibrated.
The strategy identified involves firstly "*classification of the airports with attribution to each of national, regional or local value and associated functional*

On right, the minor airports in Italy.
Source data: ENAC, 2010.
Map by Laura Cipriani.


secondary airports
0
100
200
300
400
500
600
700
800
900
1000 Km

specialisation"[9] in order to clarify the vocation of each airport (scheduled passenger, low-cost, charter, cargo)[10]. Secondly, it proposes "*incentivising creation of co-ordinated airport systems in order to guarantee a more rational and efficient distribution of air traffic flows.*"[11] The aim is to promote regional airport systems or systems with contiguous traffic basins in order to maximise the systemic effect of the airports while avoiding damaging competition dynamics.

The text focuses particular attention on the local area. The proposed strategy sets out to achieve a balance between the economic liberalism governing the forces of air mobility and urban-infrastructural organisation. While the free market has been the dominant factor in decision-making on routes and airports during recent years, today, a posteriori, the State is claiming a predominant role in the strategic development choices of Italy's airports.

Market, competition and transport exert a determining force on forming space. The only possible way ahead must necessarily oscillate between the two opposing forces (local area and market) to achieve as far as possible that *aurea mediocritas* of Latin memory. Flexible, dynamic, multi-layer planning at various administrative levels is the only possible way to obtain harmonious regional development as the forces of air transportation vary. The phenomena must not be demonised or opposed, but on the contrary guided and incentivised within a clear planning framework or flexible alternative scenarios.

NOTES

1 Data from the Assaeroporti website (www.assaeroporti.it).

2 Council of Ministers 1993, 'Legge n. 537 del 24 dicembre 1993. Interventi correttivi di finanza pubblica' (Law no. 537 of 24 December 1993. Public Finance Corrective Measures, in Italian), *Gazzetta Ufficiale*, no. 303, Ordinary Supplement no. 121, 28 December.

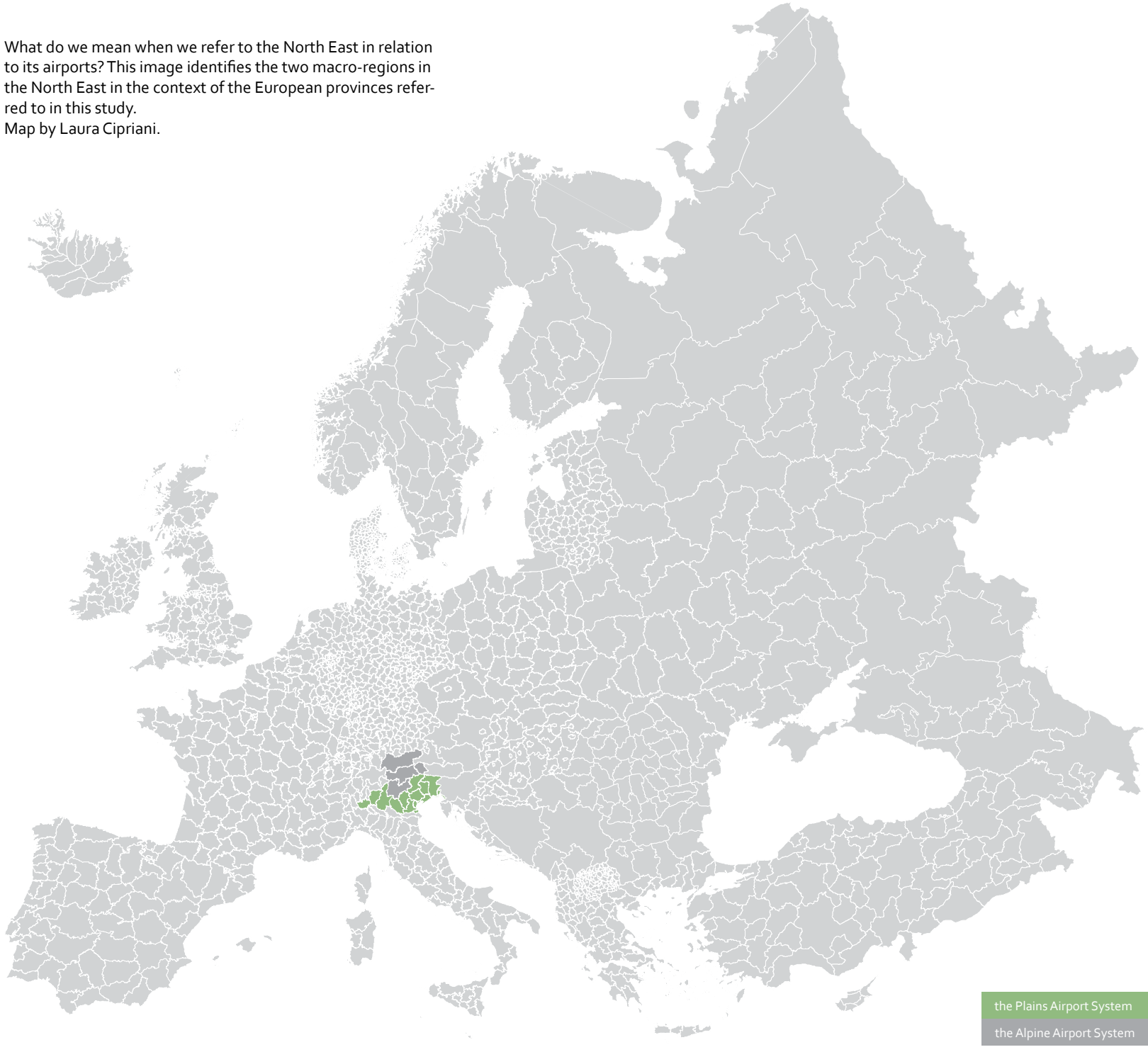
3 Council of Ministers 1995, 'Legge n. 351 del 3 agosto 1995. Conversione in legge, con modificazioni, del decreto-legge 28 giugno 1995, n. 251, recante disposizioni urgenti in materia di gestioni aeroportuali, di trasporti eccezionali e di veicoli adibiti a servizi di emergenza' (Law no. 351 of 3 August 1995. Ratification with amendments of decree-law no. 251 of 28 June 1995 containing urgent provisions on the management of airports, exceptional transport and emergency vehicles, in Italian), *Gazzetta Ufficiale*, no. 197, 24 August.

4 The total of past and present investments during the last twenty years in Italy does not exceed

€2 billion, considerably less than that programmed by other European countries.
5 Ministry of Infrastructure and Transport 2000, 'Delibera CIPE, n. 86 del 4 agosto 2000. Schema di riordino della tariffazione dei servizi aeroportuali offerti in regime di esclusiva' (Interministerial Committee for Economic Planning Resolution no. 86 of 4 August 2000. Scheme for the reorganisation of tariffs for exclusive airport services, in Italian), *Gazzetta Ufficiale*, no. 225, 26 September.
6 Over and above the responsibilities attributable to the legislature, the process of liberalisation is also slowed down and obstructed by a number of airport operators. The role of coordinating the activities of the various subjects in the airports, assigned by the new legislation directly to the operators, in fact encourages obstructionist attitudes, against which there is no incisive ENAC vigilance.
Finally, the Social Protection Clause of this legislation is also a further impediment to full liberalisation of the sector. This clause makes it obligatory to employ the previous operator's personnel during the 30 months following entry into force of the decree, thus representing a disincentive to the entry of new operators in the handling market.
7 The new regulation (known as "System Requirements") simplifies the previous regulations and introduces penalisation mechanisms. Simplification is fundamental as the contracts between airports and ENAC provided for by CIPE resolution 86/2000 on airport fees have been ineffectual as a result of the technical difficulties caused by the excessive complexity of the regulation.
See: Council of Ministers 2005, 'Legge n. 248 del 2 dicembre 2005. Conversione in legge, con modificazioni, del decreto-legge 30 settembre 2005, n. 203, recante misure di contrasto all'evasione fiscale e disposizioni urgenti in materia tributaria e finanziaria' (Law no. 248 of 2 December 2005. Ratification with amendments of decree-law no. 203 of 30 September 2005 containing measures to oppose tax evasion and urgent fiscal and financial provisions, in Italian), *Gazzetta Ufficiale*, no. 281, Ordinary Supplement no. 195, 2 December.
8 Council of Ministers 2006, *Atto di indirizzo per la riforma del trasporto aereo nazionale* (Guideline for reform of national air transportation), 12 December, p. 1.
9 Council of Ministers 2006, *Atto di indirizzo per la riforma del trasporto aereo nazionale* (Guideline for reform of national air transportation), 12 December, p. 3.
10 The concessionary tool could be used to divide the "vocations" of the various airports within the Italian national airport system. The competition procedures for privatisation of the airport operators could on the other hand represent an opportunity to introduce a number of constraints with the aim of promoting regional airport systems or contiguous traffic basins.
11 Ibid.

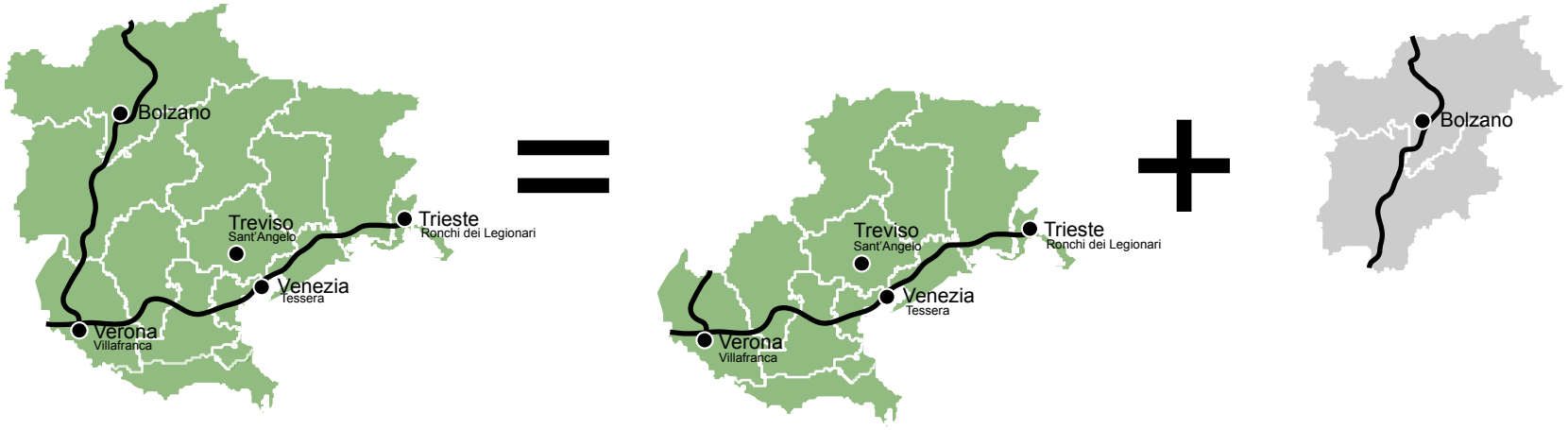

TO WHAT AREA DOES THE NORTH EAST
AIRPORT SYSTEM CORRESPOND?

What do we mean when we refer to the North East in relation to its airports? This image identifies the two macro-regions in the North East in the context of the European provinces referred to in this study.
Map by Laura Cipriani.



TO WHAT AREA DOES THE NORTH EAST AIRPORT SYSTEM CORRESPOND?

What image do people have of the geographical location and boundaries of the North East?
For the purposes of this study, the North East airport system is defined in relation to the landscape and includes an area more or less corresponding to the regions of Veneto, Trentino-Alto Adige and Friuli-Venezia Giulia, together with a number of neighbouring Italian and European provinces, creating a "multiple airport system" in which the airports served by the air transportation service depend on their geographical location rather than on exclusively political-administrative control.
When working with the territory, it is not possible to take an established boundary as a reference. In this study, I therefore tried to schematically reduce the two North East airport systems: on one hand the Plains Airport System consisting of a series of main airports linked by the A4 motorway and rail lines, on the other the Alpine Airport System linked by the A22 motorway and extending beyond the Italian frontier. Although schematic, this subdivision is based on the awareness that on the one hand, the respective catchment areas of the main airports are in close relationship with the road and rail infrastructure systems and that, on the other, the physical configuration of the land on which the airports stand and on which air operations depend (one on the plains, one in the mountains) are radically different and as such require specific treatment.
After describing the specific characteristics of the Italian airport system, a sort of reference atlas of the main airports in the area was drawn up, defining the problems and potentials of the airports concerned and concluding with the proposal of possible short and long term land transformation scenarios on local and interregional scale.
More than other areas in Italy, the economic organisation of the North East is characterised by a demand for long distance, highly flexible mobility, fragmented



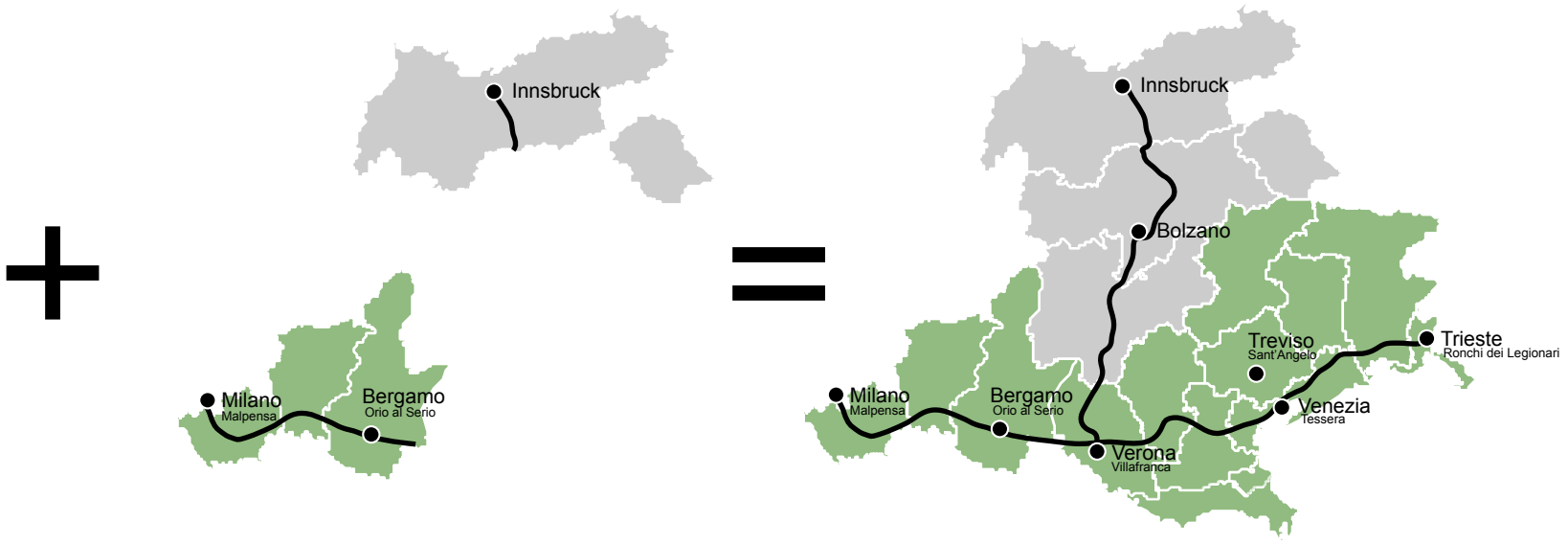
The North East and associated airport-regional systems. The system corresponding to the Alpine Area along the A22 motorway is shown in grey. The system corresponding to the Plains Area along the A4 motorway is shown in green.
Map by Laura Cipriani.

in both origin and destination. In recent decades internationalisation of the economic system and delocalisation of production activities have intensified, without corresponding development of an adequate long distance transport system.

In this area, there are in fact numerous airports at different levels, from the main airport centres of Venice-Tessera and Verona through the airports of Treviso, Bolzano, Trento and Ronchi dei Legionari to a myriad of airfields covering almost the entire area. They are still not, however, organised according to a coherent plan on first national, then interregional level.

For many years, the lack of specific airport infrastructure plans made a long term vision impossible, creating a state of permanent uncertainty not just concerning airports, airport operators, airlines, local authorities and financers, but above all in the local area from a landscape, environmental and urban point of view.

The lack of vast scale planning has fuelled risky competition among airports,



often translating into fierce antagonism between cities and regions.
Geographical and socio-economic characteristics, inadequate regulatory provisions and a fragmented offer are just some of the elements peculiar to the Italian aviation sector. State action is contradictory. On one hand it is absent and unable to provide continuity and regulatory uniformity, on the other, it is the preponderant protagonist in pervasive but often unsuitable public action.
Constitution of an airports network, efficient both in terms of the use of scarce resources (land, airspace, etc.) and in the provision of services (to ensure that the development of one airport does not damage that of another), calls for the creation of complementary, rather than competitive, functional links.
A series of considerations must also be made regarding the environmental systems in relation to the main airports in the North East. It is significant to note that many airports currently defined as first level stand on delicate environmental systems near watercourses and in areas of widespread urban development.

THE PLAINS AIRPORT SYSTEM

PROVINCES	MILAN	BRESCIA	BERGAMO	VERONA	VICENZA	PADUA
AREA km²	1,578	4,784	2,722	3,120	2,725	2,141
						
POPULATION inhabitants Source data: ISTAT, 2010	3,156,694	1,256,025	1,098,740	920,158	870,740	934,216
						
MAIN AIRPORTS	Malpensa Linate		Orio al serio	Villafranca		
						
SECONDARY AIRPORTS	Bresso		Valbrembo	Boscomantico	Asiago Thiene Vicenza	Padova
						
AIRFIELDS I HELIPORTS Source data: ENAC, 2011	5 | 18	7 | 4	0 | 5	2 | 5	4 | 8	8 | 3

ROVIGO	TREVISO	VENICE	BELLUNO	PORDENONE	UDINE	GORIZIA	TRIESTE
1,790	2,476	2,466	3,678	2,273	4,904	466	212
							
247,884	888,249	863,133	213,474	315,323	541,522	142,407	236,566
							
	Sant'Angelo	Marco Polo					Ronchi dei Legionari
							
		San Nicolò	Belluno		Udine	Gorizia	
							
1|2	5|5	7|7	3|14	3|1	6|3	0|3	0|1

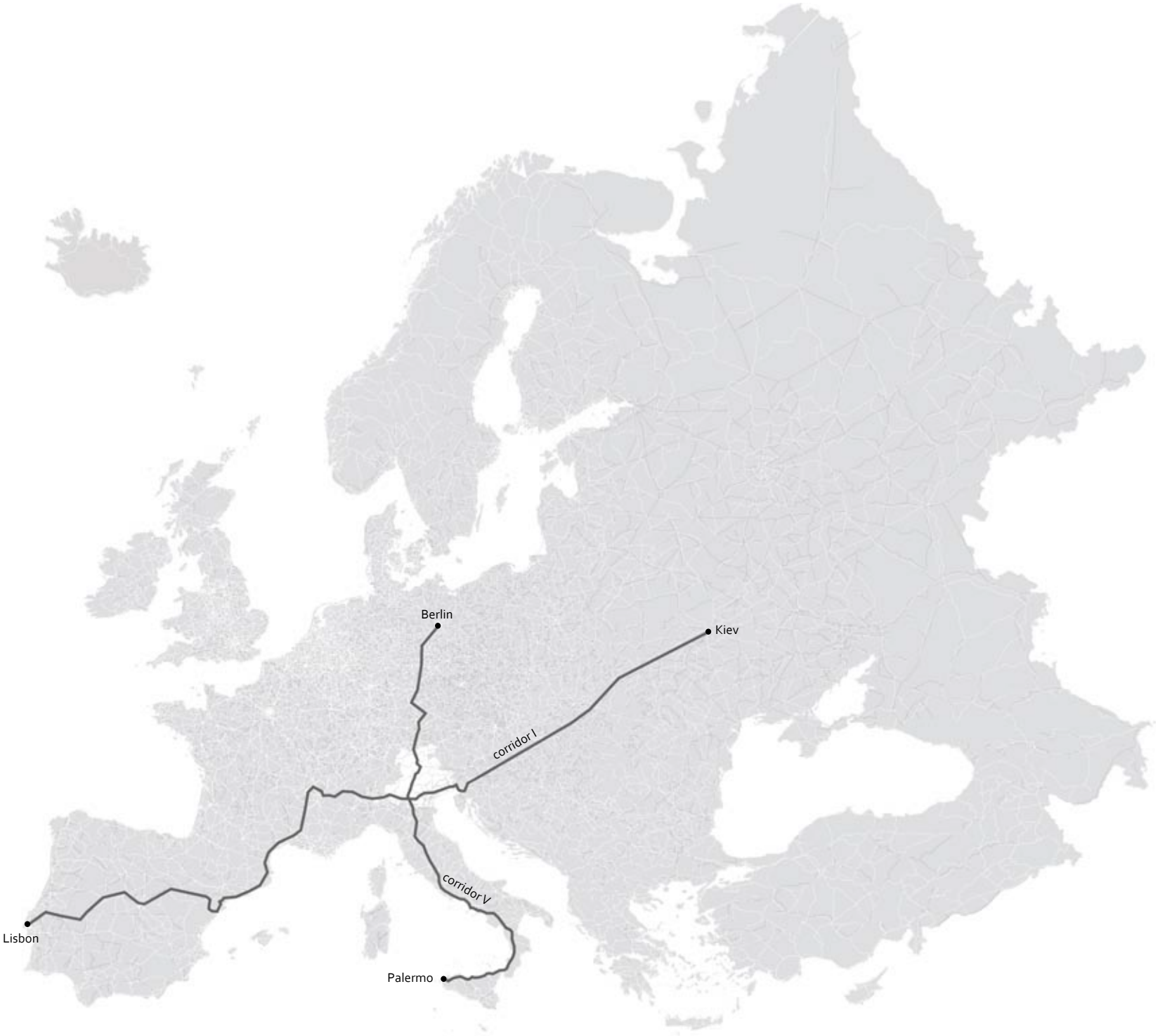
THE ALPINE AIRPORT SYSTEM

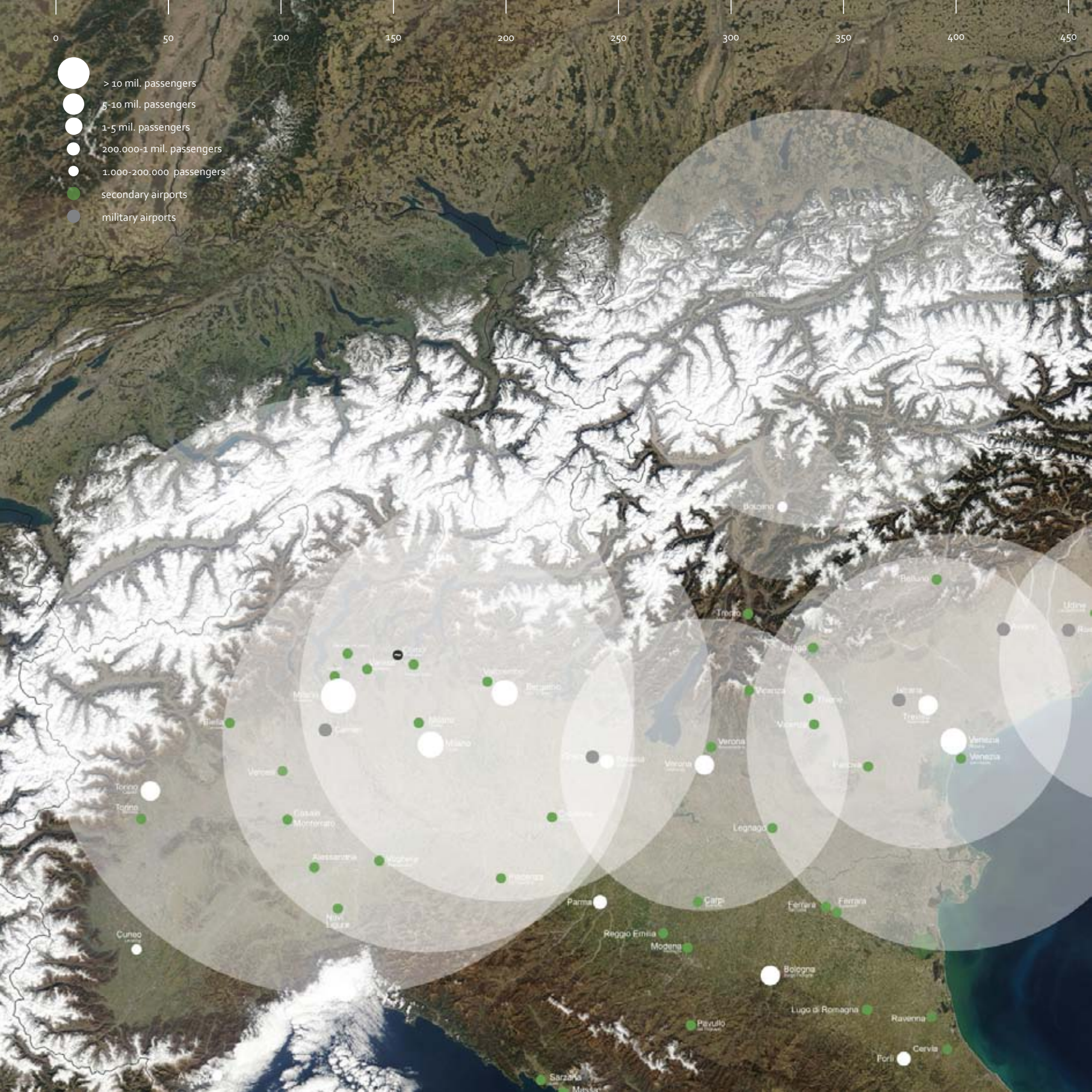
PROVINCES	TRENTO	BOLZANO	TIROLO	VERONA
AREA km²	6,206	7,399	12,640	3,120
POPULATION inhabitants	529,457	507,657	710,048*	920,158
MAIN AIRPORTS		Bolzano	Innsbruck	Villafranca
SECONDARY AIRPORTS	Mattarello			3.100.000
AIRFIELDS I HELIPORTS	0 | 11	3 | 25	n.p. | —	2 | 5

Source data: ISTAT, 2010;
* Landesstatistik Tirol Einwohnererhebung It. ZMR, 2010

Source data: ENAC, 2011

The two trans-European transport corridors that cross the Italian North East. Map by Laura Cipriani.



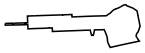
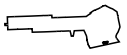
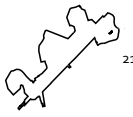
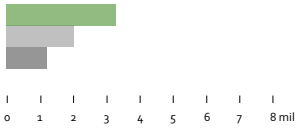
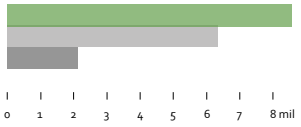

0
50
100
150
200
250
300
350
400
450
> 10 mil. passengers
5-10 mil. passengers
1-5 mil. passengers
200.000-1 mil. passengers
1.000-200.000 passengers
secondary airports
military airports
Bolzano
Trento
Belluno
Udine
Milano
Bergamo
Verona
Venezia
Torino
Cuneo
Parma
Reggio Emilia
Modena
Bologna
Ferrara
Lugo di Romagna
Ravenna
Cervia
Forlì
Pievulo
Legnago
Sarzana

Considering Veneto, Friuli, and Trentino Alto Adige Regions, in the north east 3 main airports (Venice, Treviso, and Trieste) and 5 secondary airports (Belluno, Vicenza, Verona Boscomantico, Udine Campoformido, Gorizia) are located next to Special Conservation Areas (SACs) and Special Protection Areas (SPAs). Although it is evident that Venice-Tessera is today preparing to become the first intermodal node in the North East mobility network along the Trans-Europe Corridor V, it is necessary to look beyond contingent issues to propose long term scenarios for the future.

The inevitable growth of air transportation, probable airport congestion and emerging conflict with local communities therefore necessitate an in-depth study to promote a series of alternative scenarios and precise measures for short term and above all long term environmental mitigation.

Left, main airports catchment areas.
Source data: ENAC, 2010. Map by Laura Cipriani.

MAIN AIRPORTS

	AIRPORT AREA hectars (Ha)	RUNWAY LENGHT meters (m)	TERMINAL square meters (m²)	PASSENGER NUMBER millions (mil)
BOLZANO	 78 Ha	 1.297 m	 800 m²	
TRIESTE	 247 Ha	 3.000 m	 23.565 m²	
TREVISO	 147 Ha	 2.459 m	 11.500 m²	
VERONA	 371 Ha	 3.067 m	 21.750 m²	
VENICE	 335 Ha	 2.780 m 3.300 m	 53.000 m²	

0 1 2 3 4 5 6 7 8 mil

total number of passengers
international passengers
national passengers
city

CARGO

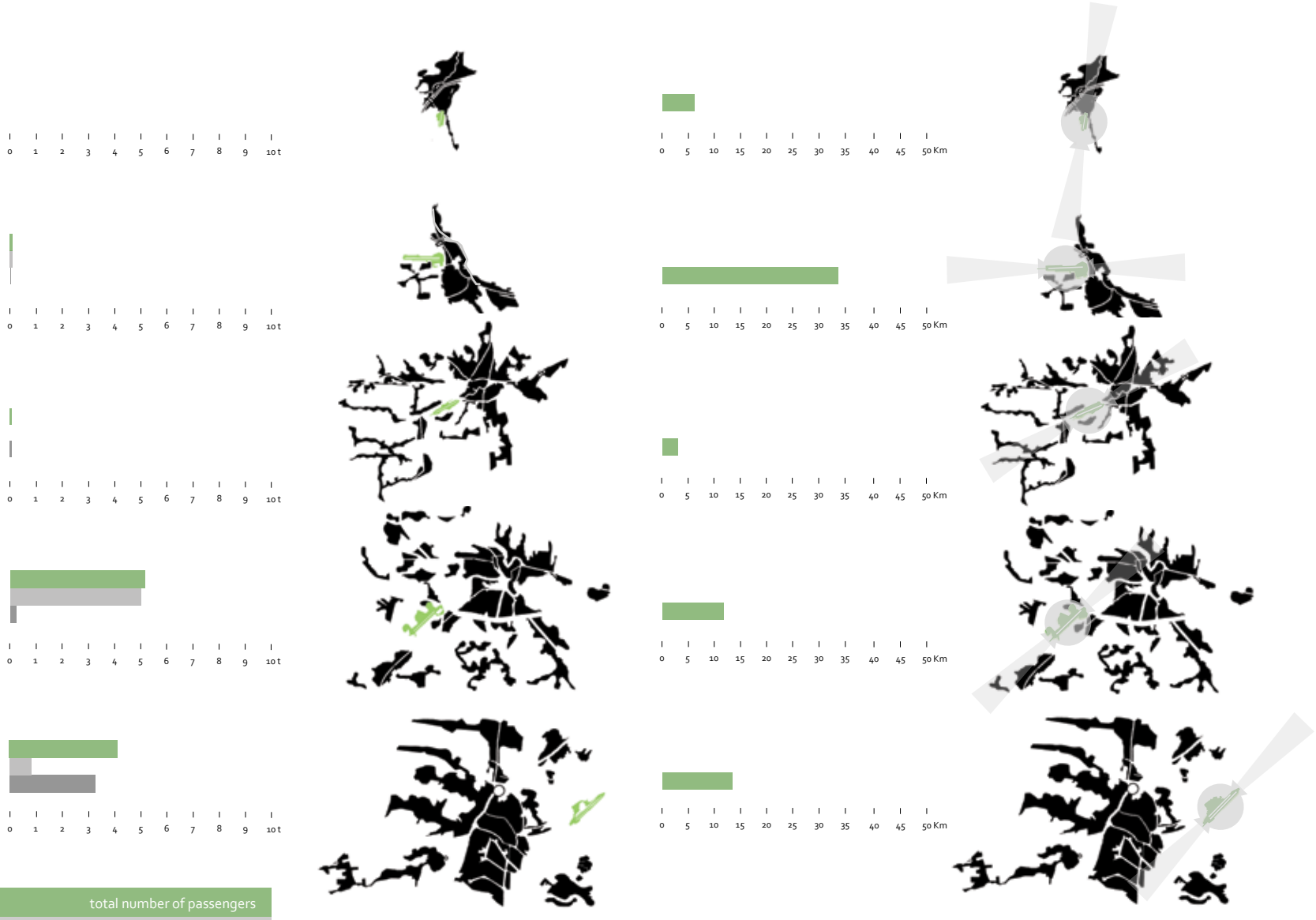
x 10.000 tons (t)

AIRPORT & CITY

DISTANCE OF THE AIRPORT FROM THE CITY

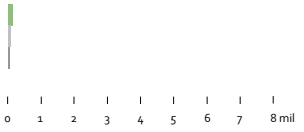
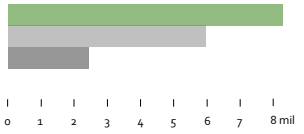
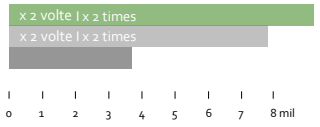
kilometers (Km)

TAKEOFF-LANDING AREA



Source data: Assaeroporti, 2011; ENAC, 2010.
Diagrams by Laura Cipriani.

MAIN RELATED AIRPORTS

	AIRPORT AREA hectars (Ha)	RUNWAY LENGHT meters (m)	TERMINAL square meters (m²)	PASSENGER NUMBER millions (mil)
INNSBRUCK	 280 Ha	 2.000 m	 - mq	
BRESCIA	 350 Ha	 2.990 m	 7.250 mq	
BERGAMO	 296 Ha	 3.024 m 778 m	 34.150 mq	
MILAN LINATE	 400 Ha	 2.442 m 600 m	 76.300 mq	
MILAN MALPENSA	 1.235 Ha	 3.920 m 3.920 m	 288.465 mq	

0 1 2 3 4 5 6 7 8 mil

international passengers

national passengers

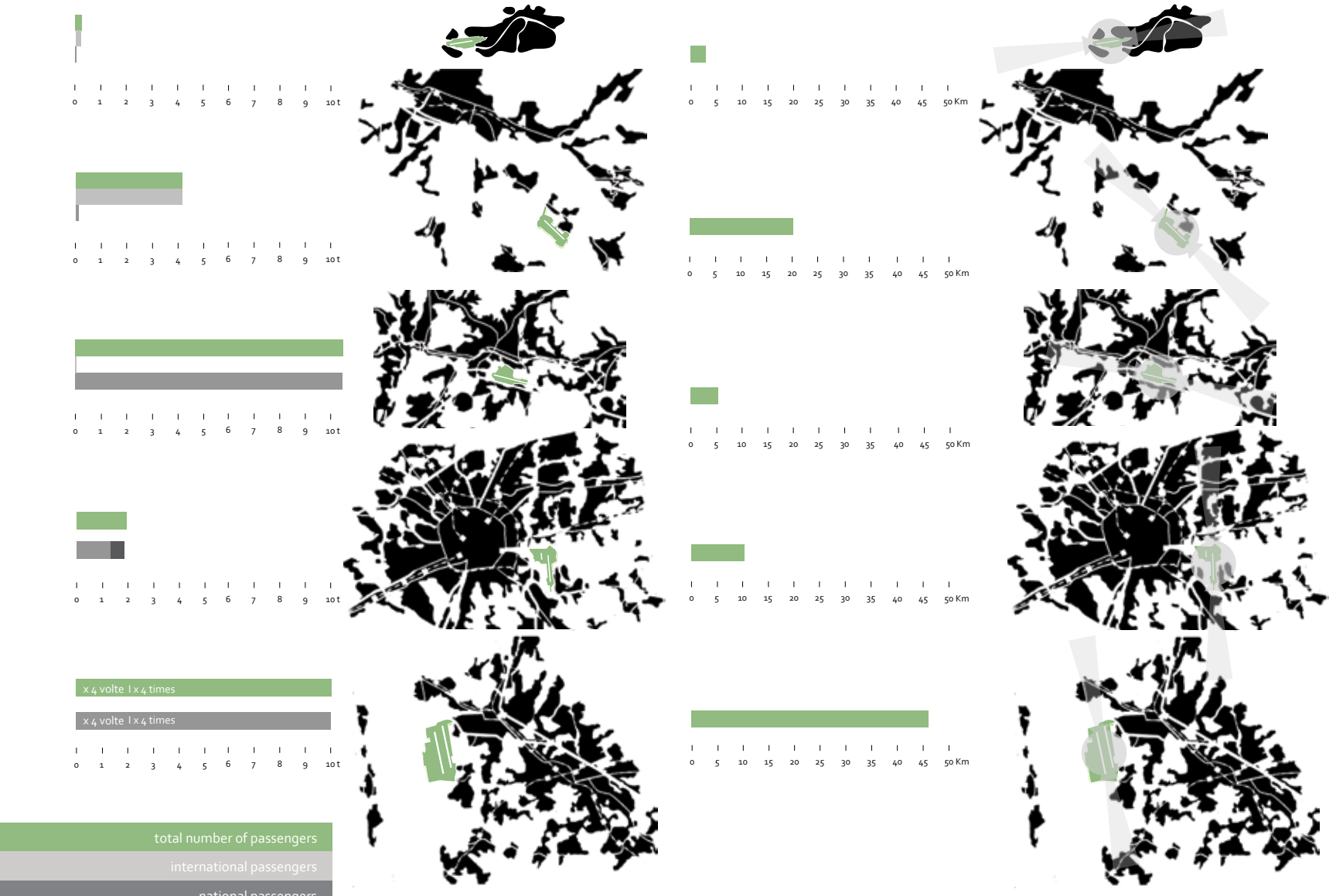
city

CARGO
x 10.000 tons (t)

AIRPORT & CITY

DISTANCE OF THE AIRPORT FROM THE CITY
kilometers (Km)

TAKEOFF-LANDING AREA



Source data: Assaeroporti, 2011; ENAC, 2010.
Diagrams by Laura Cipriani.

“

MANY ITALIAN AIRPORTS STAND ON DELICATE ENVIRONMENTAL SYSTEMS NEAR WATERCOURSES AND IN AREAS OF WIDESPREAD URBAN DEVELOPMENT.

CONSIDERING VENETO, FRIULI, AND TRENTINO ALTO ADIGE REGIONS, IN THE NORTH EAST 3 MAIN AIRPORTS AND 5 SECONDARY AIRPORTS ARE LOCATED NEXT TO SPECIAL CONSERVATION AREAS (SACs) AND SPECIAL PROTECTION AREAS (SPAs).

”

On right, Special Conservation Areas (SACs), Special Protection Areas (SPAs) and Italian airports. Source data: ENAC, 2010; Italian Ministery for Environment, 2010.
Map by Laura Cipriani.


main airports over 1 million passengers
secondary and military airports
SACs and SPAs
0
100
200
300
400
500
600
700
800
900
1000 Km


VENICE AIRPORT

Aerial view of Venice airport. Photographs by Brian Robbins.

VENICE AIRPORT
THE ROLE OF THE AIRPORT: STUDIES AND FUTURE SCENARIOS

In common with many other Italian and European airports, Venice-Tessera airport is at the centre of fierce debate: on the one hand, the demand to expand the airport and develop neighbouring areas; on the other, the need to protect the delicate environmental system on which the infrastructure stands.
There can be no doubt that airports are today playing an ever more important role in the development of cities and metropolitan contexts. Airport infrastructure is not just a catalyst for urban growth in the immediate vicinity directly involved in the transformation process, it often also generates future metropolitan expansion.
Infrastructure on this scale benefits society as a whole and generates socio-economic benefits for the region, but the environmental effects are a particularly heavy burden on the communities directly involved.
According to Eurocontrol, the expansion of 60% of European airports is limited by planning and environmental constraints. This is destined to rise to 80% during the next five years (Eurocontrol, 2004) given that air movements in Europe will reach a figure of more than 11 million by 2016 and about 15-19 million in 2025 (Eurocontrol 2010). The studies carried out clearly demonstrate that the main airports in the North East are also located in an area with widespread urbanisation and often near delicate environmental systems.
The effects of climate change on air transportation and the airports themselves must be added to the scenario of a growth in air transportation and consequent increase in local environmental conflict.
Experts agree that climate change is already occurring with dynamics which are now irreversible. According to a study carried out by Eurocontrol in 2009 (Eurocontrol, 2010) numerous effects will have consequences for aviation, the demand for air transportation and airports themselves.
In the long term, the rise in sea level could affect many European airports

Aerial view of Venice airport. Photograph by Rui Sousa.

located along the coast. An increase in extreme weather events could have repercussions on the capacity, punctuality and flexibility of the European airports network in the short and medium term. The rise in temperature in a number of tourist resorts could reach extreme levels, modifying the seasonal demand and consequently the configuration of airport space and relative demand for infrastructure. The rise in temperature could also have repercussions on the operational performance of the aircraft, for example, necessitating longer takeoff and landing runways or, alternatively, smaller sized aircraft able to operate from a runway of a given length. Extreme weather events such as winter storms, turbulence, wind-fog and volcano ash could even cause a change in the network distribution of airports, in favour of, for example, a diffuse capillary network rather than a network concentrated on large traffic nodes.

Eurocontrol claims that at least 34 European airports are located along the coasts or on alluvial plains below sea level. Other airports have a runway built on artificial land or reclaimed land extending over the sea. The rise in sea level in the future could increase the demand from the airports concerned for effective mitigation measures to oppose this phenomenon.

Built in the early 1960s on land reclaimed from the Venice lagoon basin, in the near future, Venice airport must therefore make an informed decision which combines the need to satisfy the current growing demand for air transportation with the short, medium and long term environmental, landscape and urban issues.

Venice airport is in a privileged position among Italian airports. In 2011, it was the leading airport in North East Italy and the third in Italy for number of passengers with 8.5 million and in the next few years it will become an intermodal node for air, rail, water and road interchange.

Positioned along Corridor V (or the Mediterranean Corridor to give it its new Community name) in the Trans-European Transport Network (TEN-T) connecting Lisbon to Kiev, the airport plays a strategic role in Europe. The new 2014-2020 European programme in fact identifies Venice Marco Polo airport as one of the 37 airports in the central European transport network.

The recent "Feasibility Study of the Venice Marco Polo Airport Intermodal Node" co-funded by the European Commission as part of the TEN-T programme brings the proposals for the intermodal node together in a single

framework. According to a recently presented study, the air terminal and new underground railway station will be connected to a single transport system – the Regional Metropolitan Railway System from 2020, the HS/HC Venice-Trieste railway from 2030, the sub-lagoon metropolitan railway to Venice, water-based services across the lagoon and the new Mestre tram and road-based local public transport system. The entire complex will also be served by a people mover connecting the basin with the airport and interchange parking system.

According to a report presented by SAVE, the Master Plan for the intermodal node estimates that with completion of construction in 2030, 3.8 million passengers/year will use the HST; 6.6 million passengers/year will reach the airport by tram/sub-lagoon railway, regional metropolitan railway and high speed railway; 9.3 million passengers/year will be able to transit through the station heading for the various connected means of transport; 13 million passengers/year will be able to use the air terminal and a total of 19 million passengers/year will transit through the area heading for the various destinations covered by the intermodal node. The study estimates that the division between ways of arriving in the airport will gradually change over time, with a progressive increase in rail-based travel and consequent reduction in road-based travel. This is to be considered as a short-medium term measure, implemented in line with the Community's policy of preparing Europe's principal airports for full and complete intermodal operation.

The potential of infrastructural development of this importance involving both the airport and the intermodal node to act as a catalyst for urban growth in the future is evident. As demonstrated by the growing literature on the subject, an ever greater number of cities in Europe and the world have developed, and are continuing to develop, around airport infrastructure. The presence of an airport is without doubt a decisive factor in generating regional development. Genuine cities spring up and grow around airports according to the precise spatial development models referred to above (airport city, aerotropolis, airport corridor, airport region and airport metropolis).

With adoption of the Regional Framework Plan in 2009, the Veneto Region began a season of urban and regional planning aimed at defining a series of strategic projects, including one entitled "Airport Citadels" as provided for by article 40 of the Plan's Technical Regulations. For Marco Polo international

airport, the plan envisages reinforcing its role through appropriate development of infrastructure and services and adequate integration with regional transport systems. Treviso Airport is considered as necessary to complete the Venice airport system and as such is included in an organic and unified development programme, together with Marco Polo.

As an intermodal infrastructure node, Venice airport will thus assume a strategic role in the North East network, but also in the Italian national airport context, as indicated by the National Plan (not yet approved) and at Community and international level as part of the new Trans-European transport network.

A project of this scale, located moreover in an ecologically sensitive environment near built-up areas, must take the complexity of the urban, landscape and environmental issues it raises into consideration.

Knowledge of the equal-loudness contours, landing and takeoff cones, obstacle plan, bird impact, soil permeability, flood risk map, green areas system, sites of historical-archaeological interest, infrastructure systems and relative catchment basins is fundamental to understanding the delicate relationship linking the airport to the local and regional context. To this must be added a series of short and long term scenarios, as we will see in the next chapter.

1925 Nicelli Airport at San Nicolò al Lido was opened.

1958 The first stone was laid in the presence of the future Pope John XXIII, Angelo Roncalli.

1954 Seven projects were presented for the location of the new airport. From these, the project locating the airport on state-owned land on the Tessera salt marshes was chosen.

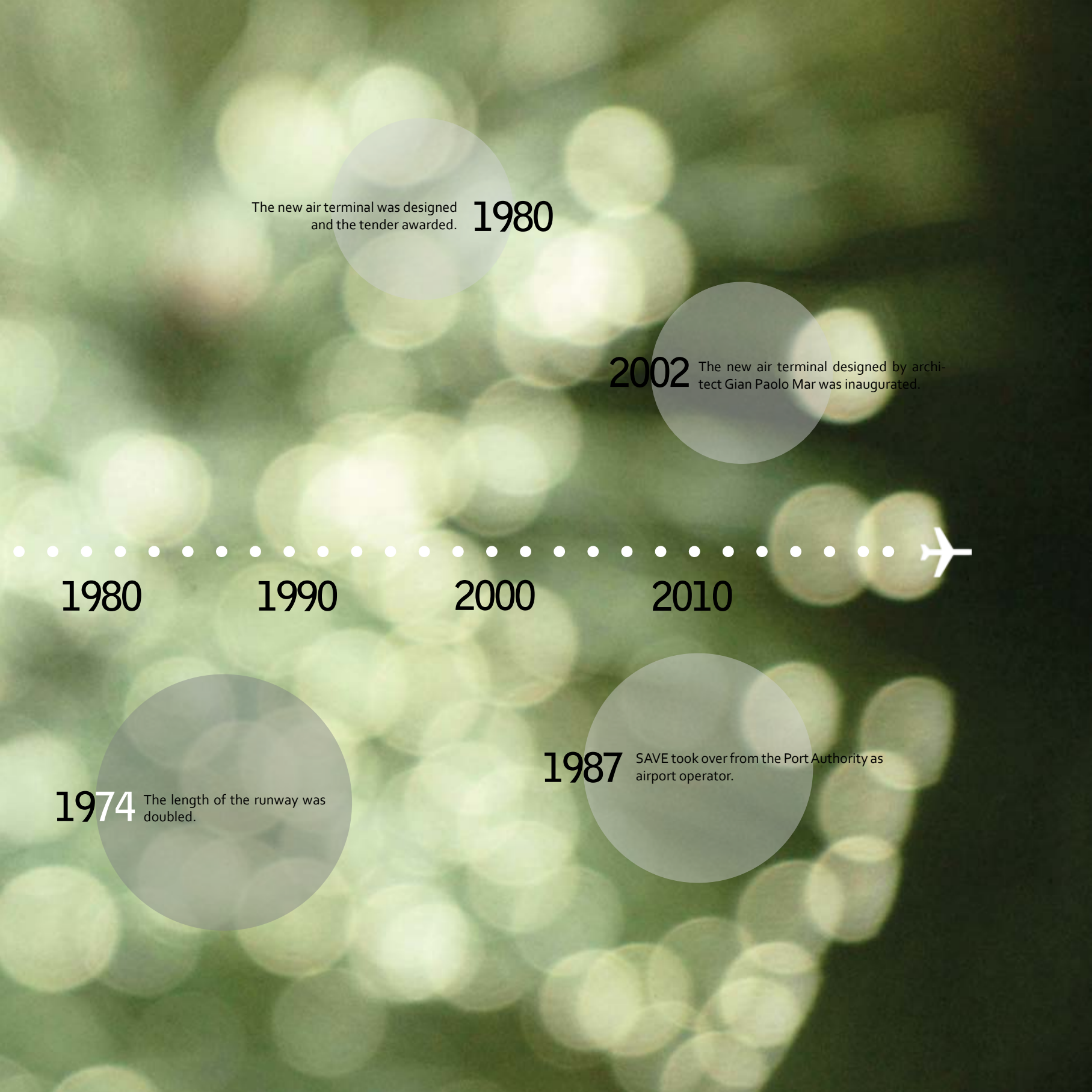
1960 1 August. Marco Polo airport was inaugurated with the first flight.

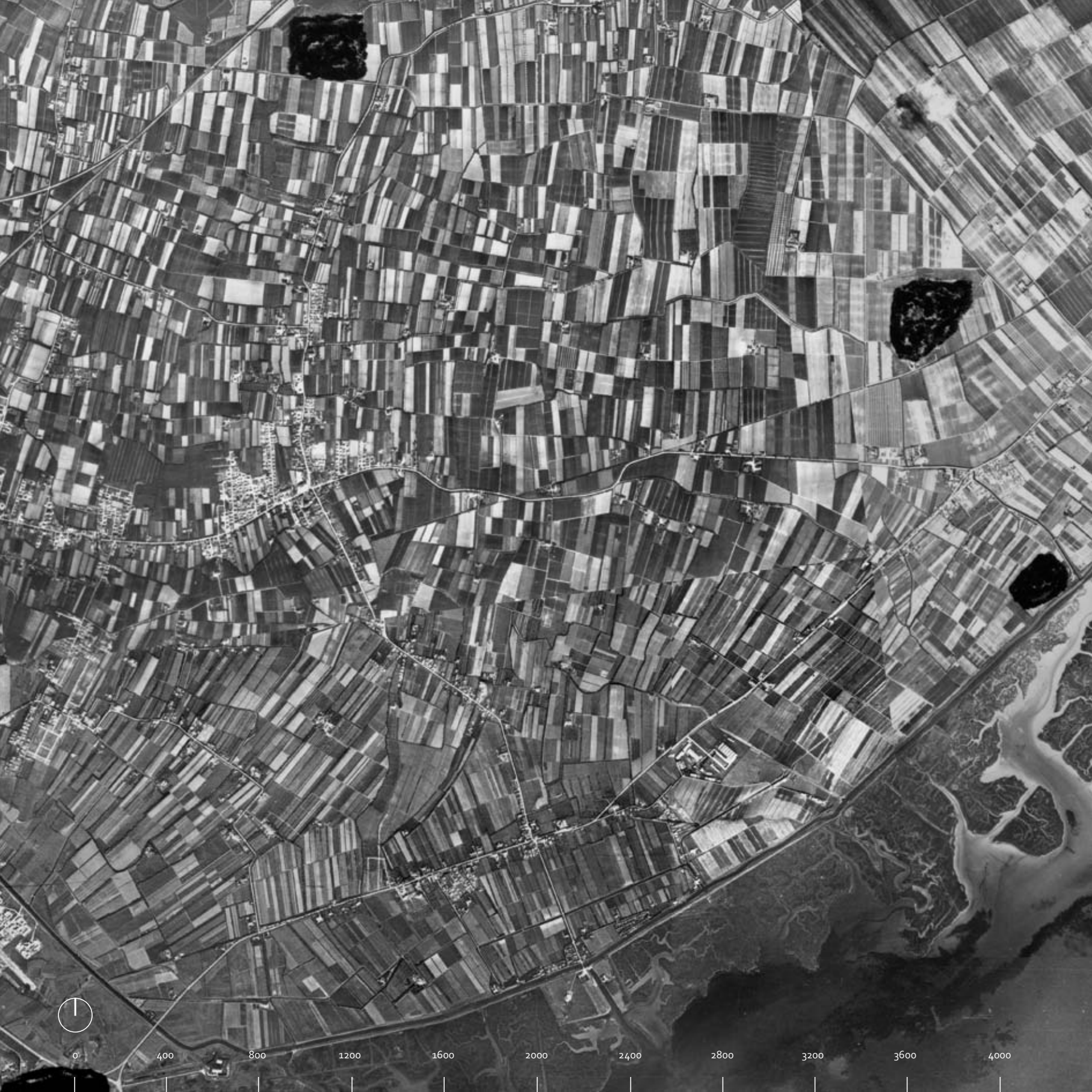
1930 1940 1950 1960 1970

1957 The final design for construction of the airport was presented to the Port Authority. The airport was designed by engineer Ascanio Pagello and architect Angelo Scattolin.

1950 The Venice Consortium for the Development of Air Communications expressed an opinion on construction of a new airport on the mainland as near as possible to Venice.

1958-60 A 1.5 km long area of land was reclaimed with a stone embankment protected by an artificial breakwater 2 m above sea level. Two hundred and fifty hectares of salt marsh were eliminated, a surface four times larger than originally intended.


The new air terminal was designed and the tender awarded.
1980
2002
The new air terminal designed by architect Gian Paolo Mar was inaugurated.
1980
1990
2000
2010
1974
The length of the runway was doubled.
1987
SAVE took over from the Port Authority as airport operator.


0
400
800
1200
1600
2000
2400
2800
3200
3600
4000

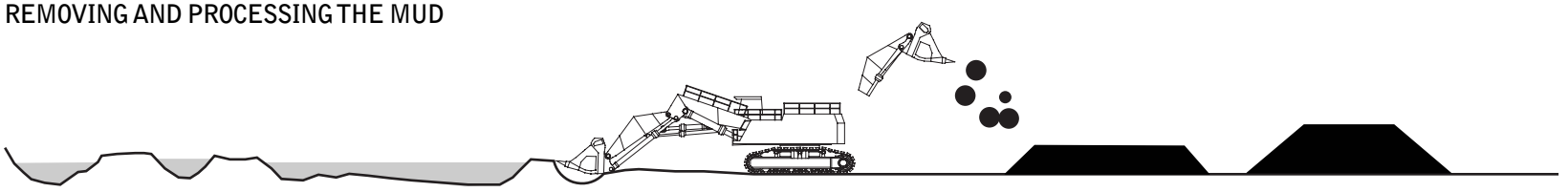
1954

Collage of historic photographs from 1954.
Source data: GAI flight, 1954-55. Photo collage by Laura Cipriani.

LANDSCAPE TRANSFORMATIONS

"*The corollary of historiclumpiness. Most major cultural change does not occur gradually, but instead in great sudden historic leaps, commonly provoked by such great events as wars, depressions, and major inventions. After these leaps, landscape is likely to look very different than it did before.*"[1]
According to Pierce Lewis in his famous article: "*Axioms for reading the landscape,*"[2] one of the fundamental axioms for reading the landscape considers the causes and modalities of the transformation of places.
Changes in the landscape are often induced by unexpected events. These may be historical events such as wars and conflicts, or technological innovations, such as for example the invention of air travel.
This proceeding by leaps and bounds, by instantaneous episodes, characterises the history of every airport.
Before the new Venice airport was built, the landscape was characterised by sandy lagoon land at a level of between -50 m and +30 m with respect to sea level. To construct the airport runway, it was decided to create a vast raised area 3 m above sea level, thus protecting "*runways and aprons from all risk of flooding which would otherwise cause certain damage to the infrastructure.*"[3]
Due to its high water content, the surface layer of land was dried and appropriately corrected with sand and stone coming from two quarries in the Treviso area, Porcellengo and Santa Bona, while the silty material was brought

REMOVING AND PROCESSING THE MUD



the lagoon salt marshes

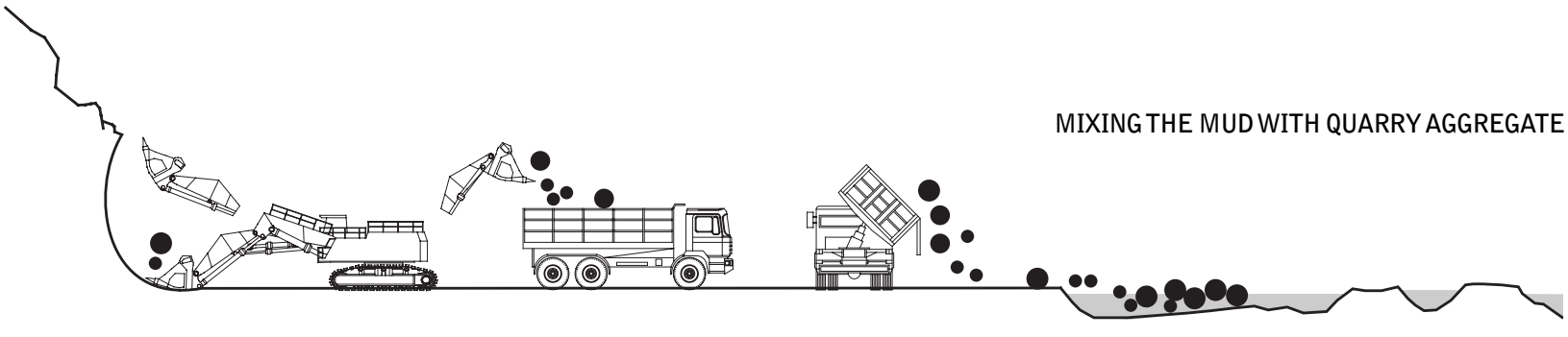
drying the mud

mixing the mud with aggregate

to a suitable moisture content and compaction. Official data place the volume of mud removed and treated at about 500,000 m^3. About 350,000 m^3 were removed and 150,000 m^3 were left on site, after suitable correction.
After an initial hypothesis according to which only suitably dried lagoon sand mixed with quarried material would be used, the idea was abandoned in favour of a raised area constructed entirely of quarried material to improve the technical characteristics.

NOTES

1 Lewis, P 1979, 'Axioms for reading the landscape. Some guides to the American scene', in Meinig, D, *The Interpretation of ordinary landscape*, Oxford University Press, Oxford. p. 23.
2 Ibid.
3 Toniolo, A & Bellotto, U 1963, *Aeroporto internazionale Marco Polo: relazione tecnica relativa al sedime, al rilevato, alle pavimentazioni*, Consorzio per lo sviluppo delle comunicazioni aeree delle Venezie Provveditorato al Porto di Venezia, (*Marco Polo International Airport: technical report on the airport area, survey findings, paving and flooring*, Consortium for the development of air communications in the Tre Venezie, Venice Port Authority), Venice, Arti Grafiche Gasparoni, p. 13.



MIXING THE MUD WITH QUARRY AGGREGATE

extraction of the aggregate from quarries in the Treviso area transport unloading on the airport site the lagoon salt marshes

LANDSCAPE TRANSFORMATIONS

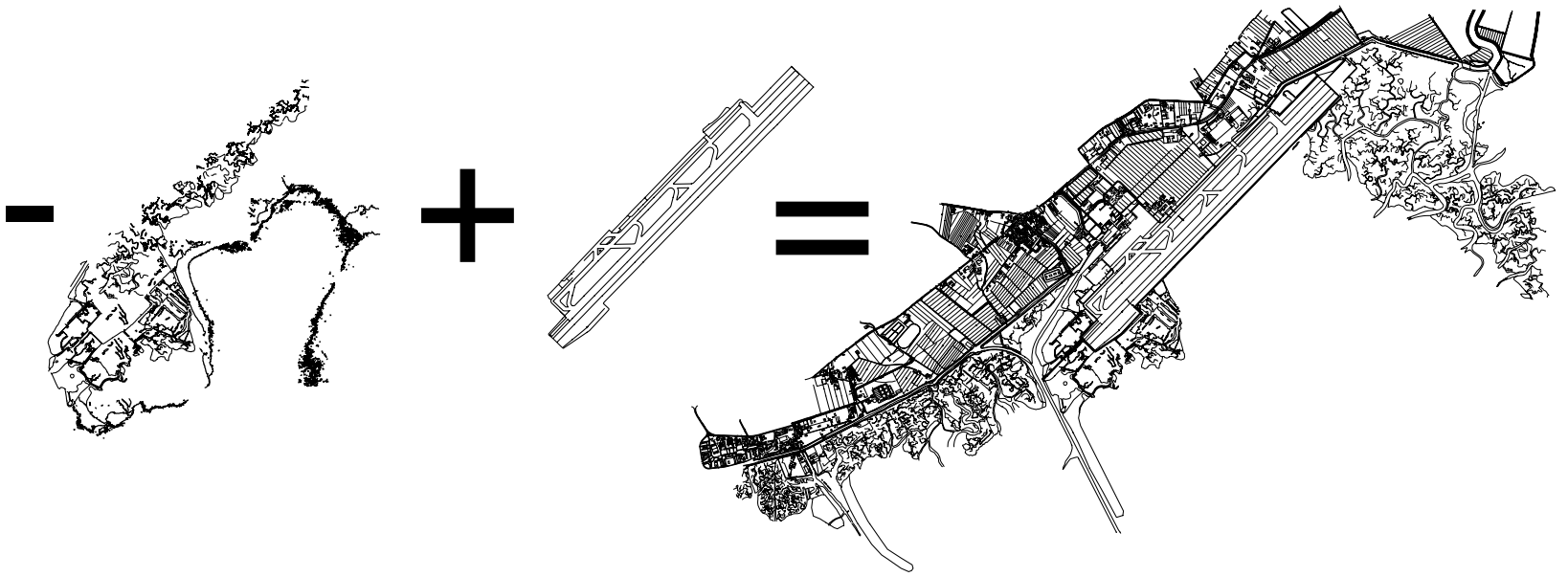
BEFORE...

+ the salt marshes in the natural state – lagoon land and salt marshes are at a height of between -50 and +30 m with respect to sea level

WATER

+ filling in of the Orsellin canal in correspondence to the canal between the flight paths and the mainland

The landscape before the construction of the airport (1954), the construction works (1954-55) and the airport today (2008).
Source data: GAI Flight, 1954-55; CTR, 2008. Maps by Laura Cipriani.



SALT MARSHES

+ removal of the surface layer in the salt marsh area

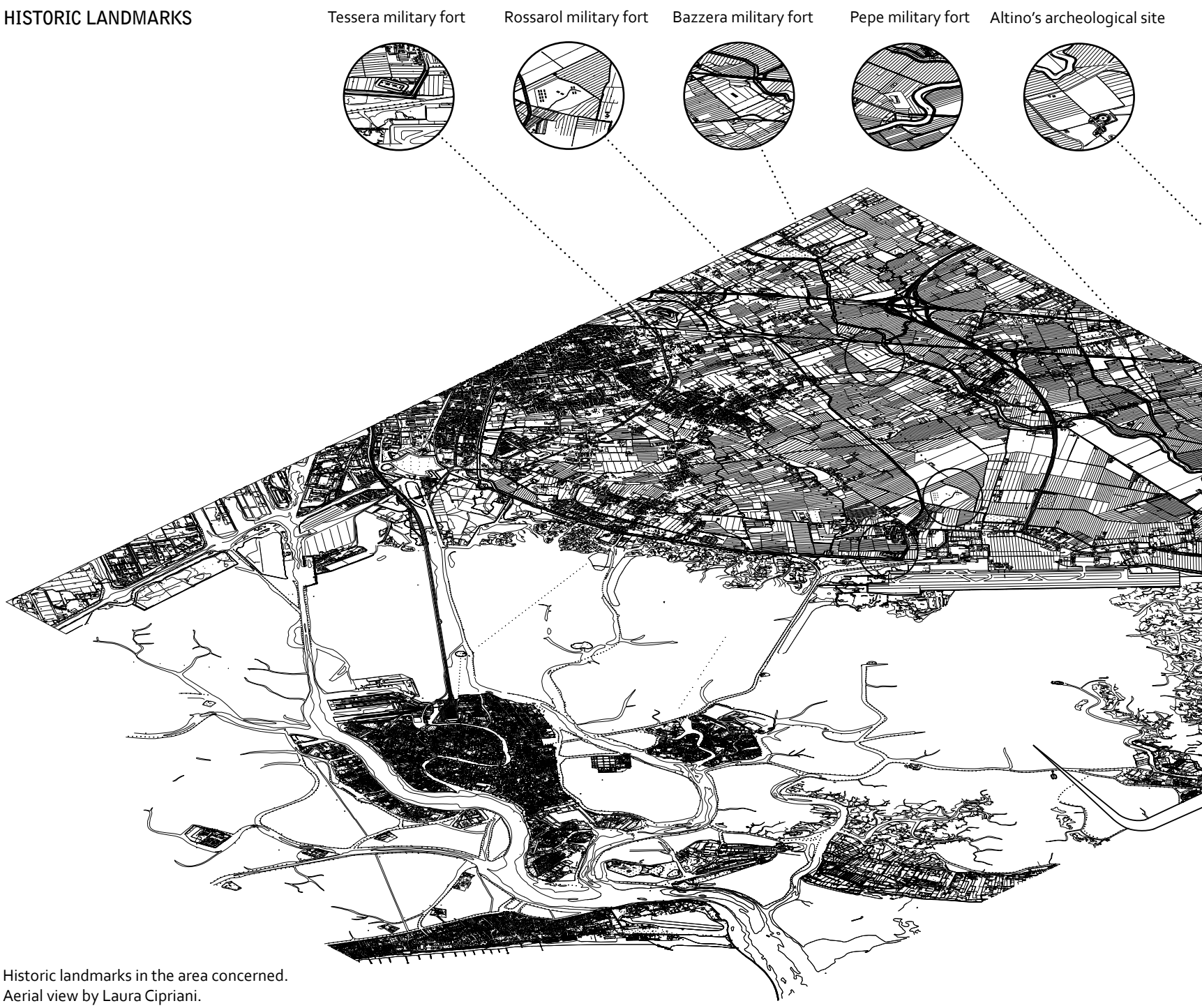
RUNWAY

+ construction of the raised area for the runway 3 m above sea level

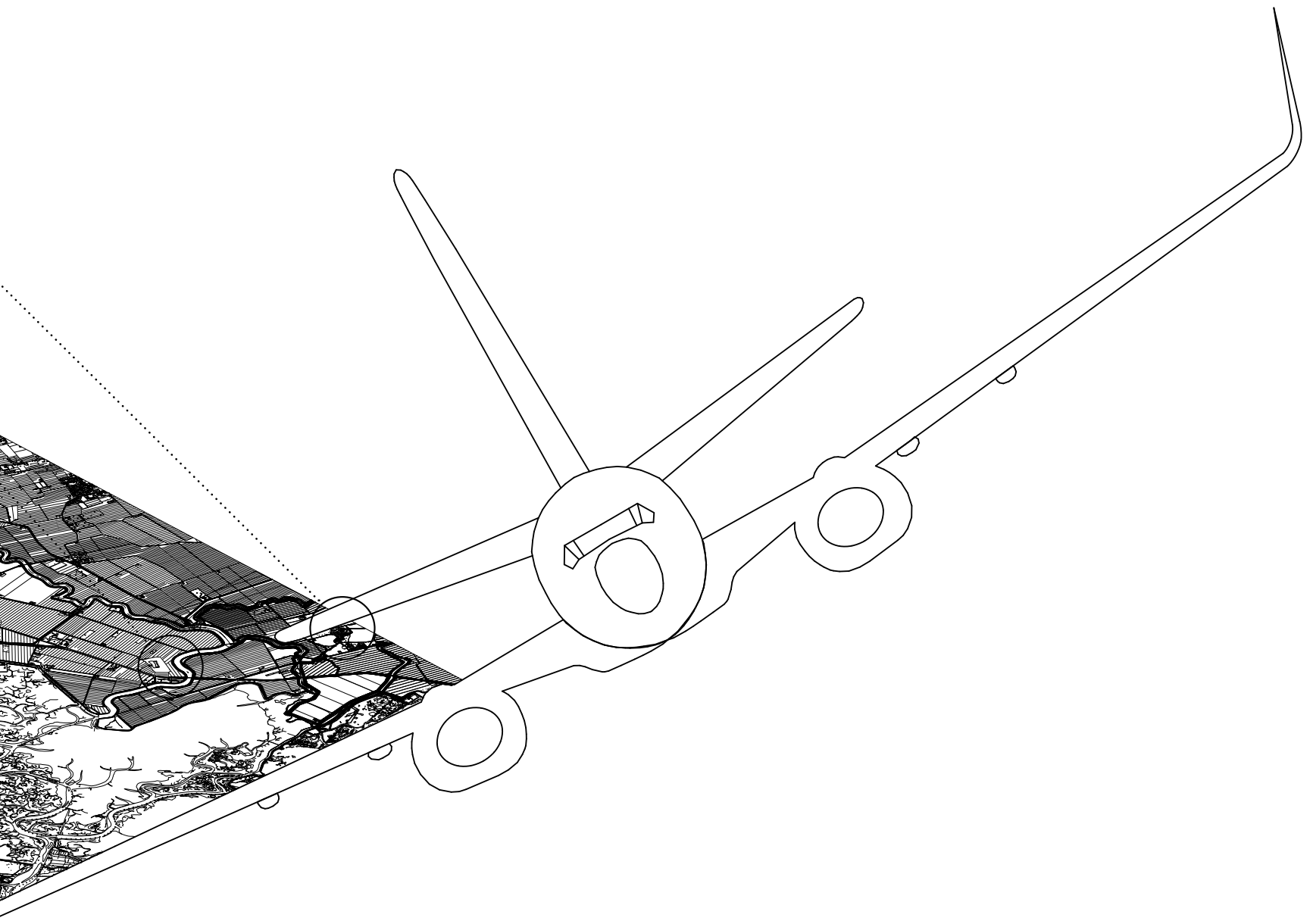
AFTER...

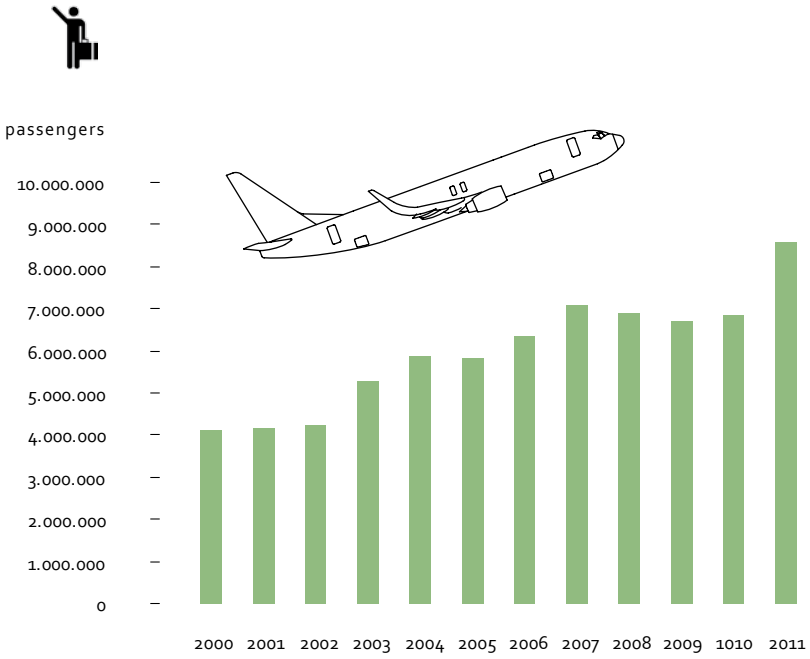
+ the airport site today

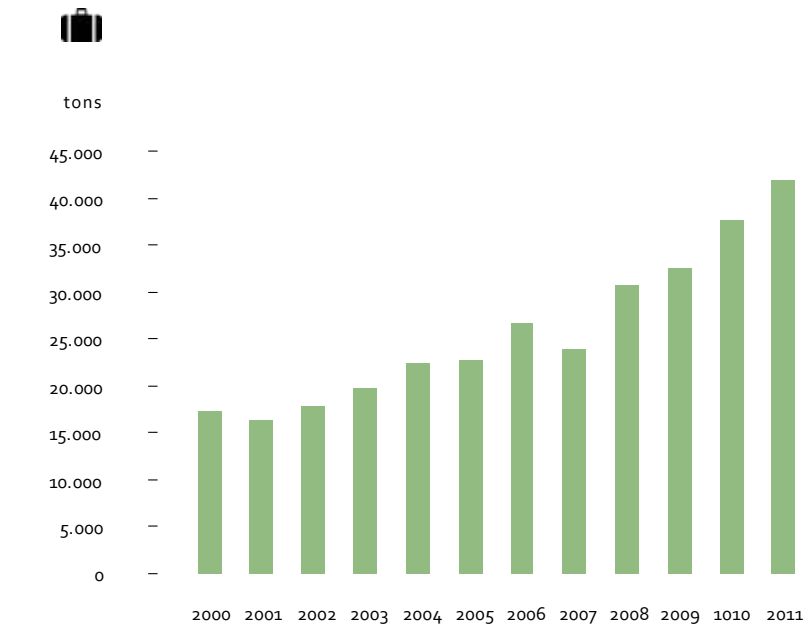
HISTORIC LANDMARKS



Historic landmarks in the area concerned.
Aerial view by Laura Cipriani.







Left: air traffic from 2000 to 2011 (passengers and cargo). Source data: Assaeroporti, 2012. Charts by Laura Cipriani. Right: landing and takeoff cones on the basis of the instrumental approach map. Source data: Instrumental approach map, 2008; Terraltaly ortophoto, 2006. Map by Laura Cipriani.


0
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11
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14
15 Km


01


02


03


04


05


01


02


03


04


05


01


02


03


04


05

06

07

08

09

10

LANDING

PARKING

06

07

08

09

10

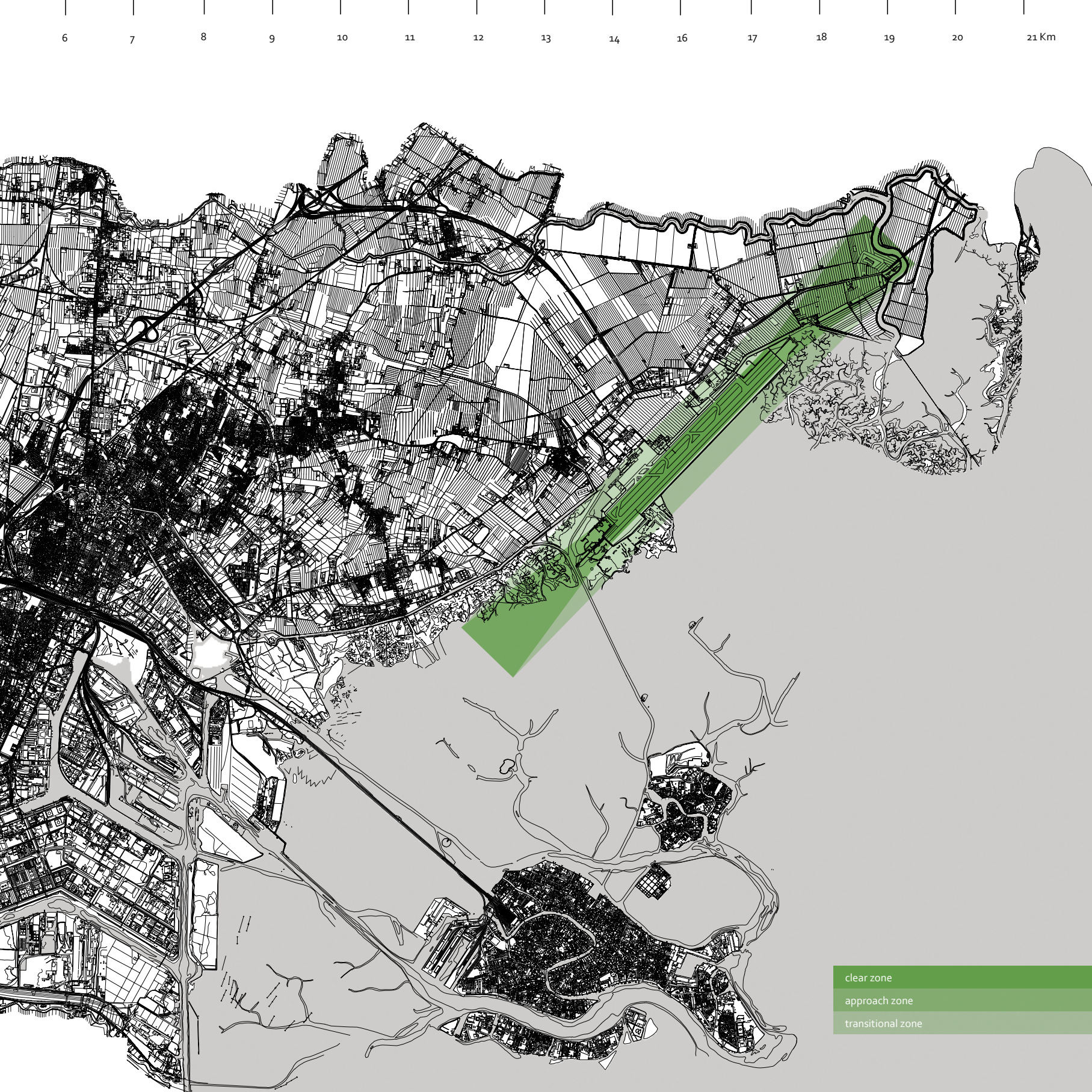
TAKEOFF

OBSTACLES PLAN

The areas surrounding an airport are strictly regulated to safeguard air movements and at the same time mitigate local impacts.
Firstly, the safety of air movements is guaranteed by regulatory boundaries consisting of planning constraints and represented by airport easements. Regulated by Law no. 58 of 4/2/1963, these influence the height of possible obstacles in the space surrounding the airport. Structures, buildings, trees and electricity lines are banned in the name of air safety.
New building is completely prohibited along the takeoff and landing cones for a distance of 300 m from the airport boundary. Beyond 300 m in the landing direction, the construction of any form of obstacle more than 6 m above the mean level of the airport is absolutely prohibited.
Airport easements are defined according to the size of the airport.
At a distance of 300 m from the perimeter of the airport, there is a ban on the construction of obstacles which, with respect to the mean height of the sections of perimeter corresponding to the landing directions, exceed the height of:

1. 12 m if the airport has a landing length of less than 1,080 m;
2. 10 m if the airport has a landing length equal to or more than 1,080 m, but less than 1,500 m;
3. 7.50 m if the airport has a landing length equal to or more than 1,500 m. Although there is no implementing decree, this law must nevertheless be taken into consideration in the planning schemes of municipalities affected by the easements.

Obstacle Plans. Source data: *Venezia Aeroporto Marco Polo. Studi e idee per lo sviluppo*, 2006; CTR Veneto Region, 2010.
Map by Laura Cipriani for Veneto Region.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21 Km
clear zone
approach zone
transitional zone

NOISE CONTOURS

In Italy, the acoustic impact of airport infrastructure is regulated by the Ministerial Decree of 31/10/1997 which defines specific "acoustic attention areas" dividing the airport environs into zones with particular noise limits.
The constraints are in relation to the equal-loudness contours dividing the areas in the vicinity of the airport into zones A, B and C. In Zone A, the area outside the airport, there are no land use restrictions; in Zone B, land use is limited to industrial and commercial development, following adoption of suitable acoustic insulation measures; finally, in Zone C, the airport itself, only activities connected with infrastructure services are allowed.
The equal-loudness contours are established on the basis of the Airport Noise Level (ANL) expressed in dB (A) and determined by the Airport Noise Measurement Method. In zone A, the ANL index must not exceed 65 dB(A); in zone B, the ANL index may not exceed 75 dB(A); in zone C, the ANL index may not exceed 75 dB(A). Outside zones A, B and C, the ANL index may not exceed 60 dB(A).
These equal-loudness contours, adopted in the Acoustic Zoning Plan of municipalities in the airport environs, modify the designated land use in municipal planning schemes.

Noise contours. Source data: *Venezia Aeroporto Marco Polo. Studi e idee per lo sviluppo*, 2006; CTR Veneto Region, 2010.
Map by Laura Cipriani for Veneto Region.


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14
16
17
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19
20
21 Km
> 95 dBa
85-95 dBa
75-85 dBa
65-75 dBa
55-65 dBa

FLOOD RISK AND FLOOD RISK SCENARIOS

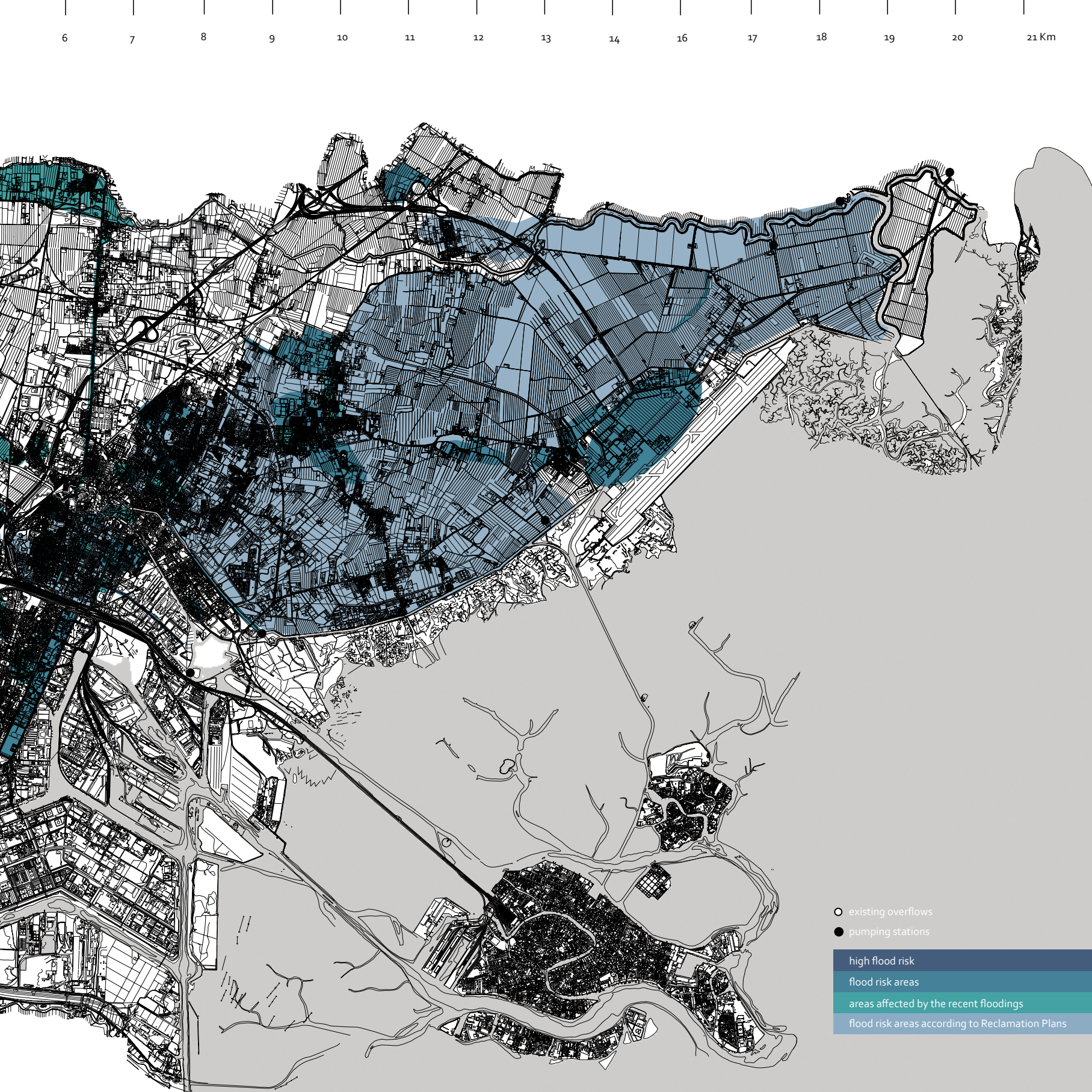
The area between Marco Polo airport and the Dese river is mostly below sea level and at variable risk from flooding. Representation of that risk in institutional documentation varies according to the source and year of representation. The Risks Map drawn up by the former Dese-Sile Land Reclamation Consortium, the Framework Plan for the Province of Venice, the Water Plan and the Land Use Plan all indicate different areas at risk of flooding and varying degrees of risk.

There is also a Flood Map produced by the Special Commissioner for the flood emergency in the Veneto, showing the areas flooded during the severe weather event of 26 September 2007.

The flood risk reported by the former Dese-Sile Land Reclamation Consortium is given on these pages, followed by the risk scenarios as represented by Venice Local Authority in 2010.

The contradictions emerging from comparison of the various flood risk maps underline the need for accurate assessment of the actual flood risk.

Flood risk. Source data: Consorzio di Bonifica Dese-Sile, Consorzio di Bonifica "Sinistra Medio Brenta", 2005.
Map by Laura Cipriani for Veneto Region.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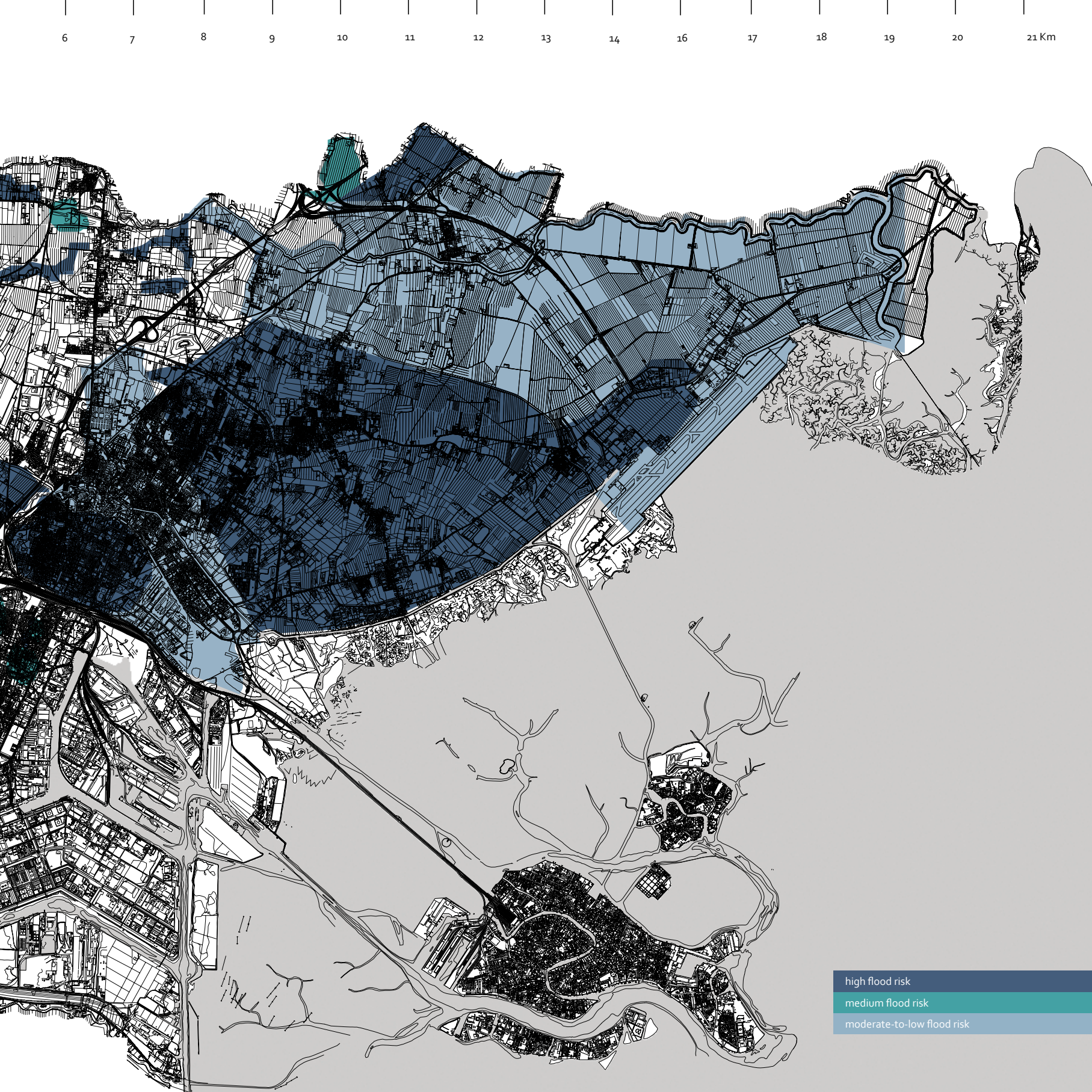
21 Km
existing overflows
pumping stations
high flood risk
flood risk areas
areas affected by the recent floodings
flood risk areas according to Reclamation Plans

Flood risk scenarios. Source data: Comune di Venezia, Protezione Civile, *Piano Comunale di Emergenza*, 2009. Map by Laura Cipriani for Veneto Region. Left, Dese river. Photos by Laura Cipriani.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21 Km
high flood risk
medium flood risk
moderate-to-low flood risk

SPECIAL CONSERVATION AREAS AND SPECIAL PROTECTION AREAS

The natural habitat, plants and animals are protected principally by the creation and management of protected natural areas and areas forming part of the European Natura 2000 network (the 92/43/EEC "Habitat" Directive and 79/409/EEC "Birds" Directive).
This network consists of areas designated as SCIs (Sites of Community Importance) which at the end of the formal procedure will become SACs (Special Areas of Conservation) and SPAs (Special Protection Areas) on the basis of the presence and representativeness of habitats and plant and animal species.
Despite the fact that Venice Airport is located on the edge of designated Sites of Community Importance and Special Protection Areas, aircraft takeoff and landing nevertheless affect these areas. Impact between the aircraft and birds, the so-called "bird strike effect", is very frequent, given the location of the airport near the lagoon.
To partly limit impact with certain species of birds, a series of devices can be used as described in the following chapters.

Special Conservation Areas (SACs) and Special Protection Areas (SPAs). Source data: Veneto Region, 2010.
Map by Laura Cipriani for Veneto Region.


6
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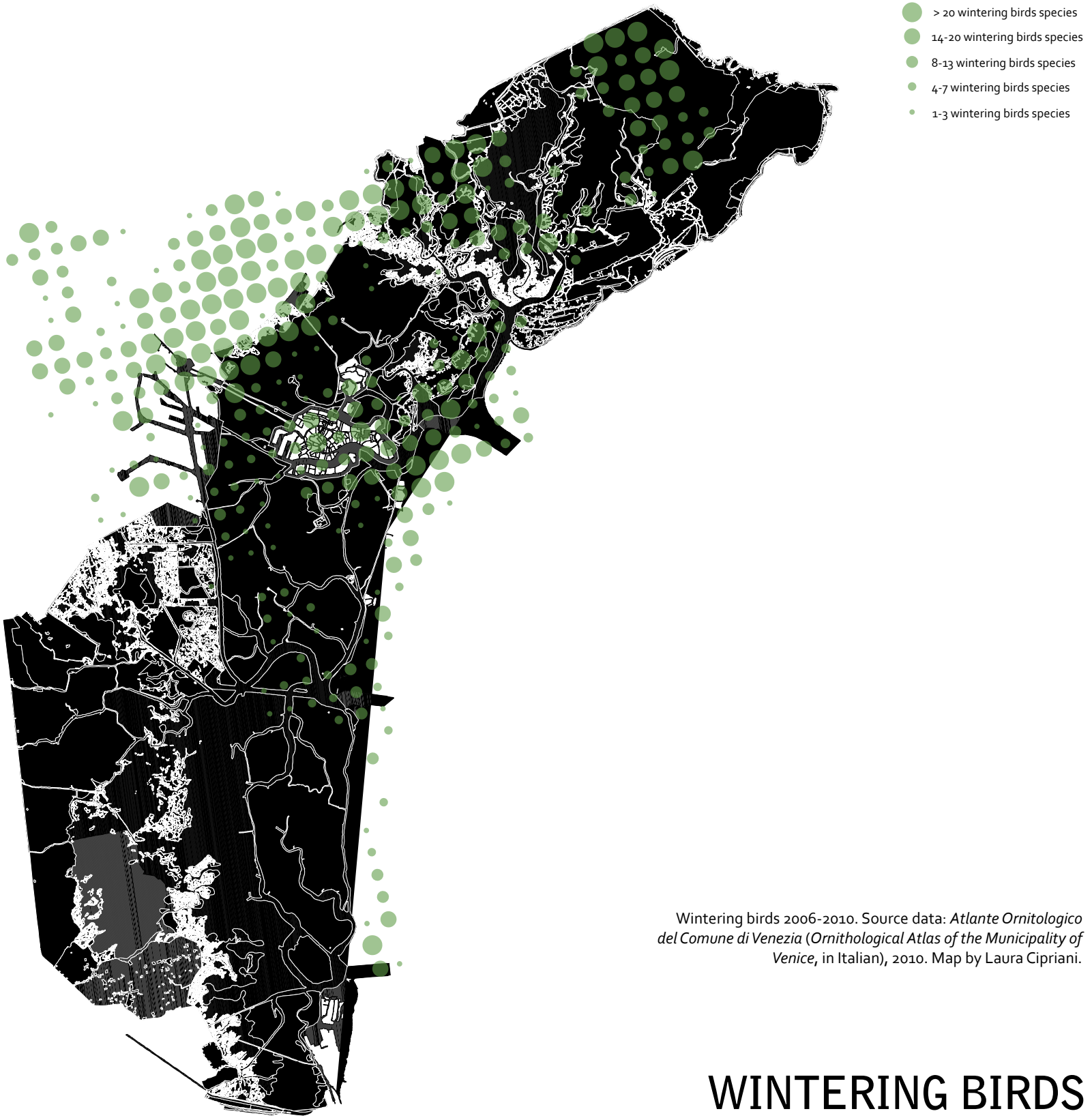
18
19
20
21 Km
Special Conservation Areas (SACs)
Special Protection Areas (SPAs)

BIRDS AND IMPACT

Airports are a source of attraction for some bird species. The "bird strike" phenomenon (collision between birds and aircraft) is extremely dangerous and frequent.
Many airports, including Venice, are located near large areas of water. For birds, airports offer a habitat for resting, feeding and breeding, while noise disturbance may be a secondary factor. The effects of noise deriving from air traffic or other human activities may be considered negligible by a number of bird species who are often used to intense noise.
Areas of grass or insects, birds and small mammals (the victims of possible impact with the aircraft) represent primary sources of food in airports. The species of birds frequenting airports are largely herbivores (ducks, geese and some passeriforms), insectivores (kestrels, starlings and other species of passeriform) and scavengers (corvids and seagulls).
A recent publication entitled "An ecological approach to bird strike analysis", published in the *European Journal of Wildlife Research* and carried out by a group of ecologists and etiologists from Venice Ca' Foscari University (Soldatini C., Vyron Georgalas V., Torricelli P., Albores-Barajas Y.), aims to analyse the risk of impact between aircraft and flying birds, starting from a case study of Venice Marco Polo International Airport. The authors produced an index known as the BRI ("Birdstrike Risk Index") which assesses and quantifies the risks in the presence of a wide range of bird species in airports.
It is interesting to note that the study takes the behaviour of the birds into consideration to calculate the risk. Usually bird strike is reduced by using falcons, or a series of ultrasound devices which keep birds away, but the fact that airports represent sources of attraction for only some, not all, bird species is not taken into consideration.
This study showed that herons and seagulls are the most dangerous species at Venice airport, involved in 857 incidents occurring during 2008 at the Venetian airport.



Wintering birds 2006-2010. Source data: *Atlante Ornitologico del Comune di Venezia* (*Ornithological Atlas of the Municipality of Venice*, in Italian), 2010. Map by Laura Cipriani.

WINTERING BIRDS

Ardea cinerea linnaeus

Larus michahellis

Columba livia

Passer domestico

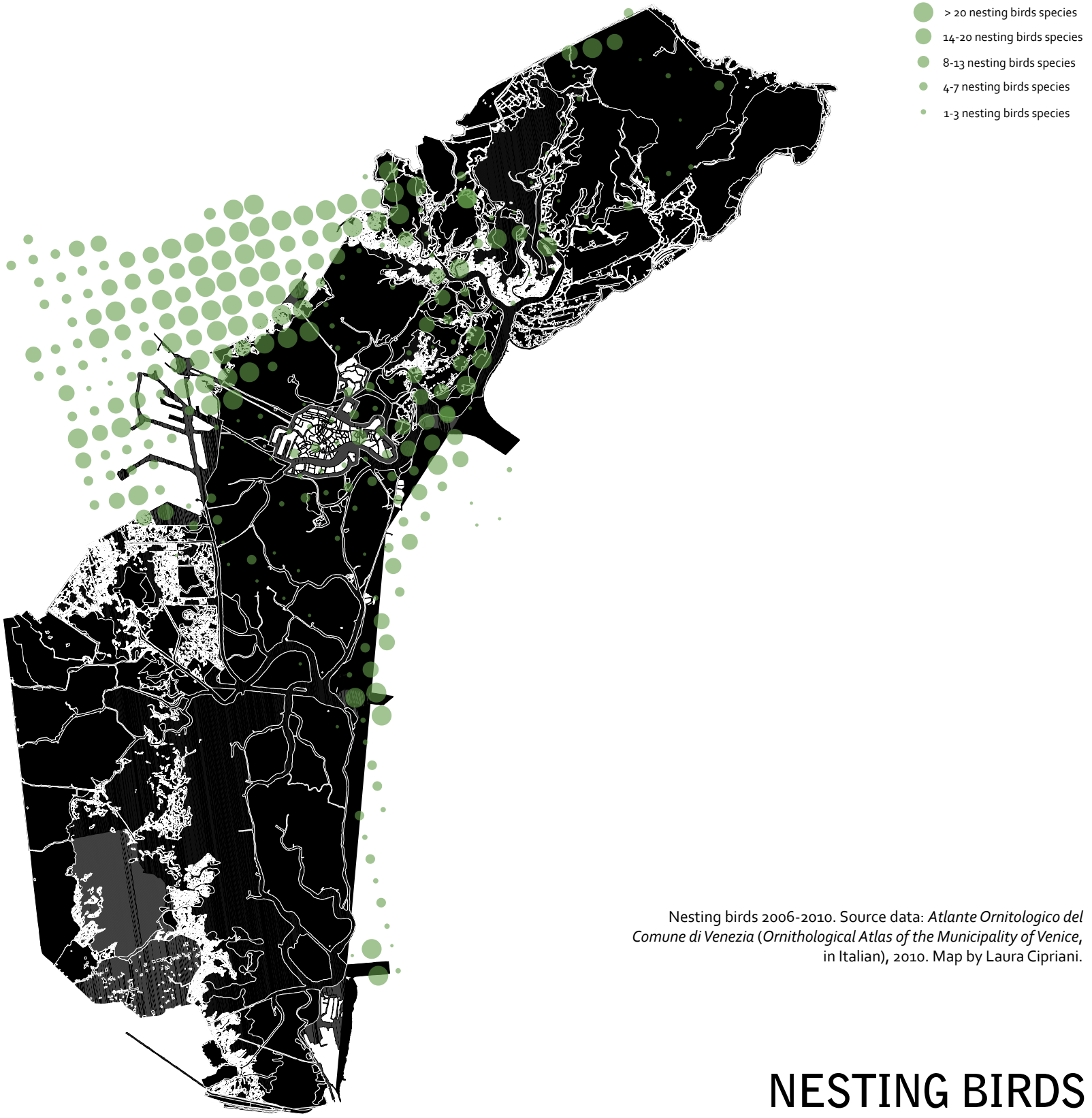
Sturnus vulgaris

Falcus tinnunculus

Passer italiae

Cardelius cardelius

Erithacus rubecula



Nesting birds 2006-2010. Source data: *Atlante Ornitologico del Comune di Venezia* (*Ornithological Atlas of the Municipality of Venice*, in Italian), 2010. Map by Laura Cipriani.

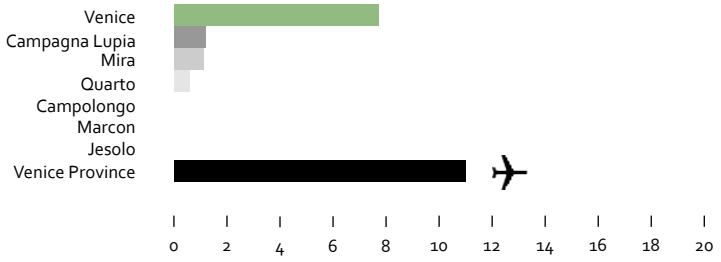
NESTING BIRDS


QUARTO
D'ALTINO
MARCON
JESOLO
MIRANO
SPINEA
VENICE
DOLO
MIRA
CAMPOLONGO
MAGGIORE
CAMPAGNA LUPIA

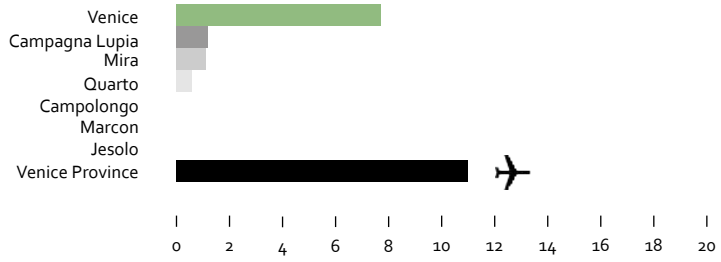
EMISSIONS

Airports are responsible for numerous sources of emission. Aircraft engines emit nitrogen oxides (NOx), carbon monoxide (CO), volatile organic compounds (VOC), sulphur dioxide (SO_2) and particulate matter (PM).
Emissions of nitrogen oxides and particulate are present mainly during the takeoff and climbing phases, while carbon monoxide and hydrocarbons are largely present during landing.
Other landside emissions are directly linked to airport operations or to other sources associated with the induced road traffic serving the airport.
The airport emissions given here, estimated by ARPAV in 2007 on the basis of 2005 traffic data, are assessed according to the activity index of the individual aircraft, in other words, according to the landing and takeoff cycle (LTO) which includes all aircraft movements and operations below a height of 1000 m, corresponding to the standard height of the mixing zone.
In particular, the tables of data given below (ARPAV 2005) provide an estimate (in tons/year) of emissions of the main pollutants by national and international air traffic below 1000 m in the province of Venice during 2005. The emissions are broken down into the seven municipalities crossed by the flight paths – Venice, Campagna Lupia, Mira, Quarto d'Altino, Campolongo, Marcon and Jesolo. The data shows that 70-80% of total emissions affect the municipality of Venice and that the municipalities of Campolongo, Marcon and Jesolo are only marginally affected.

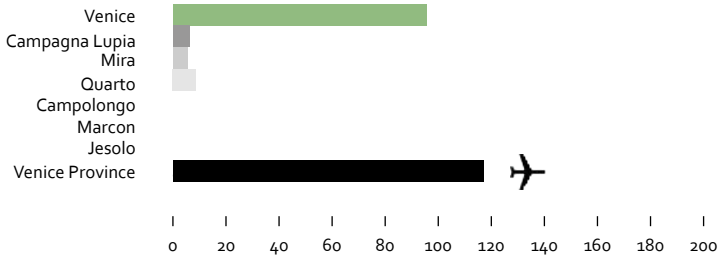
The emissions are broken down into the seven municipalities crossed by the flight paths. Source data: ARPAV, 2007.
Map by Laura Cipriani.



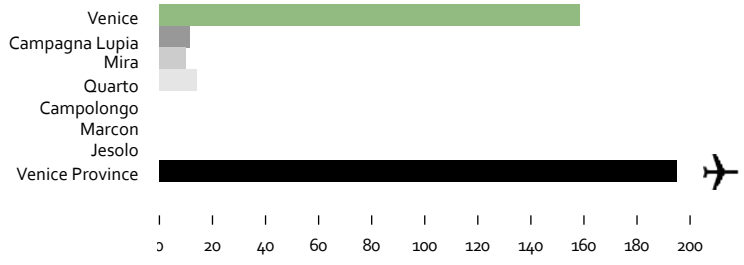
SO_x (metric tons/year) NATIONAL TRAFFIC



SO_x (metric tons/year) INTERNATIONAL TRAFFIC



NO_x (metric tons/year) NATIONAL TRAFFIC

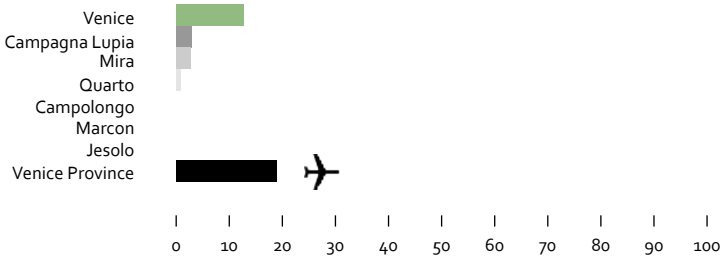


NO_x (metric tons/year) INTERNATIONAL TRAFFIC

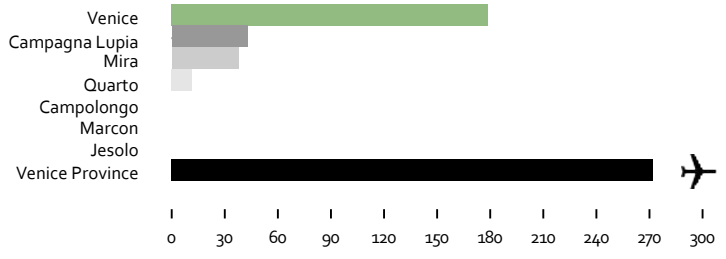
emissions
emissions
emissions
emissions
emissions

EMISSIONS

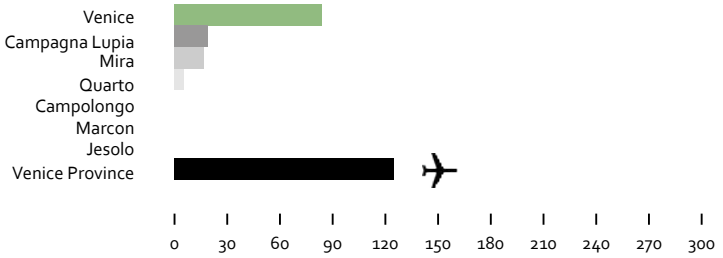
Source data: ARPAV, 2007.
Charts by Laura Cipriani.



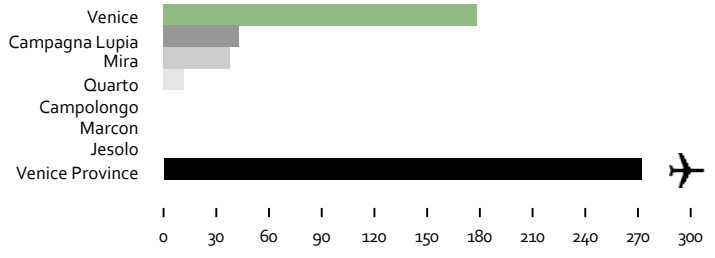
VOC$_s$ (metric tons/year) NATIONAL TRAFFIC



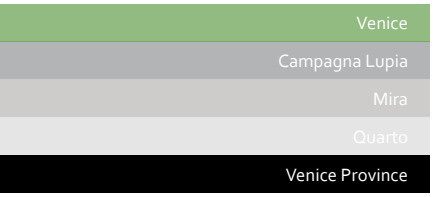
VOC$_s$ (metric tons/year) INTERNATIONAL TRAFFIC

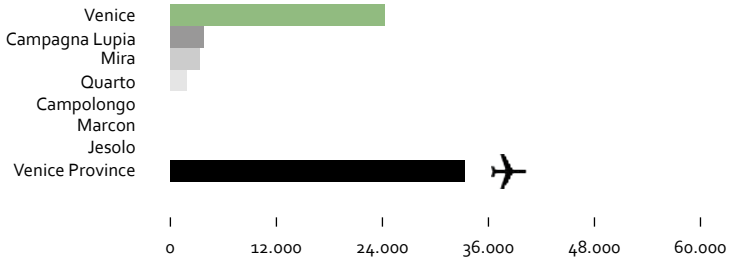


CO (metric tons/year) NATIONAL TRAFFIC

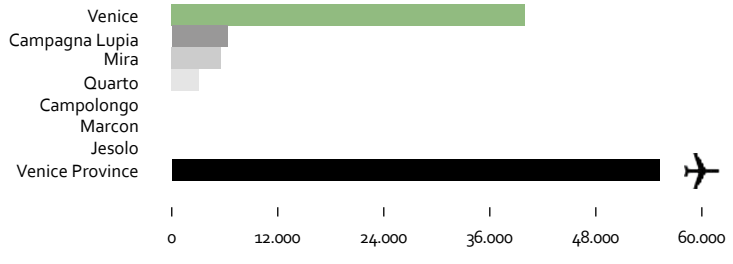


CO (metric tons/year) INTERNATIONAL TRAFFIC

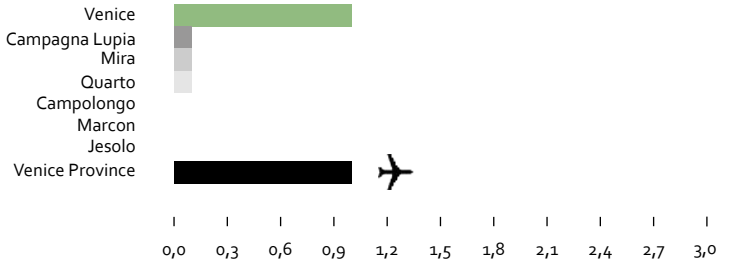




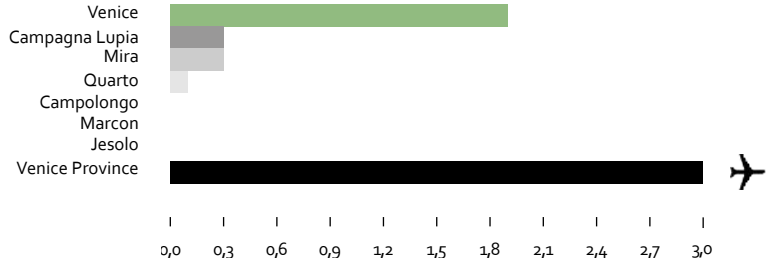
CO_2 (metric tons/year) NATIONAL TRAFFIC



CO_2 (metric tons/year) INTERNATIONAL TRAFFIC



PM_{10} (metric tons/year) NATIONAL TRAFFIC

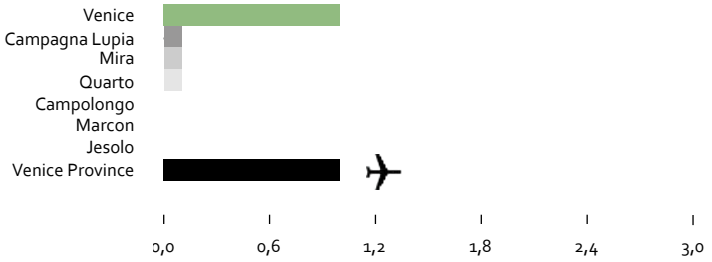


PM_{10} (metric tons/year) INTERNATIONAL TRAFFIC

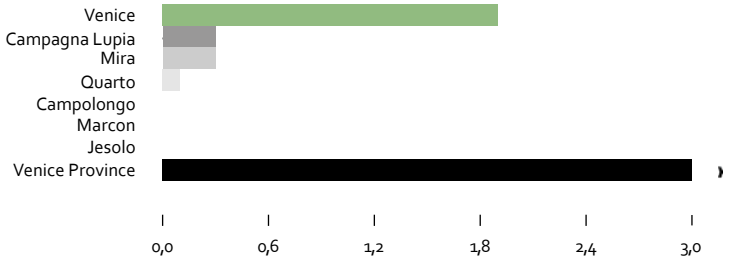
EMISSIONS

Source data: ARPAV, 2007.
Charts by Laura Cipriani.

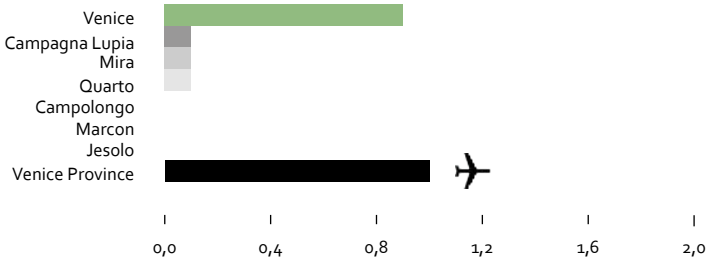
emissions
emissions
emissions
emissions
emissions



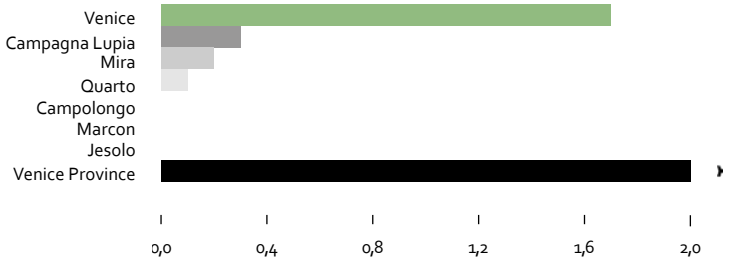
PTS (metric tons/year) NATIONAL TRAFFIC



PTS (metric tons/year) INTERNATIONAL TRAFFIC



$P_{2,5}$ (t/a) (metric tons/year) NATIONAL TRAFFIC



$P_{2,5}$ (t/a) (metric tons/year) INTERNATIONAL TRAFFIC

Venice
Campagna Lupia
Mira
Quarto
Venice Province


2030 SCENARIOS

SCENARIOS

The aim of the study was to develop a series of alternative scenarios. Two types of scenario were considered: short term (2020-2030) on the basis of the studies and proposals currently under discussion and presented by various decision-making bodies, and long term (2100), stimulating reflection on the measures and decisions to be taken in light of the severe effects of climate change.

Planning by means of scenarios means answering the question "what if...?"

For example, what happens if an airport becomes an intermodal centre? What happens if air traffic increases? What happens, on the contrary, if air traffic drops and in this case what role can the airport play in the landscape? What measures can/must be taken to mitigate noise, control the flood risk or protect the natural environment?

The aim of preparing a matrix of scenarios is not to favour a particular hypothesis, nor to confirm the validity or otherwise of decisions currently being discussed, but rather to support the decision-making process which must subsequently involve the local communities.

The objective of planning using scenarios is to support the decision-making processes inherent in issues characterised by a high degree of uncertainty. The value of scenario assisted planning lies not in the answer, but in the discipline of "creative thinking". The objective is not to select the most probable scenario, or the one which best satisfies the expectations, but rather to pave the way for a flexible response to major events if they occur and irrespective of their nature.

During this phase, consideration was given to a series of possible alternatives which the institutions and citizens must define for future development from a physical, economic and environmental point of view. The landscape transformation scenarios and strategies proposed must be considered as a whole, irrespective of the air transportation phenomena. An effective strategic

plan for airports and their environs must reflect on the complexity of the landscape, from mobility networks to water systems, green areas, ecological networks, disused industrial sites and residential areas.
The method and proposed matrix of scenarios help define landscape planning according to future alternatives, guiding not just short term decision making, but also giving the planning process the degree of flexibility necessary to adapt to the landscape transformations which may occur in the near future.
Clear, strong, well-informed landscape planning is the key not just to tackling the unpredictability of air communications, but also to planning the ecological development of the area and region concerned.
The short term scenarios are followed by long term reflection projected until 2100. What would happen if the rise in sea level caused by climate change affected Venice airport? What mitigation and adaptation measures could be implemented?
It must be remembered that, according to the Eurocontrol "*Challenger of Growth Environmental Update Study*", 34 European airports located along the coasts or on the plains are potentially at risk of sea level rise. This is just one of the main effects of climate change and its repercussions on air transportation and the European air network which must be taken into consideration in the near future.

2030 SCENARIOS

The environmental, historical and landscape resource represented by the area between Marco Polo airport and the Dese River has remained intact. Interpretation of the agricultural landscape reveals the progressive sedimentation of slow landscape transformations – from the Roman Via Annia to the archaeological remains of Altino, 19th-century military forts, water regulation structures from the early 1900s, the winding Dese River and fields where modern farming is practised.
This "piece" of countryside which has avoided the urbanisation of the sprawling city plays a delicate role in the hydrological balance of the Veneto lagoon drainage basin.
During the decision-making process, it is essential to bear in mind that every action on the territory will be left for those to come. Before creating new "pieces" of city, serious thought must be given to the actual need for the development and the possible roles of these places in the long term, after they have exhausted their life cycle.
The best solution is for these strategies to be focused in the first instance on recovering the existing built fabric. To this end, those parts of the industrial fabric of Marghera which have been, or are being, decommissioned offer an exemplary possibility for initiating a redevelopment process which, although with high reclamation costs, could create a resource for the community in the future. The building development proposals presented, involving significant urbanisation in support of the airport, must take into consideration the fact that the landscape is not a private resource, but necessarily a collective asset.
In the context of these preliminary considerations, it was decided to propose a method involving short term scenarios (2020-30) to configure a matrix (Steinitz' Framework Method for Landscape Planning).

CONSTANTS

The proposed scenarios respect a series of planning strategies which become genuine design "constants". These constants involve integration of the airport into the local area, accessibility, the water system, the green area system, the

presence of mitigation devices near the airport, conservation of the historic sites present, protection of plants and animals and aspects relating to landing/takeoff of the aircraft.
Each scenario must therefore:
1. merge the airport into the surrounding landscape as part of a regional system of green areas and increase the ecological corridors along highways and primary canals;
2. make the airport accessible to the local area by guaranteeing at least rail access;
3. increase the current floodwater collection capacity, treat stormwater run-off and implement a series of local and regional strategies to improve soil permeability;
4. preserve existing ecological corridors;
5. install noise mitigation devices near the airport;
6. preserve and enhance the historic sites in the area (the Altino archaeological area, forts with bastions, etc.);
7. promote the conservation of protected species;
8. preserve the view during landing/takeoff and maintain the landing/takeoff corridor free of possible obstacles to guarantee the safety of air operations.

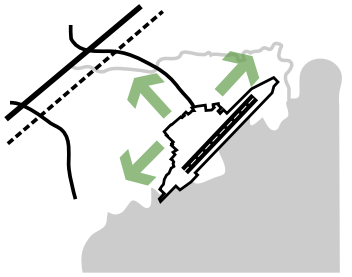
VARIABLES

On the basis of the design constants, a series of short term scenarios were defined with a series of variables relating to the rail system, metropolitan rail system, airport system, water-based transportation system, airport services, developed areas and the water system.
The variables were associated with the following:
1. improved accessibility to the airport by means of an intermodal transport system, either already in existence or currently in the design phase (railway, regional metropolitan rail system, water-based transportation);
2. maintenance of a single runway or the possible addition of a second runway should airport capacity reach levels considered critical. According to a SAVE study, after 2015 the existing runway could reach saturation, in which case a parallel runway with landing and takeoff functions (although specialising in

takeoff to reduce noise in residential areas) would have to be constructed. I estimate that a feasible threshold for Venice airport could proximally be 16 million passengers per year (today the airport handles more than 8 million passengers per year);
3. improved wastewater and rainwater quality;
4. greater flood storage capacity upstream and on site;
5. various proposals relating to airport services;
6. various proposals and approaches for the possible development of mixed function zones (tertiary, residential, commercial).

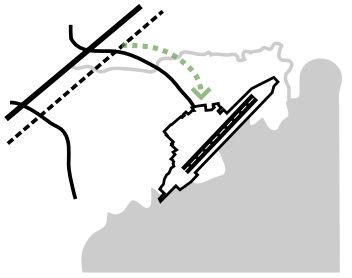
INFRA-SUTURE

+ integration of the airport into the surrounding landscape



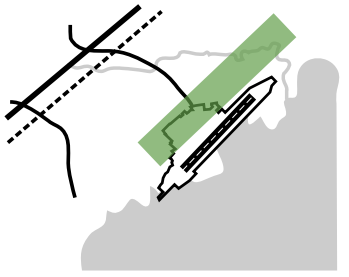
ACCESSIBILITY

+ accessibility of the airport to the local area
+ guaranteed rail access



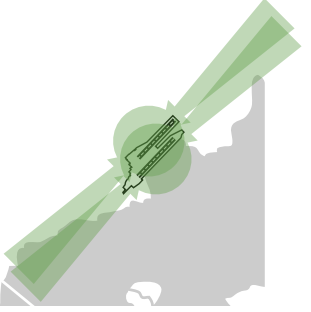
RUNWAY

+ protection of the area with an absolute ban on construction in the immediate vicinity of the airport in case a third runway is required in the future



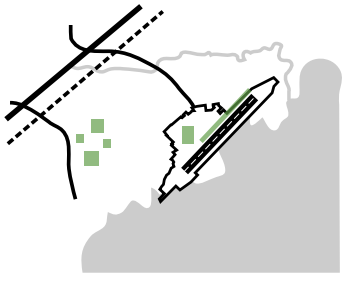
LANDING-TAKEOFF

+ protection of the landing and takeoff cones of the existing runway and a possible third runway through an absolute ban on construction



DEVICES

+ application of noise mitigation devices in the vicinity of the airport



CONSTANTS

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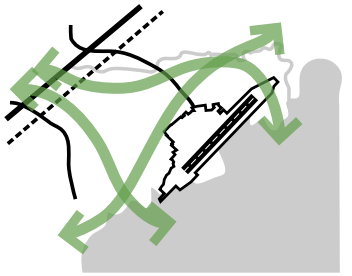
for Veneto Region.

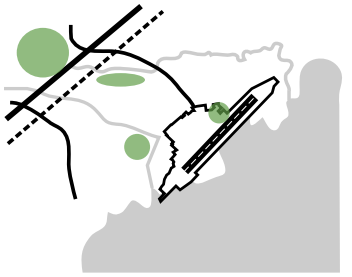
GREEN

+ preservation of existing ecological corridors



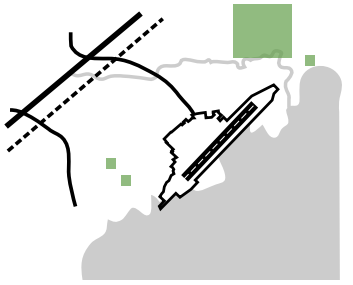
WATER

+ guaranteed containment of floodwater
+ treatment of run-off rainwater
+ application of devices to increase soil permeability



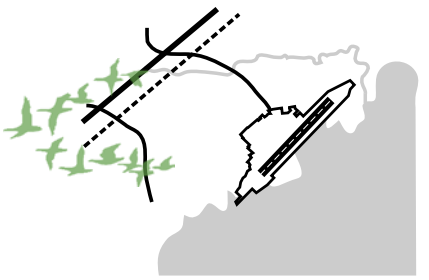
HISTORIC SITES

+ preservation and promotion of sites of cultural interest, possibly with "green" itineraries



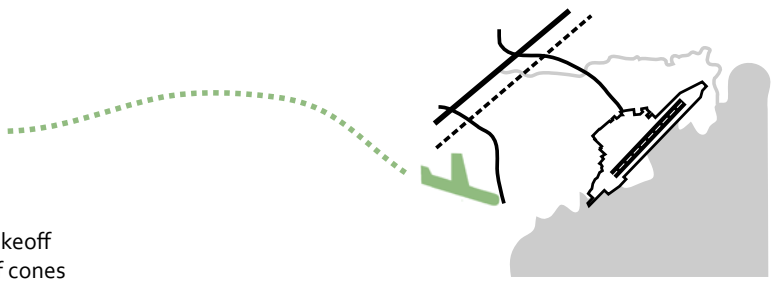
WILDLIFE

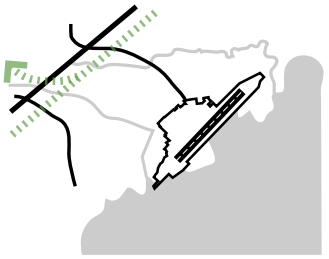
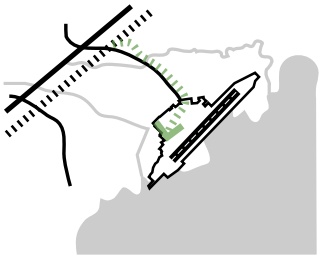
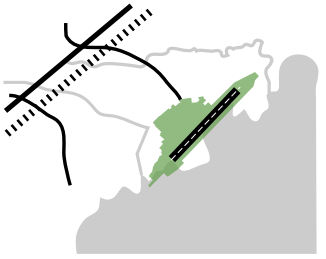
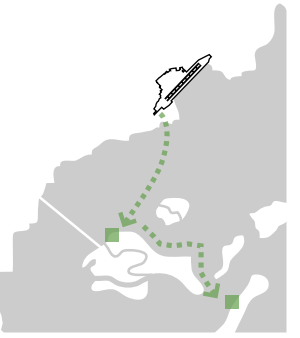
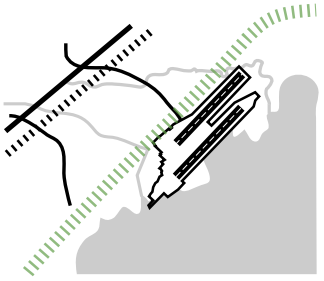
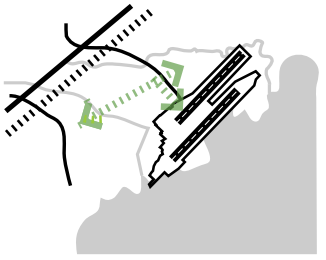
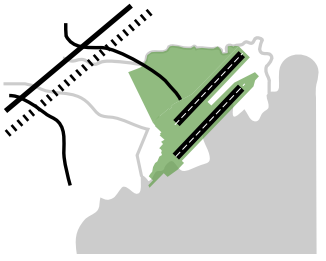
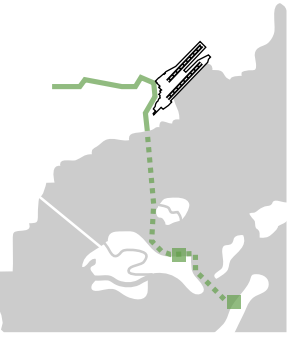
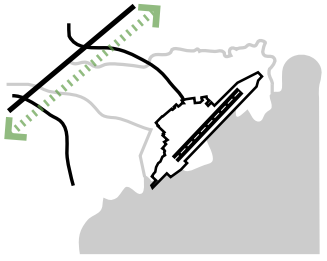
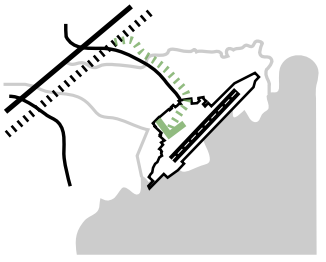
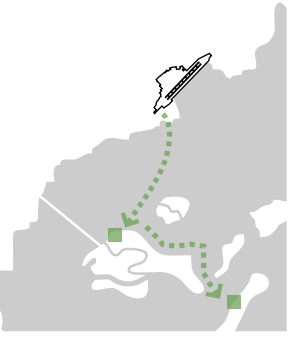
+ conservation of the habitat of protected species



VIEW FROM ABOVE

+ preservation of a clear view during landing/takeoff
+ maintenance of obstacle-free landing/takeoff cones



	RAILWAY	METROPOLITAN RAIL SYSTEM	AIRPORT	WATERWAYS
SCENARIO 1				
SCENARIO 2				
SCENARIO 3				

VARIABLESMATRIX

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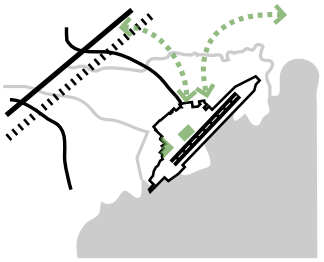
for Veneto Region.

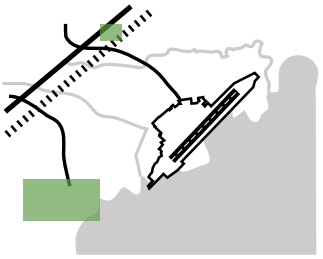
AIRPORT SERVICES

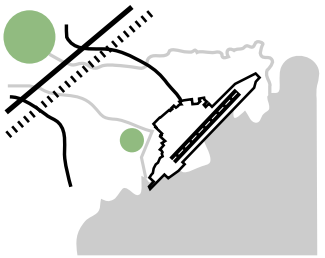
BUILT ENVIRONMENT

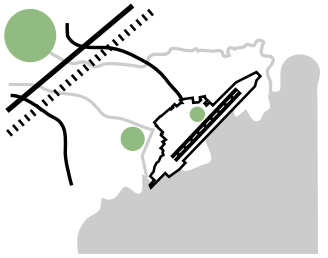
WATER CAPACITY

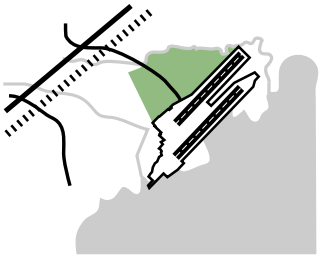
WATER TREATMENT

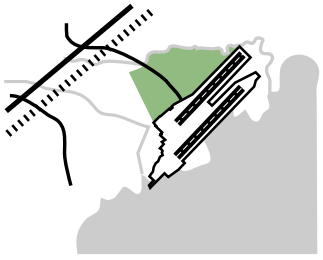


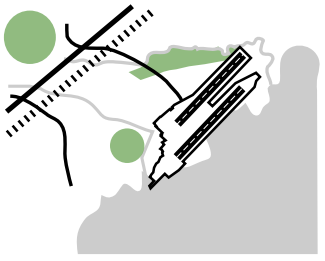


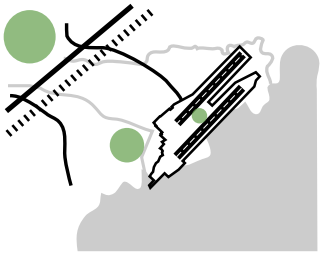


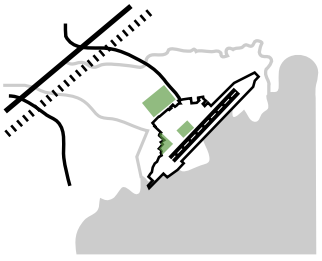


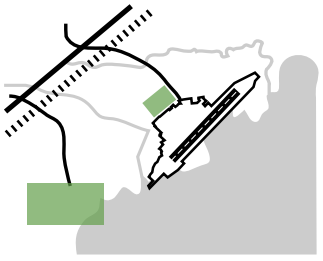


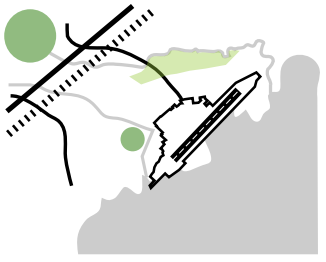


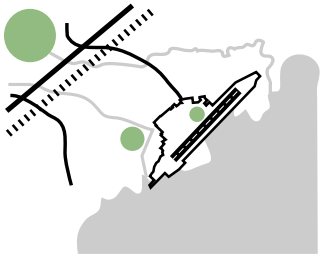






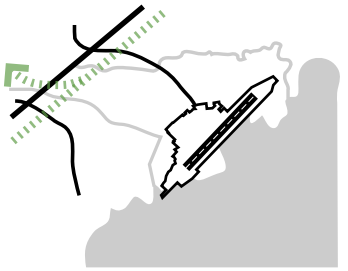






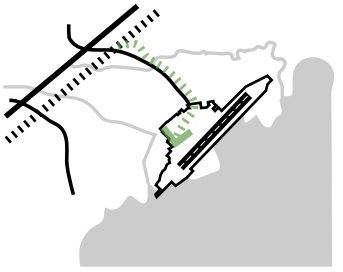
RAILWAY

+ no high speed train
+ enhancement of the Bivi Railway (Source: Veneto Region, *Regional Transport Plan*, 2004)



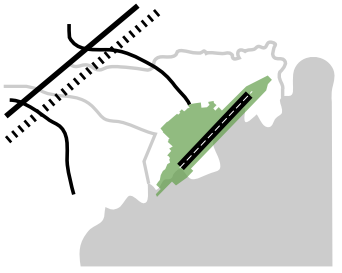
REGIONAL METROPOLITAN RAIL SYSTEM

+ regional metropolitan railway currently in the design phase (Source: Veneto Region, *Regional Transport Plan*, 2004)



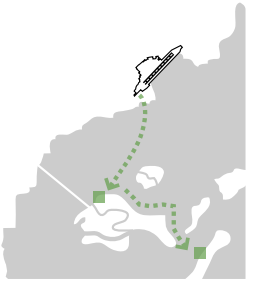
AIRPORT

+ no additional runway
+ rationalisation of airport capacity



WATERWAYS

+ new water-based links (*vaporetto*)



SCENARIO 1 VARIABLES

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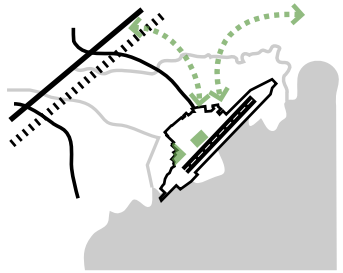
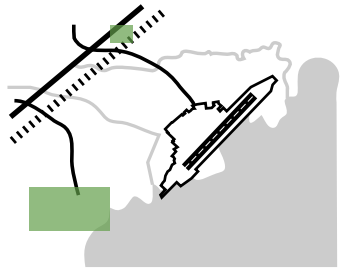
AIRPORT SERVICES

+ airport services within the boundaries of the airport itself
+ shuttle links with nearby commercial areas and sites of historical interest



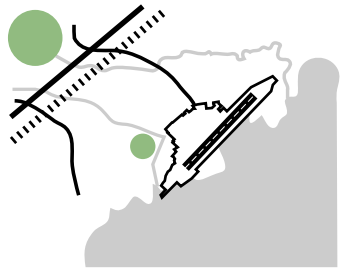
BUILT ENVIRONMENT

+ redevelopment of the existing built fabric for mixed tertiary use; "building on the built" approach



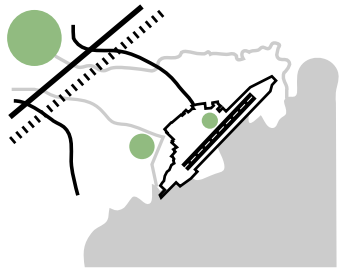
WATER CAPACITY

+ containment of floodwater as far as possible upstream
+ containment of water in the area



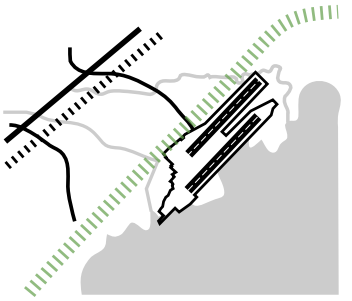
WATER TREATMENT

+ treatment of run-off rainwater



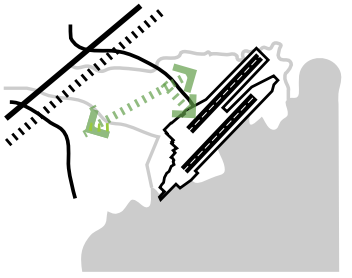
RAILWAY

+ HST along the lagoon boundary (Source: Veneto Region, *Regional Transport Plan*, 2004)



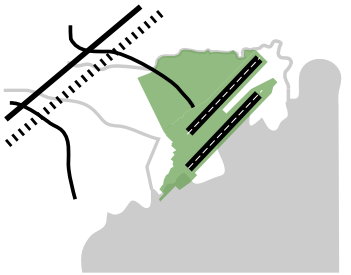
REGIONAL METROPOLITAN RAIL SYSTEM

+ new tram route



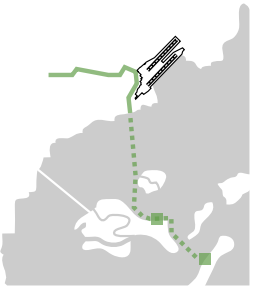
AIRPORT

+ expansion of the airport (if passengers per year ≥ 16 millions)
+ construction of a third runway
(Source: SAVE Engineering, "Lo schema strutturale del nuovo Master Plan", in *Venezia Aeroporto Marco Polo. Studi e idee per lo sviluppo*" ("Structural scheme of the new Master Plan" in *Venice Marco Polo Airport, Studies and ideas for growth*, in Italian), 2004)



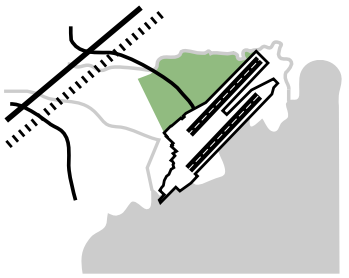
WATERWAYS

+ construction of a sub-lagoon railway (Fondamenta-Lido) (Source: Municipality of Venice, Chamber of Commerce, *Studio di fattibilità di un collegamento sub lagunare Tessera – Murano – Arsenale* (*Feasibility study of a sub-lagoon connection Tessera – Murano – Arsenal*, in Italian), 1999)



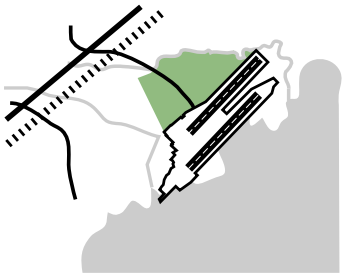
SCENARIO 2 VARIABLES

Work by Laura Cipriani for Veneto Region.



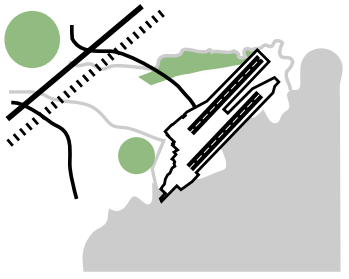
AIRPORT SERVICES

+ creation of new airport services



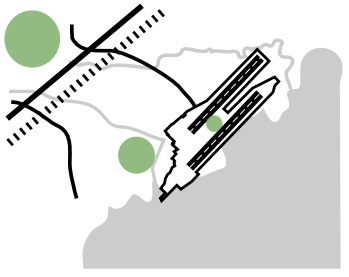
BUILT ENVIRONMENT

+ construction of new developments with mixed-tertiary use (Fonte: SAVE Engineering, "Lo schema strutturale del nuovo Master Plan", in *Venezia Aeroporto Marco Polo. Studi e idee per lo sviluppo* ("Structural scheme of the new Master Plan" in *Venice Marco Polo Airport, Studies and ideas for growth*, in Italian), 2004)
+ reuse and redevelopment of abandoned areas of the existing urban built fabric for mixed tertiary use
+ progressive relocation of nearby residential areas further from the airport



WATER CAPACITY

+ containment of floodwater as far as possible upstream
+ containment of water in the area
+ creation of a "buffer band" to increase permeability

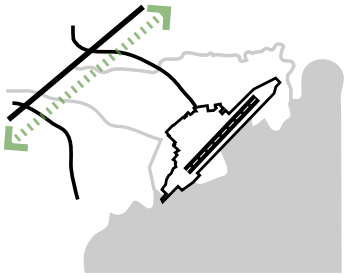


WATER TREATMENT

+ treatment of run-off rainwater

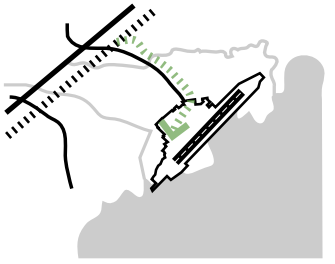
RAILWAY

+ no high speed train
+ enhancement of the rail link with Trieste (Source: Veneto Region, *Regional Transport Plan*, 2004)



REGIONAL METROPOLITAN RAIL SYSTEM

+ regional metropolitan railway currently in the design phase (Source: Veneto Region, *Regional Transport Plan*, 2004)

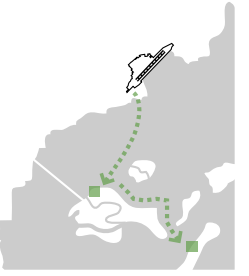


AIRPORT

+ division of the airport system into three airports on a North East scale

WATERWAYS

+ new water-based links (*vaporetto*)

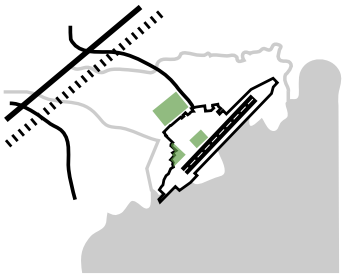


SCENARIO 3 VARIABLES

Work by Laura Cipriani for Veneto Region.

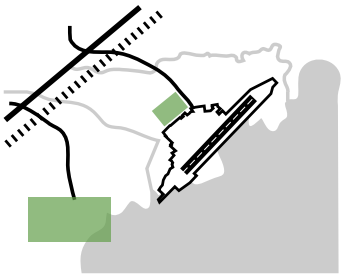
AIRPORT SERVICES

+ airport services inside and outside the airport boundaries



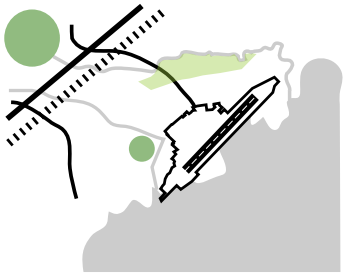
BUILT ENVIRONMENT

+ construction of new developments with mixed-tertiary use
+ redevelopment of the existing built fabric; "building on the built" approach



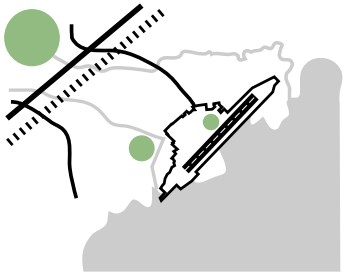
WATER CAPACITY

+ containment of floodwater as far as possible upstream
+ containment of water in the area
+ creation of a buffer band

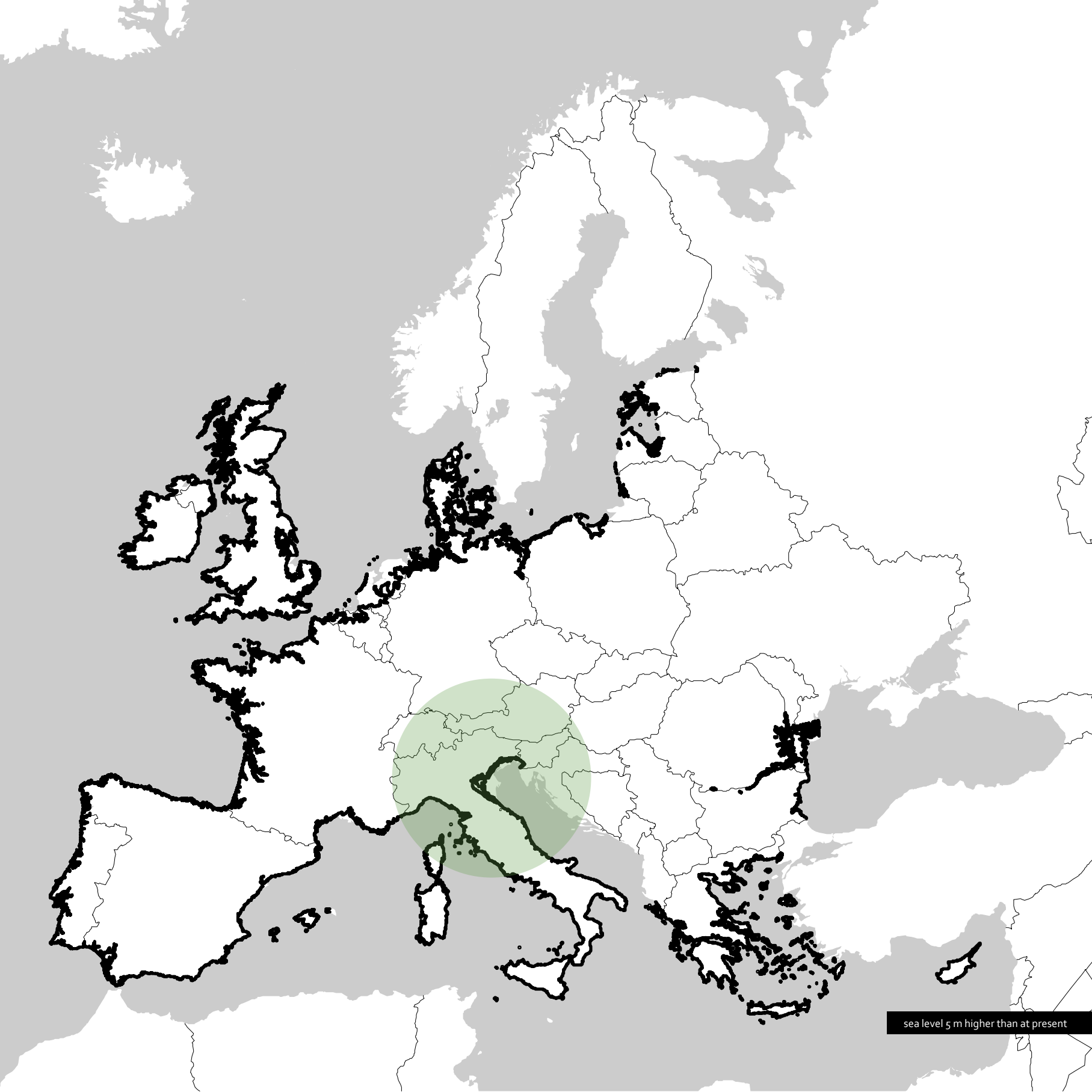


WATER TREATMENT

+ treatment of run-off rainwater



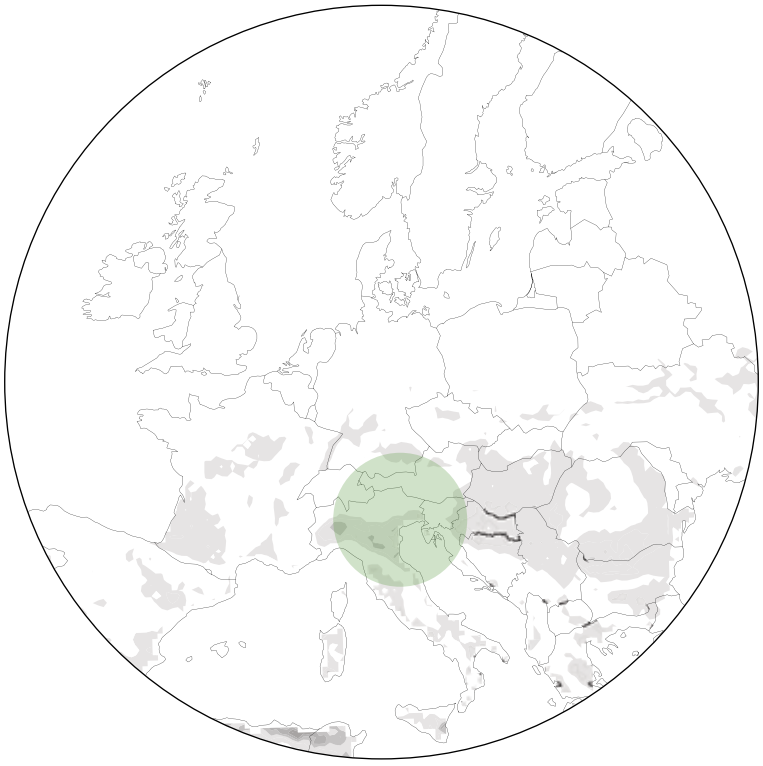

2100 SCENARIOS


sea level 5 m higher than at present

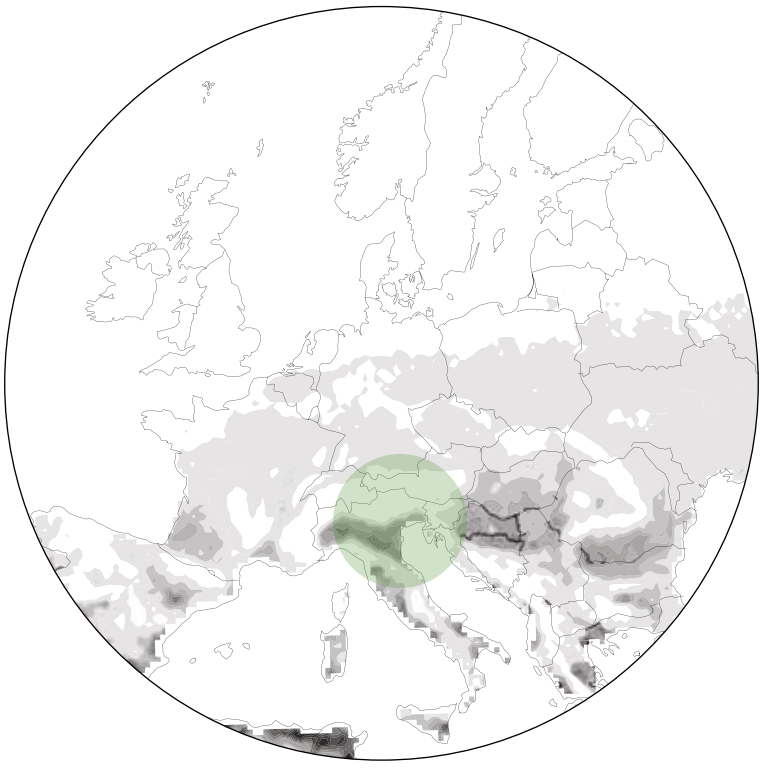
2100 SCENARIOS

The climate change scenario is today accepted by numerous disciplines.
What would happen if the rise in sea level caused by climate change affected Venice airport? What mitigation and adaptation measures could be implemented?
It must be remembered that, according to the Eurocontrol "Challenger of Growth Environmental Update Study", 34 European airports located along the coasts or on the plains are potentially at risk of sea level rise. This is just one of the main effects of climate change and its repercussions on air transportation and the European air network which must be taken into consideration during the near future.
Numerous other effects will have repercussions on operations and the type of runway necessary for takeoff/landing of the aircraft – the rising temperature will necessitate prolonging runways to allow operation of large aircraft.
The changes will not affect just individual airports but also the complex network system.
What changes will be required in the North East network system? What changes will be required in the landside infrastructure network?
Far from proposing solutions, the aim of the 2100 scenarios is to focus attention on a series of questions which stimulate thought on the future of air transportation and the territory itself.
During the decision-making process, it is essential to bear in mind that every action on the territory will be left for those to come. Serious thought must be given to the actual need for the development and the possible roles of these places in the long term, after they have exhausted their life cycle.
The scenarios projected into the near future consist of questions rather than unambiguous answers. How can we combine today's technological requirements with the need for unforeseen new functions in the future? What would happen, for example, if in 2100 the aviation world underwent radical

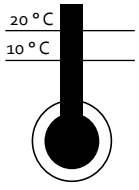
Sea level 5 m higher than at present.
Source data: European Environment Agency (EEA), 2010.
Map by Laura Cipriani.



1961-1990

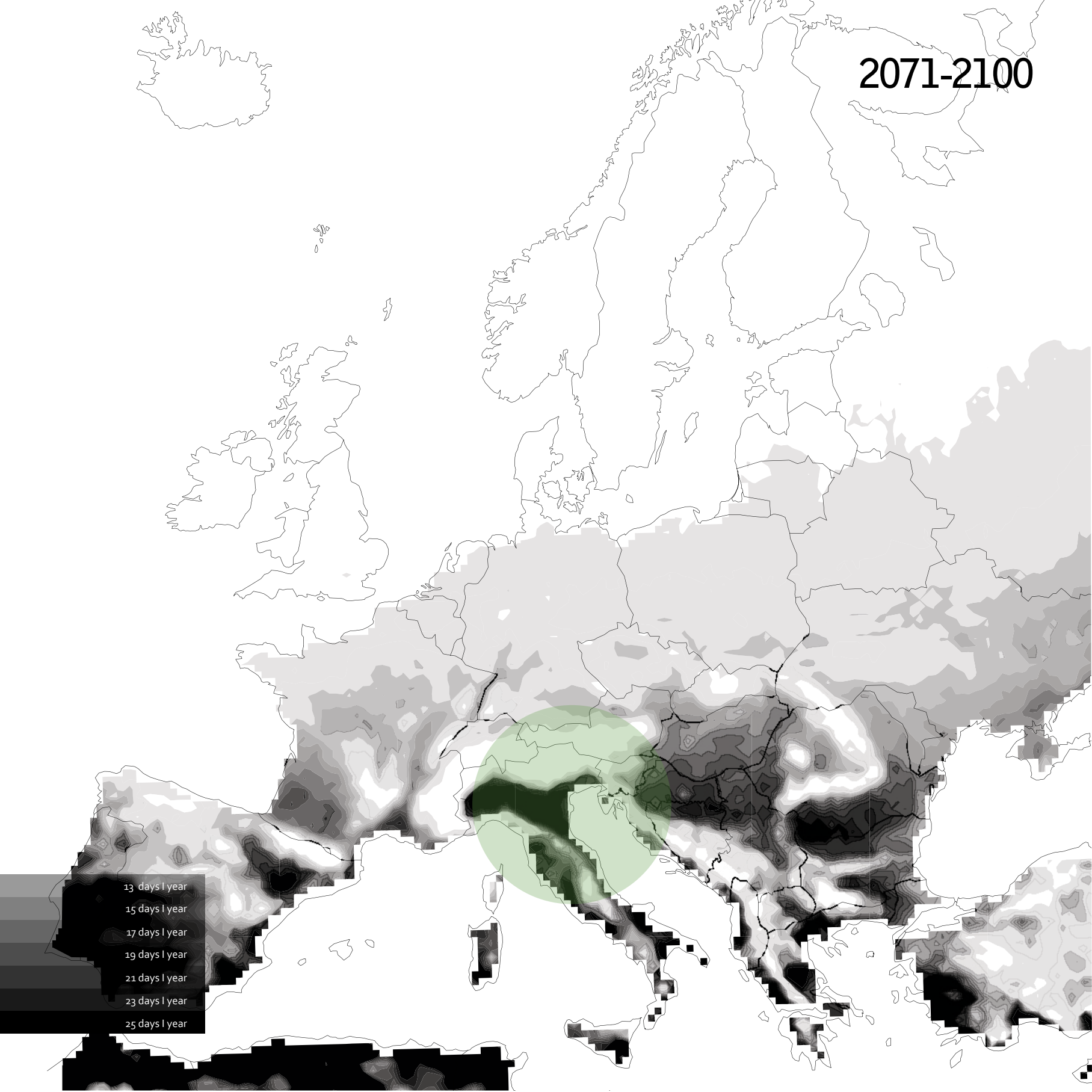


2021-2050



1 day I year
3 days I year
5 days I year
7 days I year
9 days I year
11 days I year
13 days I year

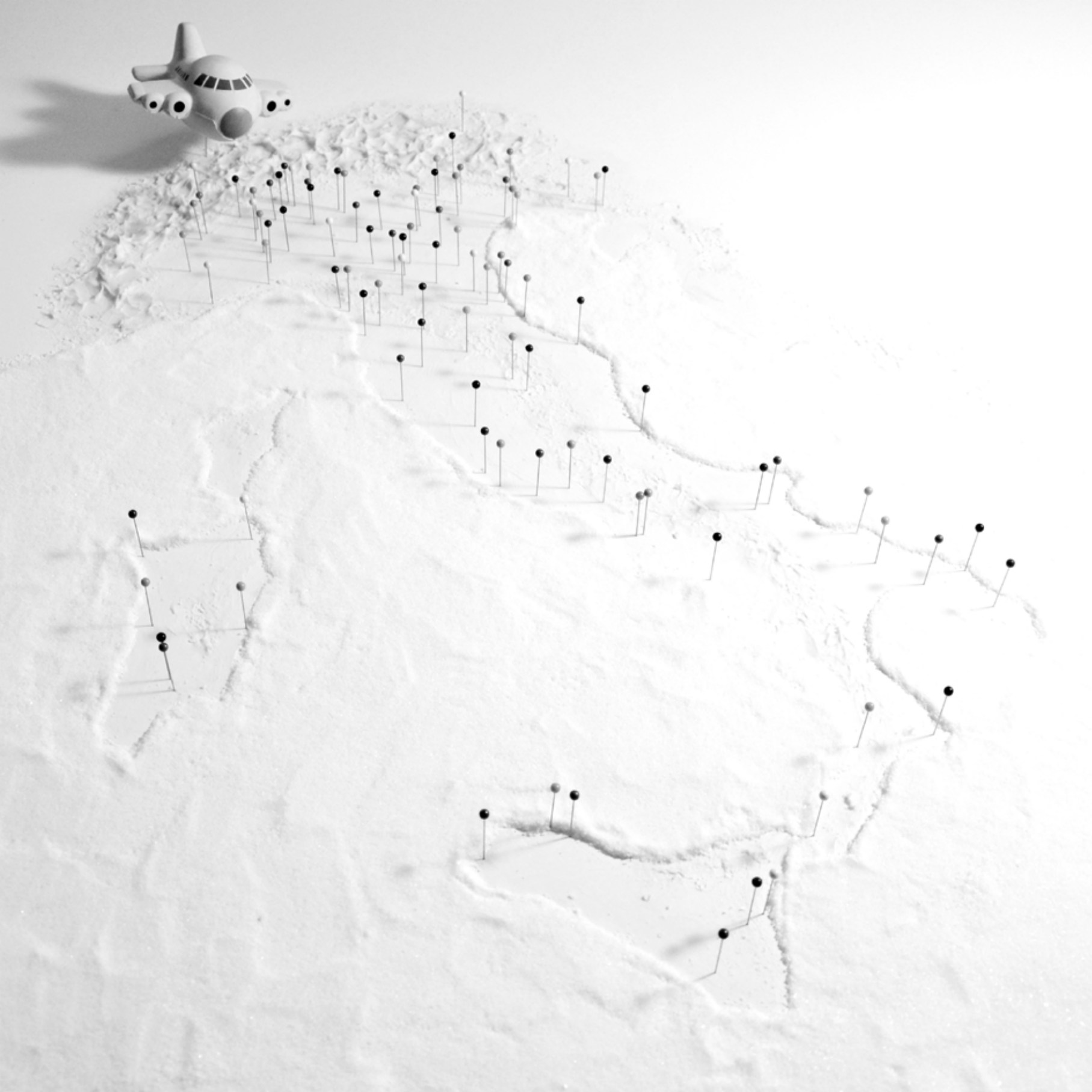
Number of days per year with temperatures higher than 40.7°C during the period 1961-1990 and scenarios for a rise in temperature during the periods 2021-2050 and 2071-2100.
Source data: EEA, 2011. Maps by Laura Cipriani.


2071-2100
13 days I year
15 days I year
17 days I year
19 days I year
21 days I year
23 days I year
25 days I year

transformation and airports were no longer necessary or, rather, were no longer capable of accommodating the new technological requirements? What happens when the life cycle of the airport machine comes to an end? What types of function could a disused airport accommodate? How could the runways be re-utilised? Is it currently possible to design airport infrastructure with characteristics of extreme flexibility?
What changes would take place if an aeroplane became a means of transport like a car in terms of size and frequency of use? What changes would occur if the minor transport network of small airports became the principal network?

Scenario with a 5 m rise in sea level. As can be seen, Venice airports (Tessera and San Nicolò on the Lido) are potentially at risk of sea level rise.
3D model and photograph by Laura Cipriani.

On this page, top, the main airports in the North East; centre, the main and secondary airports in the North East; bottom, scenario with a 5 m rise in sea level. Right, scenario with a 5 m rise in sea level in the Italian peninsula. In Europe, 34 European airports are located along coasts or on plains potentially at risk of sea level rise.
3D model and photograph by Laura Cipriani.



DESIGN STRATEGIES AND DEVICES

DESIGN STRATEGIES AND DEVICES

By their nature, use, form and size, airports are often considered as spaces extraneous to the landscape and difficult to integrate into the local context. They have a strong impact on the local area, modifying not just its morphology, but also its social structure, economy and environmental quality. Generally speaking, the impacts can derive from the transport function, such as noise and air pollution, or from the infrastructure itself, such as the visual impact of the airport structure on the landscape, the impact on possible groundwater present and the waste generated.

While the noise impact generated by air movements is one of the most important environmental problems and a source of great conflict with local communities, there are numerous other effects on the environs. These include, for example, the way in which runways, terminal roofs, roads and large paved areas prevent rainwater from percolating into the subsoil and contribute to water pollution with a strong concentration of heavy metals, oil, grease and de-icing liquids.

This is where regional and landscape planning on the various scales can play a fundamental role in defining airport infrastructure which effectively balances the positive effects and negative externalities.

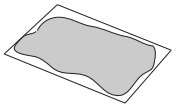
The noise and air pollution, soil contamination and urbanisation associated with airports are today fundamental issues which must be tackled urgently in order to assess risks and benefits, define targeted operational land management tools, identify a number of possible design strategies and adopt a series of design devices.

The aim is therefore to present the reader with a series of projects proposing measures acting on air quality, noise abatement, water quality, land pollution, the use of renewable energy sources and conservation of the natural environment.

An exploration of the theme without doubt makes an important contribution

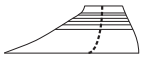
WATER & SOIL PERMEABILITY

+ constructed wetlands & water collection

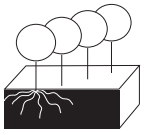


+ constructed lakes for water storage

+ green roofs



+ porous and colored asphalt

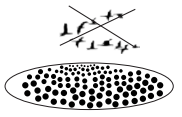


+ tree planting & phytoremediation

+ bioswales

WILDLIFE

+ ecological bridges



+ bird balls

AIRPORT LANDSCAPE DEVICES

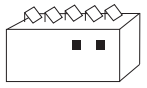
Images by Laura Cipriani

+ solar trees

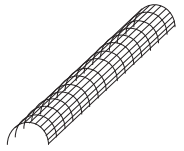
ENERGY

+ wind trees & microturbines

+ solar panels

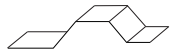


+ green tube



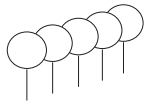
NOISE

+ landfills

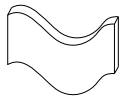


+ green roofs & insulation

+ tree planting



+ sound barrier



to understand the state-of-the-art, in terms not just of reflection and possible approaches, but also of design practices aimed at economic, environmental and regional sustainability.
It is fundamental to compile a sort of anthology bringing together and documenting "designed" projects which form a platform from which to observe the theme of the airport from a landscape perspective. Far from presenting solutions to be imitated, the intention is to offer the possibility of comparing the decision-making processes, design approaches and attitudes of the various parties involved, from administrators to citizens and the business sector.

NOISE

The possible measures which can be considered to mitigate noise are:

1. Reduction of aircraft noise at source

A reduction of noise at source is generally associated with the introduction of new quieter aircraft into the fleet of airlines using a given airport. In fact, it is also the result of the constant technological improvements introduced during the life cycle of an aircraft not of the latest generation to improve noise performance.

2. Operational noise mitigation procedures

Identification of the most appropriate noise prevention procedures during takeoff and landing can optimise the environmental benefits. Variations in engine revolutions along the takeoff path and a different flap configuration can modify the noise levels during takeoff. Similarly, the noise perceived for a landing aircraft is influenced by the flight parameters and inclination of the approach path. A combination of preferential noise prevention paths and appropriate flight technique can therefore optimise environmental benefits.

3. Operational restrictions

Operational restrictions consist in extraordinary noise reduction measures aimed at regulating aircraft access and reducing the number of air movements. Legislative Decree no. 13 of 17 January 2005 lays down operational restrictions for Italian airports with traffic exceeding an average of 50,000 movements during the three previous years. Extraordinary noise reduction measures may involve night time, the type of aircraft operations and the airport approach paths.

4. Land planning and management

- It is fundamental to prevent land use incompatible with the existence of an airport and its development and to avoid buildings located at the ends of the landing and takeoff runways.

- Acoustic insulation of buildings in the immediate vicinity of the airport infrastructure. The soundproofing must include insulation of windows, roofs and wall surfaces. Use of sound absorbent material contributes to global acoustic well-being. These aspects can be integrated into the building regulations of municipalities in the airport environs.
- Acoustic insulation created by green barriers, embankments and trees in the landscape. For example, green roofs on buildings have been demonstrated to contribute appreciably to noise abatement, as well as increasing soil permeability.
- Acoustic insulation created artificially with eco-barriers.

AIR

Possible measures to improve air quality include:

1. Choice of airport location

From the moment the airport is built, the choice of location and orientation of the runway are fundamental not just to define the correct position of the runway in relation to the wind – critical for aircraft landing/takeoff – but also to guarantee air quality.

2. Planting

Some types of plant can purify the air. Planting vegetation in aircraft taxiing and takeoff points (always in respect of anti-obstacle regulations) is fundamental not just to provide acoustic protection, but also to improve air quality.

ENERGY

Airports can reduce energy use and utilise alternative sources:

1. use of photovoltaic panels on flat roofs to produce solar energy (to limit land occupation);

2. use and production of geothermal energy;

3. use of wind towers to produce wind energy;

4. possible measures to reduce energy consumption in the terminals:

- use of efficient variable speed motors for the baggage handling system, moving walkways, escalators and other airport systems which as a whole consume 60% of a terminal's energy requirements;
- efficient low energy consumption lighting systems (e.g. LED);
- automatic systems in the building able to vary heating, ventilation, air conditioning and the electrical systems according to flight activity and terminal use;
- mass transport systems such as rail shuttles, hybrid cars, shuttles using alternative fuels and electric vehicles;
- electrical and biodiesel systems for landside aircraft services;
- use of natural light to reduce the demand for electrical light in the terminal.

PERMEABILITY

One of the biggest ecological impacts of land exploitation is that it makes the land arid and impervious. In airports, the runways, terminal roofs, roads, and vast paved areas impede percolation of rainwater into the soil. As a result, rainwater runs off these impervious surfaces rapidly, flooding pipes and canals, contributing to erosion, and accumulating pollution (e.g. oils, greases, heavy metals, the de-icing liquids used on the runways) as it flows.
In response to this "runoff" problem, numerous architectural and landscape solutions have been developed to slow down the rate of flow and absorb this excess water.

The possible measures to improve soil permeability are:

1. Green roofs

Green roofs (also known as "living roofs" or "eco-roofs") can be installed on building rooftops during routine renovation. Recent advances in design allow lighter green roofs to be constructed using structural soils that also hold rainwater. The plants on the rooftops provide an evapo-transpiration function, sending water back into the atmosphere.
As well as increasing permeability, green roofs are an excellent way to reduce noise, in particular in airports where the noise source is diffuse. The illustration at pages 152-153 shows a number of airports which have used green roofs to improve permeability.
It is interesting to note that the first green roofs were developed precisely in the aviation sector as camouflage for military purposes.

2. Permeable paving

When designing airport infrastructure (runway, roads and parking), permeable paving, porous pavers and surfaces covered with vegetation should be used instead of asphalt and concrete.

3. Bioswales

Another common strategy is to collect rainwater in open grass-lined or

vegetated ditches (known as "bioswales") in place of surface waterways or underground storm sewers.
When stormwater runoff comes in contact with soil and vegetation, pollutants bound to the sediments carried by the water attach to plant roots and surfaces and are captured before they flow downstream or into the drainage network. Microbes in the soil also contribute to improving water quality by digesting oils and greases.

WATER

There are two measures involving water:

1. Floodwater storage

Water management techniques compensate for peaks caused by the excessively impervious paved ground (runways, structures, car parks, etc.), as well as improving efficiency and saving water.
Water collection systems include cisterns, drainpipes and pools which store excess water for uses such as irrigation, industrial purposes, vehicle washing and other activities. They also reduce reliance on clean drinking water supplies and help reduce flooding.
The main measures aimed at water storage are:

- Bioswales
- Settlement tanks (to be constructed upstream of the airport area and inside the airport itself)
- Porous paving: use of porous asphalt which allows rainwater to percolate into the subsoil under the runways;
- Use of autochthonous vegetation which does not require irrigation.

2. Water treatment

Contamination comes from two primary sources:

- runoff from roads, car parks, and other impervious areas, which increases heavy metal concentrations, nutrient loading, and suspended solids. In the airport sector, de-icing of runways and aircraft is one of the main sources of pollution;
- untreated wastewater which increases biological oxygen demand (BOD) and bacteria levels (e.g. faecal coliforms).

Tertiary water treatment is therefore required, using:

- Covered settlement tanks;
- Bioswales

In airports, areas of water must be meticulously covered to avoid bird strike with aircraft. A recent product consists of floating plastic balls (bird balls) which cover the surface of the water to avoid it attracting birds.

DENVER INTERNATIONAL AIRPORT, DENVER, USA

Designer: Denver Airport

Denver International airport is one of the first airports to use solar photovoltaic energy coming from two different "solar farms". The vast unused surfaces of the airport, mainly left free for safety reasons, can be used to produce solar energy. The sun farms are located over a 45 acre area and can produce up to 13 million kW/hour in a year. This solar system applied to the airport is a joint public-private project involving two private companies and generating more than 2.7 million kWh of clean energy (about 6% of the total energy required for the airport to function).

Left, view of one of the solar parks at Denver International Airport. Photograph by Denver International Airport.

1st SOLAR FARM

Area = 30,351 m²
Energy production = 3,400,000 KWh/year
Energy production = 50% terminal-gates rail line
CO_2 reduction = 1,865 tons/year

+

2nd SOLAR FARM

Area = 36,421 m²
Energy production = 2,700,000 KWh/year
Energy production = 100% fuel farm's eletricity consumption

Energy produced by the solar farms at Denver International Airport.
Source data: Denver International Airport, 2011.
Diagram by Laura Cipriani.

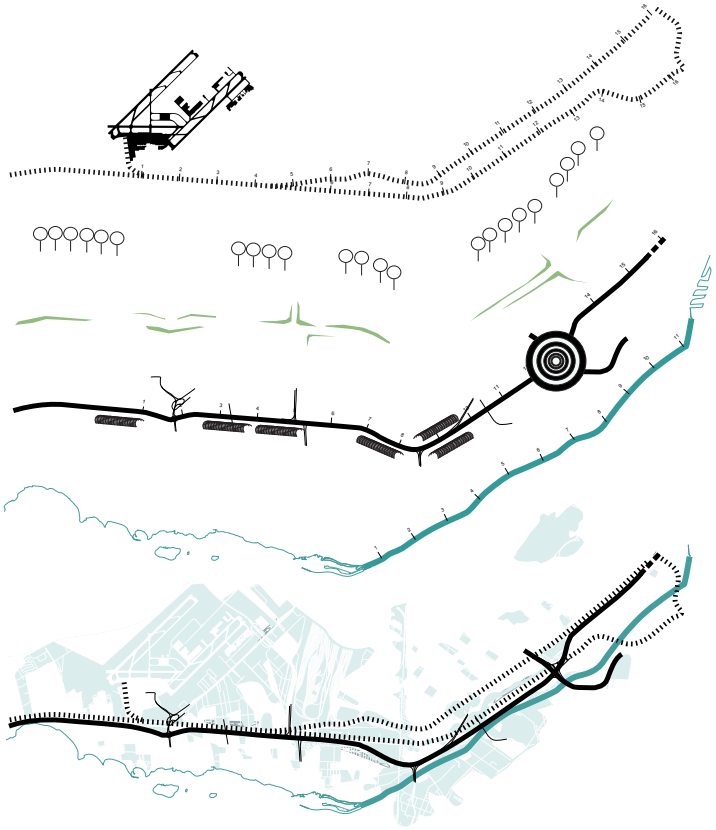
ENERGY PRODUCED BY SOLAR FARMS

3rd SOLAR FARM

Area = 113,312 m^2
Energy production = 6.900.000 KWh/year
CO_2 reduction = 5.000 tons/year

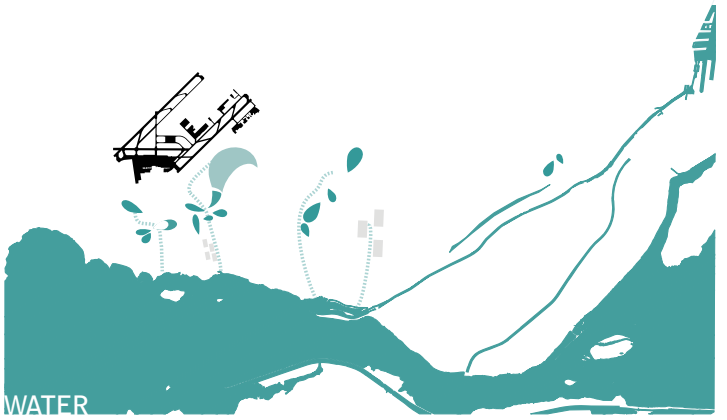
TOTAL

Area = 182,108 m^2
Energy production = 13,000,000 KWh/year
Energy production = 6% of the airport's total power requirement



NOISE

ASPHALT



WATER

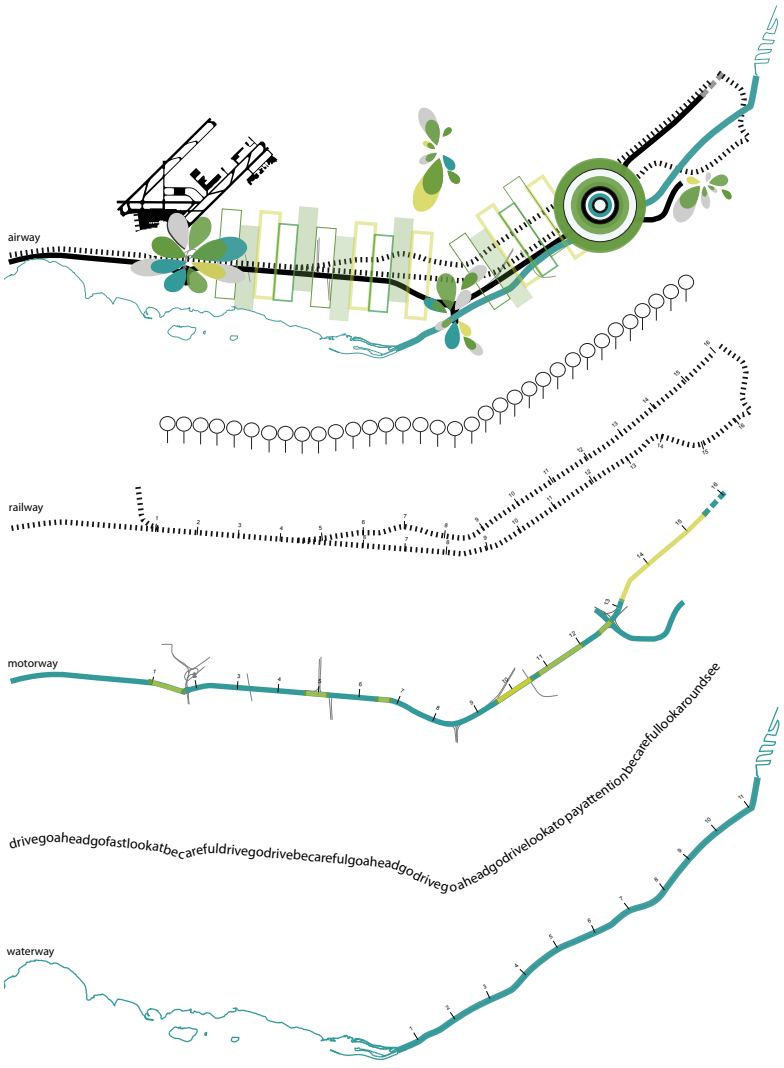
MONTREAL INTERNATIONAL AIRPORT, MONTREAL, CANADA

Designers: Laura Cipriani, Francesca Arici

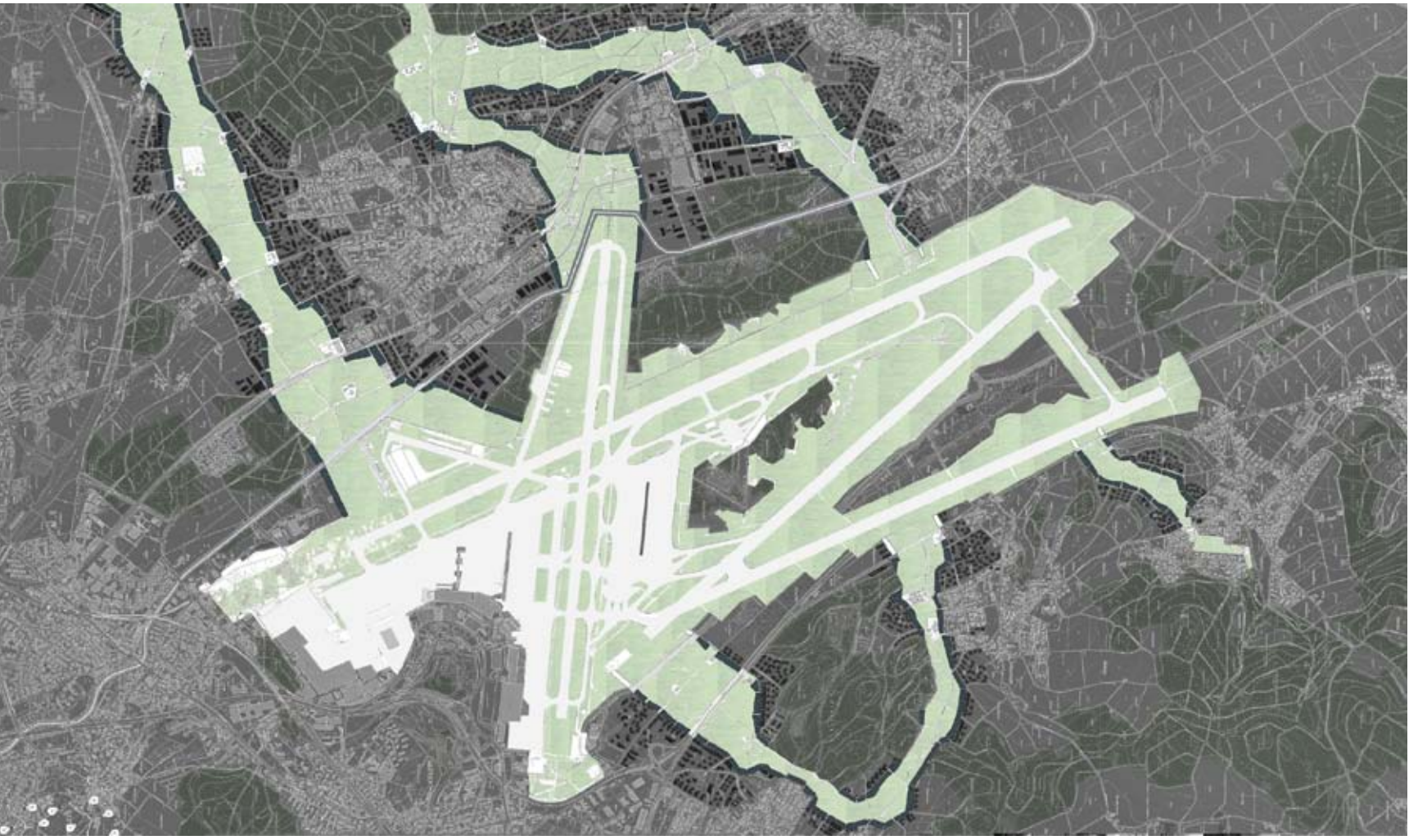
During the last 50 years the city of Montreal has developed along the motorway linking the city to YUL-MTL airport. The airport has been progressively incorporated within the urban fabric, becoming the catalysing centre of urban expansion.

The aim of the "Fertile Infrastructures" project, which received a mention of honour in the City of Montreal competition, was therefore to rethink the airport area through a series of green corridors, improvement of the water system and a number of design devices involving noise, green spaces, the energy system, navigation and intermodal transport.

Left: measures to reduce noise and maximise permeable areas and the water systems at Montreal Airport. By Laura Cipriani, Francesca Arici, Leonardo Zuccaro, Igor Kuseta, Adriano Riosa.



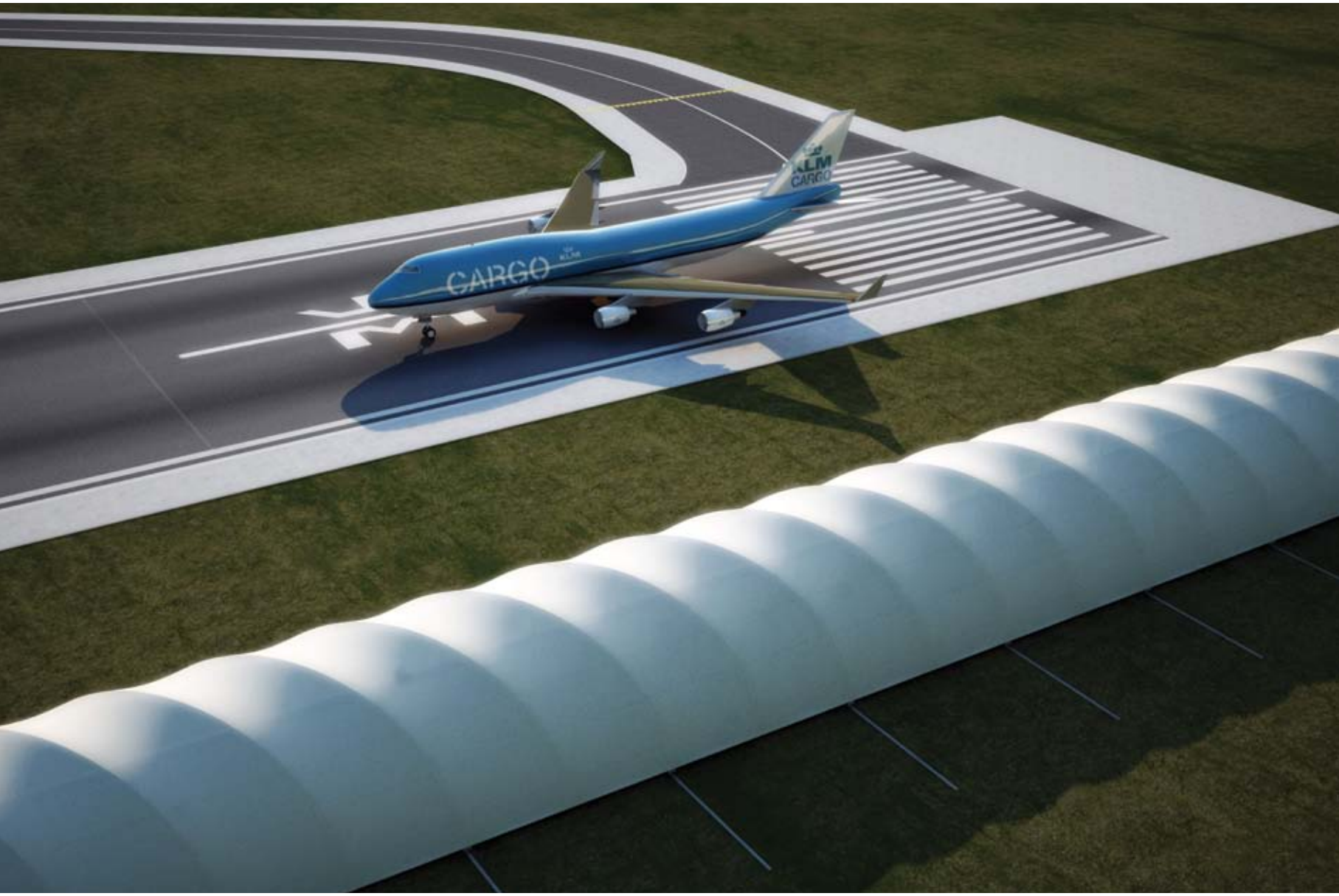
Top, navigation and orientation devices. Right, view from above of Montreal Airport and the proposed ecological corridors. -By Laura Cipriani, Francesca Arici, Leonardo Zuccaro, Igor Kuseta, Adriano Riosa.



ZURICH AIRPORT, ZURICH, SWITZERLAND
Designer: Damien Pericles

The aim of the project is to integrate Zurich airport into the landscape context, eliminating the rigid separation induced by the airport boundary. It sets out to establish visual and above all ecological communication between the inside and outside of the airport by creating a green belt around the edge and a series of green corridors.

Measures for Zurich Airport, Switzerland.
By Damien Pericles.

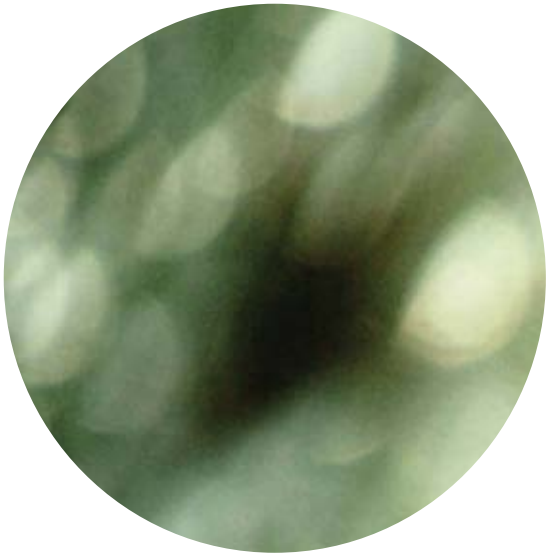

KLM
CARGO
CARGO

AMSTERDAM SCHIPOL AIRPORT, AMSTERDAM, THE NETHERLANDS

Designer: Toine van Goethem

This "eco-barrier" was designed for Amsterdam Schipol Airport to reduce the noise caused by aircraft during takeoff. Inside a glass fibre tent, a tank of algae is fed with carbon dioxide, particulate and fermented waste to produce biofuel. Nearby, waste substances such as potassium acetate and glycol, used for routine de-icing of runways and aircraft, ferment in a biological tank to produce natural gas for use as fuel.

Sound measures for Amsterdam Airport, The Netherlands.
By Toine van Goethem.



AREA (m^2)	40,001 m^2	13,330 m^2	4,000 m^2
YEAR OF CONSTRUCTION	1990	1994	2002
LOCATION	Frankfurt International Airport (FRA) Ftrankfurt, Germany	Schiphol International Airport (AMS) Amsterdam, The Netherlands	Dock E at Zürich-Kloten International Airport (ZRH) Zurich, Swiss

Airport green roofs.
Source data: Greenroofs.com, 2011.
Diagram by Laura Cipriani.

GREEN ROOFS

1,319 m^2	1,200 m^2	828 m^2	913 m^2	743 m^2	604 m^2	279 m^2	295 m^2
2008	2005	2008	2009	2003	2008	2009	2008
O'Hare International Airport (ORD) Building 607, South Vault + Duct Bank Buildings Chicago, United States	Copenhagen International Airport (CPH) Kastrup Power Plant Kastrup, Denmark	O'Hare International Airport (ORD) North Air Traffic Control Base Building Chicago, United States	Port of Portland International Airport (PDX) Headquarters Portland, United States	Boeing Field County International Airport (BFI) Terminal Building Seattle, United States	O'Hare International Airport (ORD) Mount Prospect Road Guard Post Chicago, United States	Vancouver International Airport (YVR) Terminal Richmond, Canada	Chicago Midway International Airport (MDW) Garage Chicago, United States

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