ET2050
Territorial Scenarios and Visions for Europe

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VOLUME 7 –
Territorial Impact Assessment (TIA)
of the four ET2050 Scenarios

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This report presents a more detailed overview of the analytical approach to be applied by the ET2050 ESPON project. This Applied Research Project is conducted within the framework of the ESPON 2013 Programme, partly financed by the European Regional Development Fund.

The partnership behind the ESPON Programme consists of the EU Commission and the Member States of the EU27, plus Iceland, Liechtenstein, Norway and Switzerland. Each partner is represented in the ESPON Monitoring Committee.

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The web site provides the possibility to download and examine the most recent documents produced by finalised and ongoing ESPON projects.

This basic report exists only in an electronic version.

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1. Goals and methodology

The application of TIA to assess territorial impact of the four scenarios built for 2030 is considered an essential part of the TPG work, as it can provide knowledge support to the ongoing and following participatory and partnership process intended at defining a shared 2050 Vision for the EU.

The methodology utilised is the one developed since the beginning of the ESPON Programme through subsequent Projects: the previous project on Scenarios 3.2, which produced the prototype model TEQUILA; the TIPTAP Project which further developed it (TEQUILA 2); the ARTS Project that simplified the previous models and applied them to a number of EU Directives (TEQUILA 3). Therefore, the software of the model is substantially available, and the main methodological task regarded its fitting with the specificities of the present Project, namely its utilisation for assessing impacts of general scenarios and not of projects, programmes or policy tools (TEQUILA 4).

The TEQUILA model, in its subsequent versions produced by the team of Politecnico di Milano, is the only available assessment tool capable of responding to the complex mission that was assigned to the project: calculating the likely impacts of multiple driving forces defining the different scenarios; defining these impacts on all NUTS 2 regions of the EU 28; considering impacts on a wide list of fields, going from economy to society, from environment to local identities.

These tasks call inevitably for a quantitative tool, capable of accommodating together both quantitative forecasts and qualitative, experts' judgments. The Tequila model is therefore a flexible and interactive multicriteria model where the critical element – namely the 'weights' assigned to the different impact fields in order to calculate 'summative' impacts – is defined not in a technocratic way but through a participatory and cooperative process engaging European top ministerial officers and policy makers (those sitting in the ESPON Monitoring Committee).

In terms of impact forecasts, most of the necessary inputs to the TIA model were provided by the estimation and simulation processes of the quantitative models and tools utilised in the project (namely MASST, SASI and MOSAIC). Where this proved unfeasible, sets of complex indicators were provided through statistical elaborations on the basis of group work and discussion inside the TPG.

The phasing of the assessment process involved the definition of the criteria (or "impact fields"), of the main driving forces inside the scenarios, of the weights (attached to each criterion/impact field) to be considered in the evaluation of scenarios, and the identification of the relevant basic indicators needed.

The time horizon for the TIA was established in year 2030. Beyond that date, availability of quantitative forecasts becomes more and more scarce and unreliable, and qualitative answers through experts' judgement that were tried inside the project for 2050 proved substantially not dissimilar with respect to those for 2030.

2. The phases of the assessment process.

TIA assesses the impact of the four scenarios elaborated in the Project: baseline, megas, cities and regions on 20 single impact fields next aggregated into four macro development fields and finally summed in the overall territorial impact.

A. The criteria.

The criteria considered are 20, defined and streamlined starting by the ones proposed by the EU Impact Assessment Guidelines (2009), as agreed with the ESPON MC at the Paphos meeting in

December 2012. They are listed below in Table 1, together with their grouping into macro development fields.

Table 1. List of single impact fields and their grouping into macro-fields

Macro-field	ACRONYM	Single impact field
Economy (EC)	EC1	GDP
	EC2	Employment (manufacturing + services)
	EC3	Innovation
	EC4	Tourism
	EC5	Accessibility
Society (S)	S1	Unemployment
	S2	Disposable income per capita
	S3	Road accidents/Safety
	S4	Risk of poverty
	S5	Net migration
Environment (ENV)	ENV1	Land consumption
	ENV2	Emissions/pollutants in air
	ENV3	Congestion
	ENV4	Flood hazard
	ENV5	Land erosion
Territorial Identity (TI)	TI1	Landscape fragmentation
	TI2	Creativity
	TI3	Cultural heritage
	TI4	Natural heritage
	TI5a	Multi-culturality (urban areas)
	TI5b	Multi-culturality (rural areas)[1]

B. The assessment procedure.

A quantitative assessment procedure could be applied only to the following fields: GDP, Employment (manufacturing + services), Innovation, Accessibility, Unemployment, Disposable income per capita, Road accidents/Safety, Net migration, Emissions, Congestion, Landscape fragmentation, whose values in the four scenarios at 2030 are elaborated by simulation models. Their definition, measurement and model source are presented in Table 2.

[1] Multi-culturality was felt as an important criterion to be retained by the MC, but it was felt as an ambiguous one, being attached to different values in urban and rural contexts. Therefore the assessment was split in two sub-criteria, each one valid in a single regional context.

Table 2. Quantitative impact fields

	Impact field	**MODEL**	**Measurement**
ACRONYM	**Economy**		
EC1	GDP	MASST	GDP
EC2	Employment (manufacturing + services)	MASST	Employment (thousands of people), both manufacturing and services
EC3	Innovation	MASST	Share of firms introducing product and/or process innovation
EC5	Accessibility	SASI	Accessibility by air7road7rails
	Society		
S1	Unemployment	MASST	Unemployment rate
S2	Disposable income per capita	MASST	GDP per capita
S3	Road accidents/Safety	MOSAIC	Persons per km by motorway over persons per km by road + persons per km by motorway
S5	Net migration	SASI	Net migration rate
	Environment		
ENV2	Emissions/pollutants in air	MOSAIC	CO2 emissions due to road and rail traffic/km2
ENV3	Congestion	MOSAIC	Congestion measured as vehicle-km by road over total length of lanes (length of road x number of lanes), that is, average occupation of the infrastructure.
	Territorial identity		
TI1	Landscape fragmentation	MOSAIC	Length of new infrastructures in km (roads and rails)/km2

Potential impacts for each scenario were computed as variations with respect to regional conditions in the initial year 2010.[2]

For all other assessments, impacts were defined through experts' judgement, inside the TPG. In this process, the main elements characterizing each scenario were aggregated into four main Driving Forces, in order to help summarising their Potential Territorial Impact:

- Economic: macroeconomic elements, financial markets, international competition and trade, FDI, technological change
- Cultural/Political: international solidarity, environmental awareness, inclusiveness, migration
- Policies: Cohesion policies, rural development;
- Policies: Transport policies, urban policies.

C. Computation of the Territorial Impact

In all TEQUILA models, the territorial impact on each region derives from two elements, namely a ***"Potential Impact"***, determined by modelling or qualitative expert judgement, and a ***"Regional Sensitivity" coefficient***, indicating the different importance attributed to (similar) impacts in different regional conditions. This logic follows the methodology already implemented in the ESPON TIPTAP and ARTS projects.

The computation of potential impacts follows two distinctive logics according to the availability of quantitative indicators derived from simulation models developed in the frame of ET2050 project.

[2] In particular, for level variables (i.e. GDP, Employment, Accessibility, Disposable income per capita, Emissions, Congestion), variations were computed as annual growth rate with respect to 2010. For the remaining variables (i.e., rate or share variables), variations were computed as simple differences between the values at 2030 (in each of the four scenarios considered) and the value at 2010.

First logics: quantitative impact assessment.

When simulation and forecasting models were available for specific impact fields, a quantitative assessment procedure was applied. In particular, the territorial impacts generated by each scenario were defined in two-steps:

a. models provided quantitative *"Potential Impacts"* (e.g., on GDP, unemployment, emissions, migrations),
b. the TIA team (Politecnico di Milano) elaborated a *"Regional Sensitivity Matrix"*, indicating the relative importance attributed to (similar) impacts in different regional conditions, through a system of coefficients. This matrix was already used in the ESPON ARTS Project, and was redefined in this project according to the new and reduced list of impact fields considered. This Matrix is of course invariant with respect to the scenario considered. The definition, measurement and source of the indicators used in this matrix is available in Table A1 in Annex 1. [3]

The Territorial Impact (TIM) result is obtained by a simple multiplication:

$$\boldsymbol{TIM_{ir} = PIM_{i,r} * RS_{i,r}}$$

where TIMir is the Territorial Impact on field *i* of region *r*, PIM_{ir} is the potential impact on field *i* of region *r* and RS_{ir} is sensitivity of the region to the same impact *i*.

Second logics: qualitative impact assessment.

For the remaining fields where a model was not available, a qualitative assessment procedure was applied. In this case, the Potential Impact was defined by the TPG members by means of a questionannire, while the Regional Sensitivity Matrix remained the same as before.

Two matrices were filled through team work and discussion:

- a ***Field Impact Matrix***, defining the impact of the main driving forces of each scenario on each Impact Field, irrespective to regions, on a 5-point scale: nil, low, moderate, strong, very strong;

- a ***Regional Impact Matrix***, defining the impact of the main driving forces of each scenario on each typology of regions, irrespective to impact fields, on a 5-point scale: nil, low, moderate, strong, very strong. The typologies of regions considered were the following: Agglomerated/urban/rural; East/North/South/Centre; Mountainous; Coastal; Border; Outermost; Advanced/lagging/medium; Industrial; Service-based; Touristic.

Table 3 reports the definition, measurement and source of each typology.

[3] The general concept utilised in this matrix consists in the assumption that the relevance of the same impact for a specific region is higher the lower its present condition is with respect to the same indicator (the relevance of a same future GDP increase is inversely proportional to the present regional GDP per capita: higher in poor regions). This assumption allows us to use 'objective' statistical indicators for the sensitivity matrix.

Table 3. Regional typologies: Definitions

Regional typology	Definitions
Agglomerated/urban/rural	ESPON typology
East/North/South/Centre	EAST =BG, CZ, CY, EE, HU, LT, LV, MT, PL, RO, SK, SI NORTH = DK, FI, IE, IS, NO, SE, UK SOUTH = ES, GR, IT, PT CENTRE = AT, BE, CH, DE, FR, LI, LU, NL
Mountainous	If at least in one NUTS3 > 50% pop. Lives in mountainous regions (def. From EUROSTAT http://ec.europa.eu/regional_policy/sources/docgener/work/2009_02_geographical.pdf, p.4). Source ESPON on EUROSTAT
Coastal	If the NUTS2 contains at least one NUTS3 with a high/very high % pop. living on coastal areas. Source ESPON on EUROSTAT
Border	If the NUTS2 contains at least one NUTS3 eligible in border cooperation programmes. Source ESPON on EUROSTAT; EU external border (excluding international seas)
Outermost	Overseas territories of ES, FR, PT. Source ESPON on EUROSTAT
Advanced/lagging/medium	GDP/pc >125% of EU average =advanced; GDP/pc >75% EU average=lagging; other =medium. Source: ESPON 2005
Industrial	Location quotient based on employment in manufacturing (2007) greater than 1.25 with respect to EU average. Source: EUROSTAT
Service	Location quotient based on employment in services (2007) greater than 1.25 with respect to EU average. Source: EUROSTAT
Touristic	If the region is in the top 25% of the distribution of nights on population or in the top 10% of the distribution of 3-star Touring sites. Source: EUROSTAT, 2007 and ESPON

The two matrices, elaborated together with the Regional Sensitivity Matrix (and a support matrix indicating the belonging of each region to the different typologies) determine the Potential Territorial Impact (to be treated as before).

The Field Impact Matrix was obtained by computing the average evaluation across team members of the impact of each driving force of each scenario on each Impact Field.

The Regional Impact Matrix was similarly obtained by computing the average evaluation across team members of the impact of each driving force on each type of regions. It is worth remarking that the regional typologies considered are not always mutually exclusive. Therefore, the assumption was made that regions belonging to different types of regions are more exposed to a specific driving force, thus leading to a greater potential impact (i.e. a region belonging to many typologies shows a greater impact, given by the sum of impacts, than a region belonging to only one type of affected regions).

The regional Potential Impact was obtained, as the direct product between the Field Impact Matrix and the Regional Impact Matrix, by each driving force in each scenario, next summed across driving forces within each scenario. As all driving forces are at work in each scenario (albeit with different intensities), summation across driving forces by scenario reflects the idea that the Regional Potential Impact increases with the number of driving forces impinging on each field and type of region.

Finally, the Regional Territorial Impact was obtained by multiplying the Regional Potential Impact and the Regional Sensitivity Matrix, similarly to the quantitative assessment procedure see Figure 1).

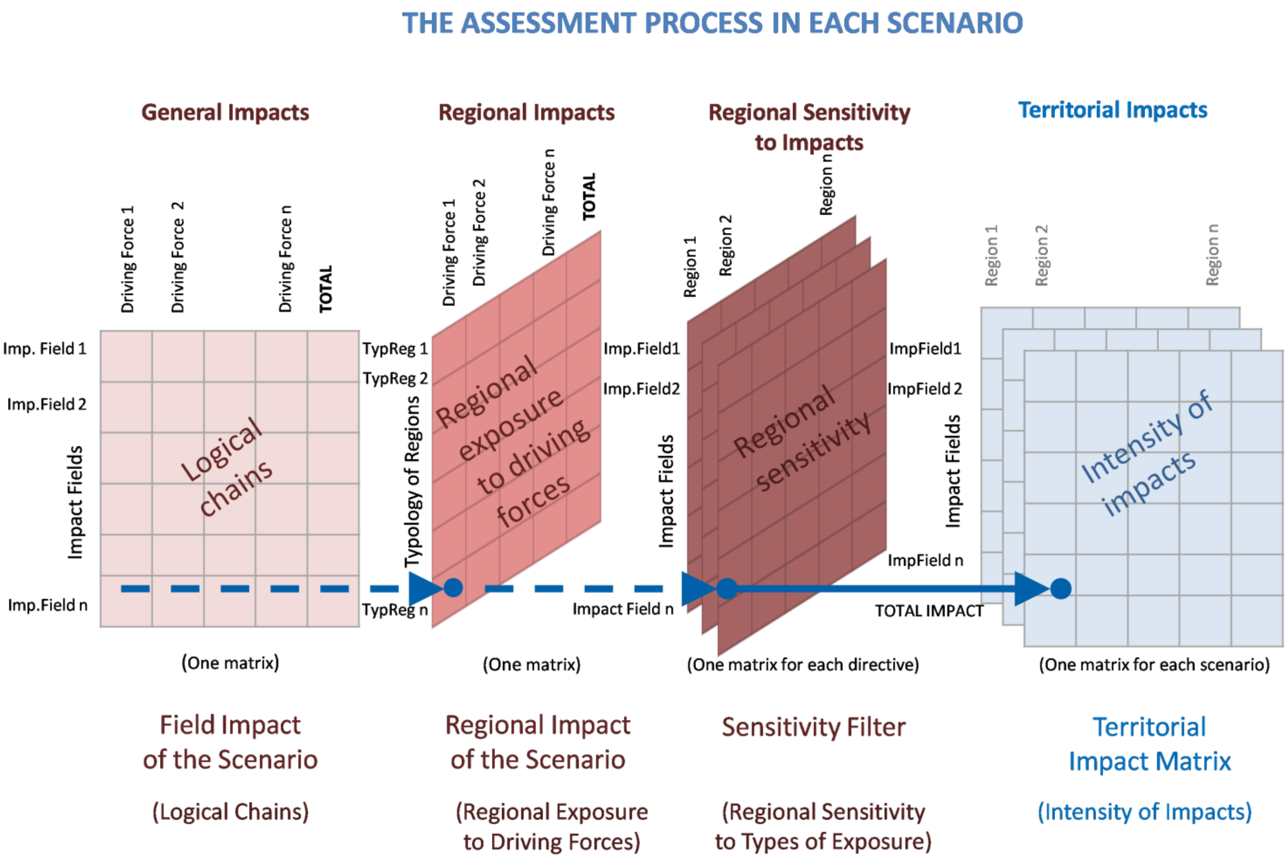
To compute aggregate impacts at the macro-field level, all Territorial Potential Impacts have been firstly min-max normalized between 0 and 100 (or 0 and -100, or between -100 and 100 when appropriate)[4].

Macro-field impacts, and the final Summative impact, have been obtained as weighted summation of the respective single impacts (or macro impacts) (see Table 1) through a system of weights obtained

[4] When the territorial impact on a specific field takes on both positive and negative values, but only a few regions (i.e. < 5% of total number of EU regions) show positive (respectively, negative) values, these regions have been treated as outliers and their territorial impact has been set to zero.

through a questionnaire circulated among MC members during the Paphos meeting, as detailed in Table 4 below. Concerning the weights of the macro fields (economy, society, environment and territorial identity), they also were defined by the members of the ESPON MC as indicated before. This weights definition to compute aggregate impacts was a major milestone of the ET2050 project: it establishes from a policy point of view the criteria to evaluate the results of the Scenarios obtained through a scientific pathway. The findings are based on 22 returned questionnaires.

Figure 1



THE ASSESSMENT PROCESS IN EACH SCENARIO
General Impacts
Regional Impacts
Regional Sensitivity to Impacts
Territorial Impacts
Driving Force 1
Driving Force 2
Driving Force n
TOTAL
Imp. Field 1
Imp.Field 2
Impact Fields
Imp.Field n
Logical chains
TypReg 1
TypReg 2
Typology of Regions
TypReg n
Regional exposure to driving forces
Imp.Field1
Imp.Field2
Impact Fields
Impact Field n
Region 1
Region 2
Region n
Regional sensitivity
ImpField1
ImpField 2
Impact Fields
ImpField n
TOTAL IMPACT
Intensity of impacts
(One matrix)
(One matrix)
(One matrix for each directive)
(One matrix for each scenario)
Field Impact of the Scenario
(Logical Chains)
Regional Impact of the Scenario
(Regional Exposure to Driving Forces)
Sensitivity Filter
(Regional Sensitivity to Types of Exposure)
Territorial Impact Matrix
(Intensity of Impacts)

Table 4.Single impact fields and development fields weights

	Weight (impact fields)	Weight (macro fields)
Economy		**28.40**
GDP	25.45	
Employment (manufacturing + services)	28.86	
Innovation	19.32	
Tourism	8.41	
Accessibility	18.18	
Sum (economy)	*100.00*	
Society		**26.82**
Unemployment	33.86	
Disposable income per capita	20.86	
Road accidents	5.50	
Risk of poverty	22.50	
Net migration	17.27	
Sum (society)	*100.00*	
Environment		**25.23**
Land consumption	24.55	
Emissions/pollutants in the air	27.73	
Congestion	19.32	
Flood hazard	15.23	
Land erosion	13.18	
Sum (environmrnt)	*100.00*	
Territorial identity		**19.55**
Landscape fragmentation	17.64	
Creativity	20.00	
Cultural heritage	25.45	
Natural heritage	22.50	
Multi-culturality (urban areas)[5]	7.205	
Multi-culturality (rural areas)	7.205	
Sum (territorial identity)	*100.00*	
Sum (macro fields)		***100***

3. Results of the assessment process

The overall process described above gives rise to a long list of maps, showing the expected territorial effects of the four alternative scenarios for the fields (20) listed in Table 1: in total, 80 maps. Then, for each scenario, 4 aggregate maps were computed for each macro-field (economy, society, environment and identity[6]) and 1 'summative impact' map: in total, 20 more maps. Overall 100 maps. Of course not all of them are inspected here, but all are shown in the data base.

Let us have a short look on them.

[5] The original questionnaire did not distinguish the impact of multi-culturality between urban and rural areas and respondents were asked only to assess multi-culturality in general. Following discussion with ESPON MC, the two dimensions were separated and, in absence of any a-priori assumption on their relative relevance, they were attribute equal weight by dividing by two the original weight attributed to multi-culturality in general.

[6] The identitarian dimension was added to the other, more common dimensions since the earliest years, with the prototype TEQUILA model. Also during the first participatory definition of weights for the TIPTAP project during the ESPON Prague meeting , with experts, top officers and policy makers, the identitarian dimension received much more consensus than expected.

Impact on GDP (EC1): these maps show substantially what was already presented in the results on regional growth produced by the MASST model, represented in terms of GDP growth. The Cities scenario shows the fastest and more diffused growth.

Impact on employment (EC2): the highest (positive) impact is on northern, central and eastern counties and on Atlantic coastal regions.

Impact on Innovation (EC3): these maps show that the period up to 2030 will be mainly one of innovation diffusion from core to more peripheral regions (Map 1). These latter regions will catch up fastly, especially in the Cities and Megas scenarios: in the former due to the dynamism of second and third-rank cities and in the latter because of a probably faster pace of generalised technical progress.

Impact on tourism (EC4): the major positive impact will show-up in the 'Latin arch' regions (both in coastal and mountain areas), in Greece and many eastern regions. In the Megas scenario there will be a higher concentration on large cities (cultural and business tourism); in the Cities scenario there will be a 'concentrated diffusion'; in the Regions scenario a wider diffusion eastward and northward (to Scandinavia and NMCs) (Map 2).

Impact on accessibility (EC5): accessibility improves smoothly in the continental periphery (Map 3). In the Megas scenario, some new poles will emerge in NMCs.

Impact on unemployment (S1): catching-up with respect to the present condition will take place in peripheral areas of the east, west and south, while core and central areas will show some emerging problems.

Impact on disposable income (S2): the improvement will mainly show up in eastern, northern (Baltic), central (Germany) and south-wstern France. In the Cities scenario a wider diffusion is apparent.

Impact on road accidents (S3): the highest problems are present in internal areas in all countries; the situation gets worse in the Regions scenario.

Impact on risk of poverty (S4): it is mainly a southern and southern-eastern problem in Europe; in the Megas scenario becomes also a problem of urban poverty due to dual societal trends (Map 4).

Impact on net migration (S5): the major positive impacts on net migrations are on those regions characterized, in 2010, by the highest flows of emigrants, such as the NMS. Countries traditionally associated to intense flows of immigration (Germany) will maintain their attractiveness.

Impact on land consumption (ENV1): mainly a problem of southern European problem (and particularly an Italian problem) on coastal and large urban regions, but also a southern-eastern problem (Map 5). In the Megas scenario the problem concentrates more on large city regions.

Impact on emissions (ENV2): the main concern refers to high growing regions in the east and northern-central Europe (Benelux regions and Denmark). In this case only the regions that were above the European average in 2010 are shown, as it would be excessive to raise concern on regions that being either less developed or virtuous in environmental terms, have increased their emissions. In the Megas scenario, negative impacts show up in capital cities (Map 6[7]). Nevertheless, interestingly enough, many regions show a decrease in total emissions.

Impact on congestion (ENV3): similarly to the preceding maps, the problem concerns mainly central Europe and emerging eastern countries (plus Tuscany in Italy). In the Megas scenario congested large traffic corridors emerge.

Impact on flood hazard (ENV4): according to the baseline scenario, it is mainly a problem for southern Mediterranean countries and coastal regions, plus north-western regions in the Iberic peninsula and

[7] Data shown in the map are not standardized. Therefore, the map shows the relative change in CO_2 emissions between 2010 and 2030.

some south-eastern regions. The intensity of the problem goes down in all, more policy oriented scenarios, and especially in the Cities and Megas ones.

Impact on land erosion (ENV5): the map for the Baseline scenario is similar to the preceding one, but on the other hand the intensity of the problem shows up increasingly in the Megas and Cities scenarios.

Impact on landscape fragmentation (TI1): the main problems refer to coastal and mountain areas and to the main traffic corridors in eastern countries.

Impact on creativity (TI2): a positive impact on creativity shows up quite uniformly, especially in the western Mediterranean countries, Portugal, south-eastern and Baltic countries. In the Cities scenario, a concentrated diffusion process takes place (Map 7).

Impact on cultural heritage (TI3): in the Baseline scenario, positive impacts show-up in the traditional heritage sites. In the Megas scenario, higher impacts manifest in large city-regions, but less exploitation is apparent in Eastern countries. In the Cities and Regions scenarios, heritage is better exploited in wide eastern and northern areas (Map 8).

Impact on natural heritage (TI4): in the Baseline and Regions scenarios, natural heritage is improved mainly in southern countries; in the Megas scenario, is improved more in the central and northern countries; in the Cities scenario, the natural environment is better utilised by cities as a specific competitive advantage.

Impact on multi-culturality (cities) (TI5a): concentrated improvements are showing up in the Megas scenario, and more diffused improvements in the Cities scenarios (Map 9).

Impact on multi-culturality (rural) (TI5b): negative impacts on many southern European regions.

Let us now analyse impacts calculated on aggregate macro-criteria: on economy, society, environment and identity.

Impact on ECONOMY: the impact on economy is overall positive, and particularly strong in NMCs, Baltic western countries, western and southern France. In the baseline scenario, a huge homogeneity appears inside countries, but also strong national effects which keep southern European countries, and Greece in particolar, much less affected by positive changes. The Regions scenario is equally homogeneous, but more cohesive as far as southern European countries are concerned: many regions in Portugal, in southern Spain, central and southern Italy and Greece benefit from some more relevant growth impacts. The Megas (Map 10) and Cities scenarios show wider regional differentiations inside the general macro-territorial development shown by the Baseline scenario; the former is of course more selective, the latter more diffused, with many more regional growth cases of with respect to the average performance of their countries.

Impact on SOCIETY: differently with respect to the previous aggregate effect, impacts on society show both positive and negative signs. Positive signs are more widespread, and show up in all NMCs, in southern Sweden and southern Finland (including Helsinki), most of France, Denmark and Spain (including capital regions), southern Portugal including Lisboa, many regions in England, Scotland and Wales, the entire Greece and Ireland. Negative scores show up in a large north-south belt running from Holland and Germany to Italy, touching also Belgium and Austria. These negative scores in some cases depend on the good present situation, which will not be totally maintained in the long term, while in other cases, like the Italian one, to persistent difficulties of the country.
Some improvements in the condition of some southern Italian, Belgian and Dutch regions show up only in the Cities scenario (Map 11), where negative signs are turning towards light positive ones.

Impact on ENVIRONMENT: impacts on environment are overall negative, but in general not too intense. The highest negative values are reported in Romania, Bulgaria and Hungary (this last country probably over-estimated), in northern Italy and Southern France, in Andalucia and Norte region, in Holland, Denmark and the entire southern Baltic coast. In the Megas scenario the impacts are overall lower, but some concentrations of negative conditions emerge in large Dutch cities, in Paris, London, Munich, in Rhone-Alpes and the entire southern French coast, in Copenhagen and southern Denmark, the North Sea coast in Germany and in Lithuania. In the Cities scenario, impacts are less severe, while some novel effects emerge in the Regions scenario (Map 12): NMCs experience a generalized higher negative impact while some relevant cases of positive environmental impacts are visible in a wide east-west belt in France, running south of Paris, in south eastern England with the exception of London, in Madrid and Extremadura in Spain, in the Warsaw region.

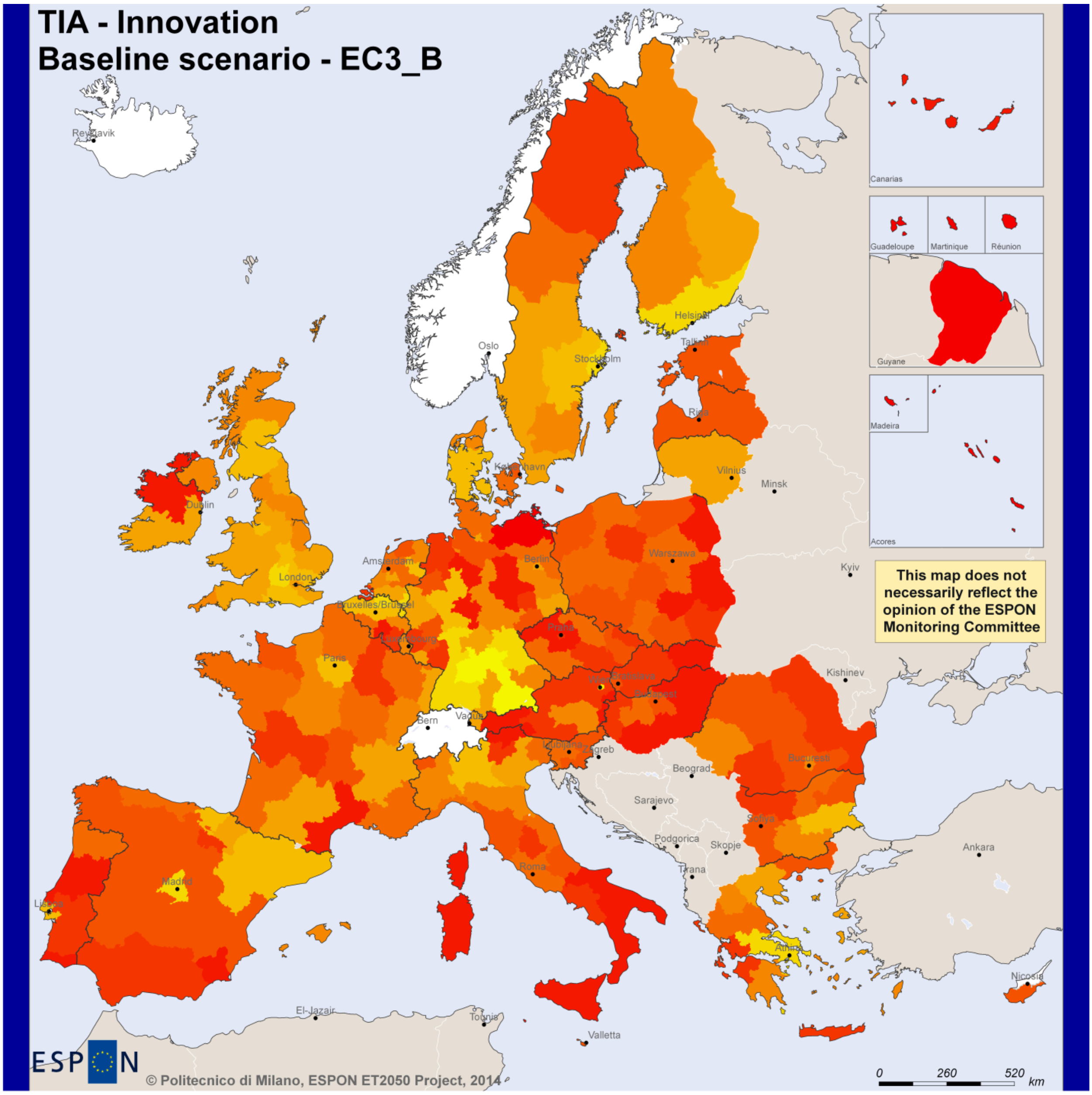
Impact on Territorial IDENTITY: impacts on territorial identities show generalized positive signs (Map 13). The highest values are shown by most southern countries (Portugal, Spain, southern France, Italy, Greece and also Romania and Bulgaria), many western and southern Polish regions, the Baltic Republics, some regions in Wales, central Sweden, southern Finland and Slovakia. A much more selective picture emerges in the Megas scenario, where only some specific regions present high values: Bavaria, Andalucie, Norte, the Krakow and Stockholm regions, Estonia, Latvia, southern Finland and most of Italian regions. In the Cities and Regions scenario in particular this last picture increasingly widens in the direction of medium-city regions and beyond.

SUMMATIVE IMPACTS. If we believe that positive and negative impacts may be compensated – and this is something that could be accepted, given the fact that impacts are not determined, in our case, by specific actions of projects, but by composite scenarios – then summative impacts may be calculated, one for each scenario.

In the baseline scenario (Map 14), we understand that positive impacts overcome the negative ones in all European regions. The picture indicates that the intensity of positive impacts will be inversely proportional to the present level of economic development, by and large, underlining a convergence in territorial cohesion that will take place in a comprehensive sense, in terms of living and working conditions and not just in economic terms. The highest scores are reached by NMCs, eastern regions in Germany, Portugal, Spain (particularly central and southern), France (particularly western), southern Belgium and also, to a lesser extent, Finland, Denmark, central and southern Italy and Greece. On the other hand, lower improvements will be experienced in Holland, western Germany, Austria and northern Italy.

The situation would slightly change in the Megas scenario, in favour of some ‘core’ areas: in south-east and central England, in northern Italy, in northern Germany, but the same diffusion of wellbeing and socio-environmental sustainability will be still apparent. The last two scenarios would not bring in any substantial differences with respect to the Baseline scenario.

Map 1. Impact on Innovation – Baseline scenario



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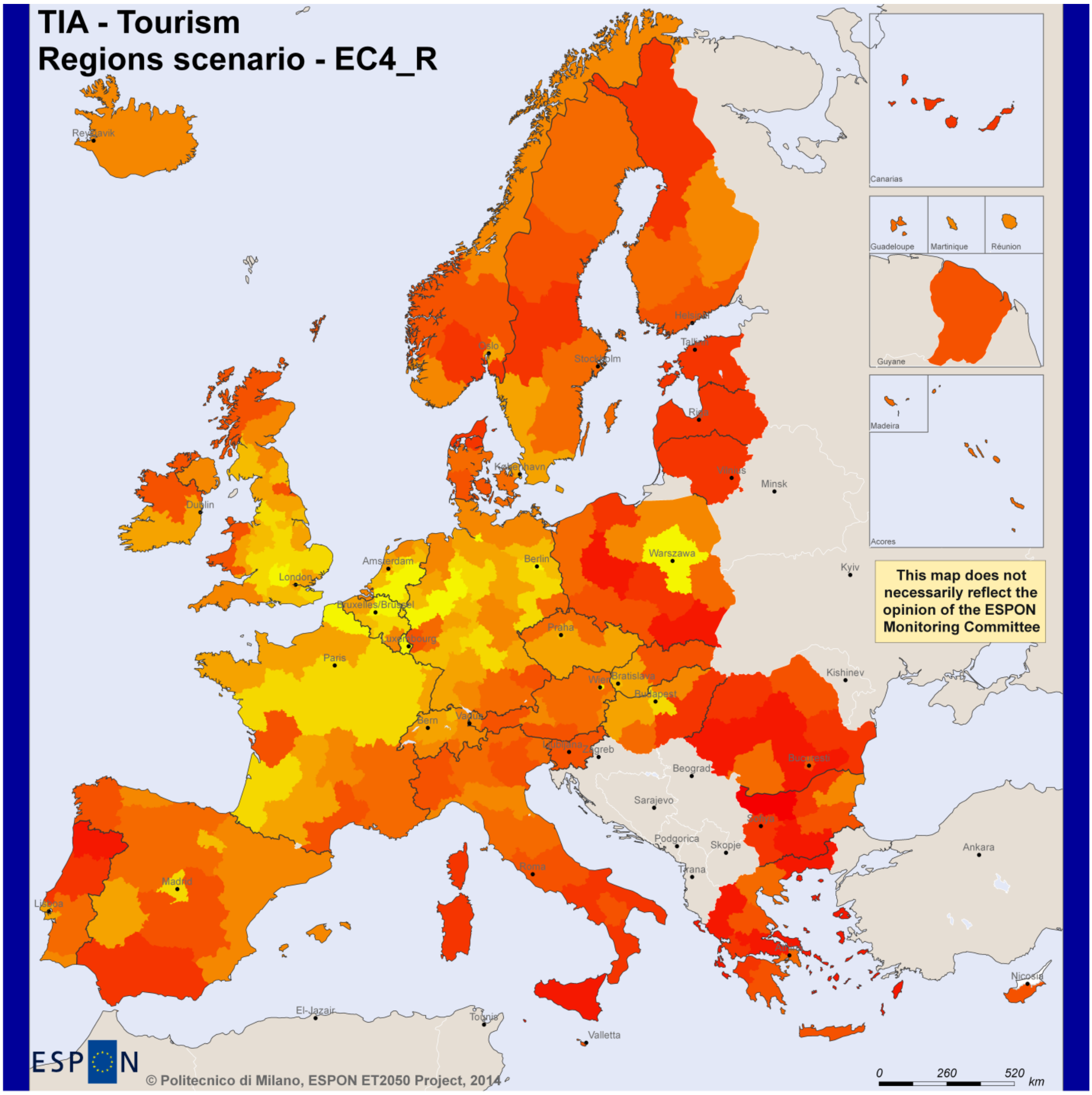
Regional level: NUTS2
Source: Politecnico di Milano elaboration, 2014
Origin of data:TEQUILA 4 model on data by MASST3

Legend

EC3_B

	0,000 - 24,150
	24,151 - 43,163
	43,164 - 53,651
	53,652 - 59,714
	59,715 - 64,246
	64,247 - 67,482
	67,483 - 70,195
	70,196 - 73,969
	73,970 - 81,051
	81,052 - 100,000
	No data

Map 2. Impact on tourism – Regions scenario



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Regional level: NUTS2
Source: Politecnico di Milano elaboration, 2014
Origin of data:TEQUILA 4 model on data by experts' judgement
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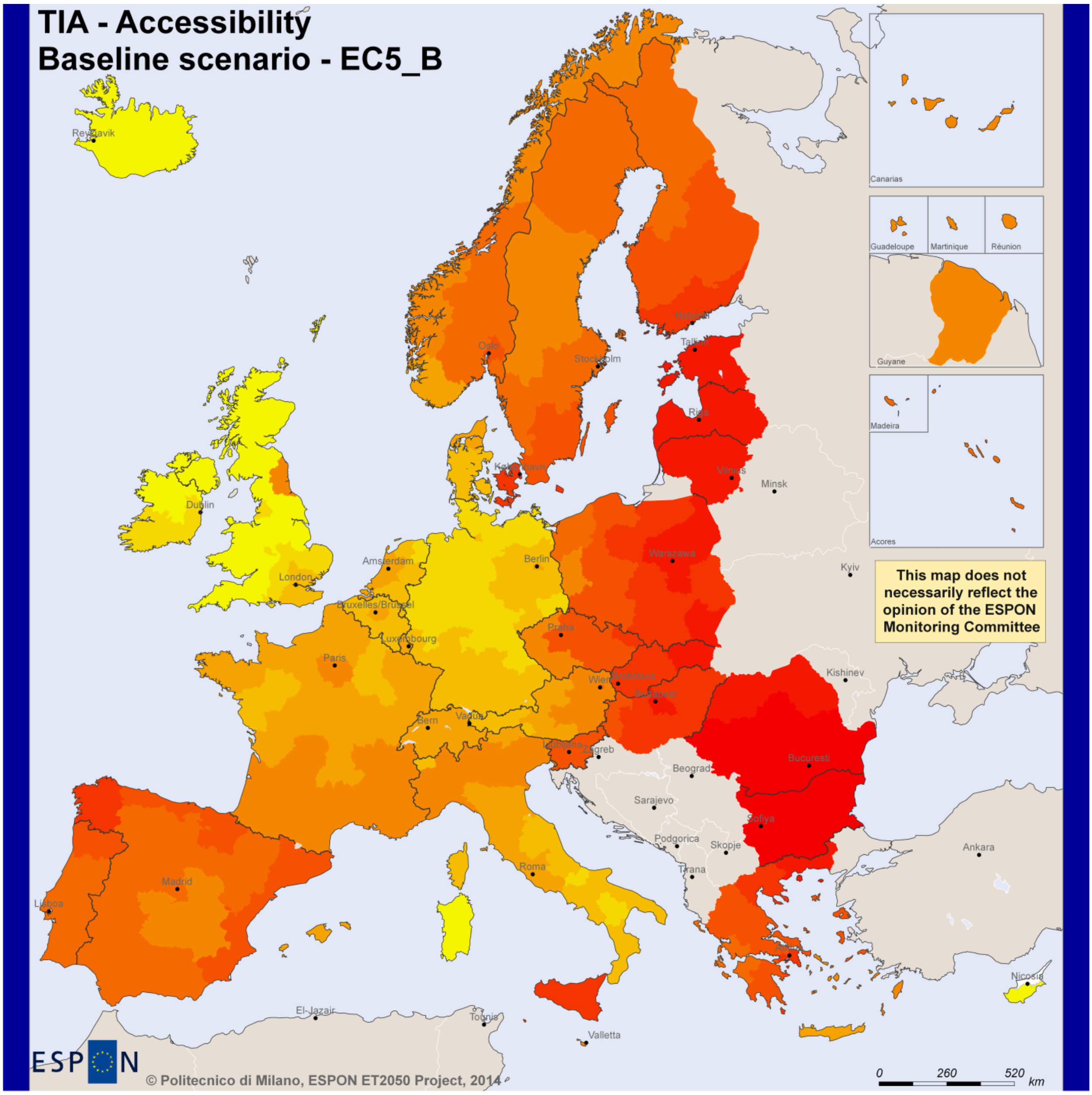
Legend

EC4_R

- 0,000 - 4,431
- 4,432 - 9,008
- 9,009 - 14,187
- 14,188 - 19,207
- 19,208 - 24,499
- 24,500 - 30,384
- 30,385 - 38,517
- 38,518 - 50,721
- 50,722 - 71,397
- 71,398 - 100,000
- No data

Map 3. Impact on Accessibility – Baseline scenario



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Regional level: NUTS2
Source: Politecnico di Milano elaboration, 2014
Origin of data:TEQUILA 4 model on data by SASI
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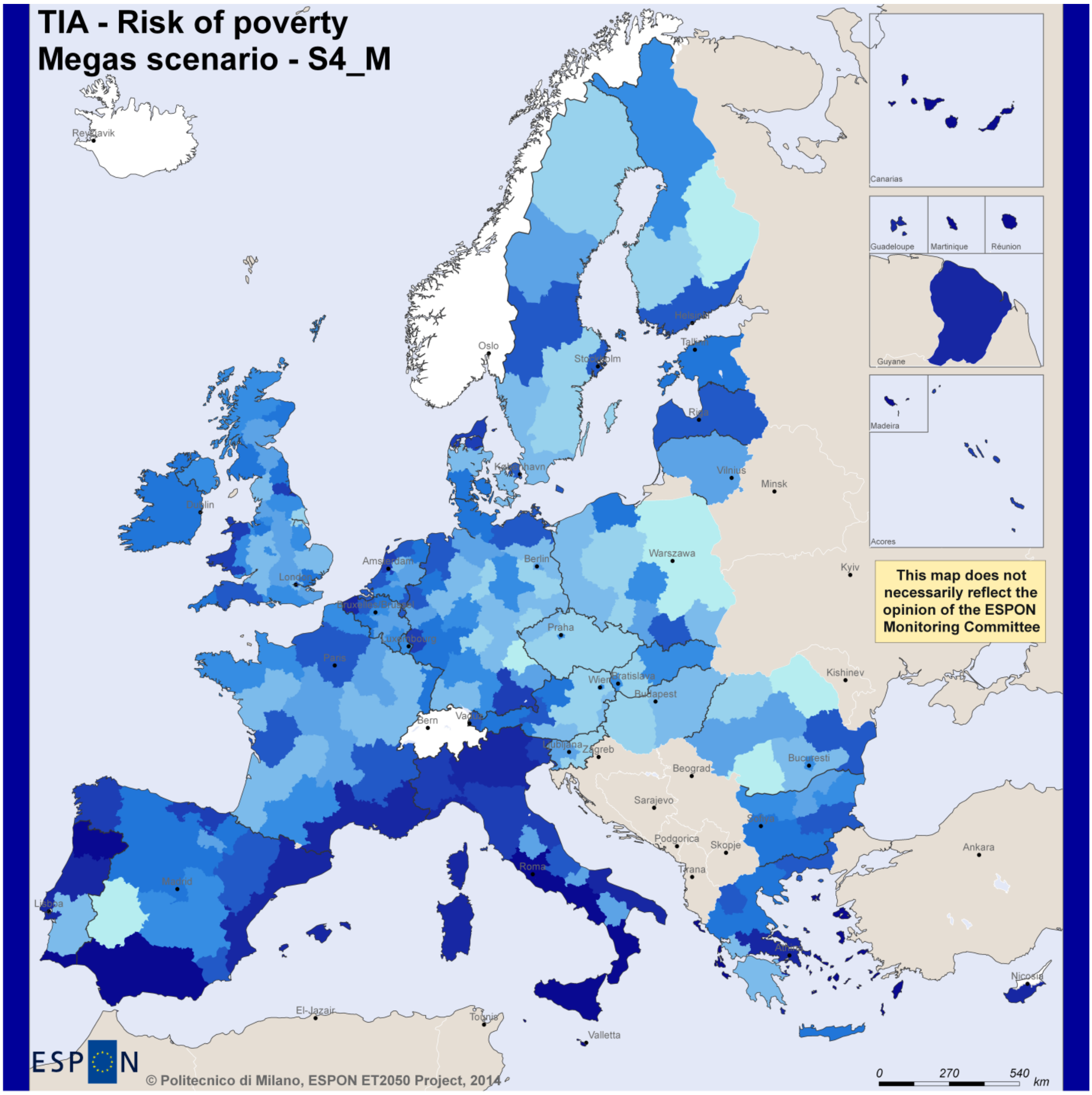
Legend

EC5_B

- 0,000 - 4,425
- 4,426 - 7,495
- 7,496 - 10,421
- 10,422 - 13,561
- 13,562 - 18,160
- 18,161 - 22,766
- 22,767 - 29,001
- 29,002 - 37,906
- 37,907 - 56,186
- 56,187 - 100,000
- No data

Map 4.Impact on risk of poverty – Megas scenario



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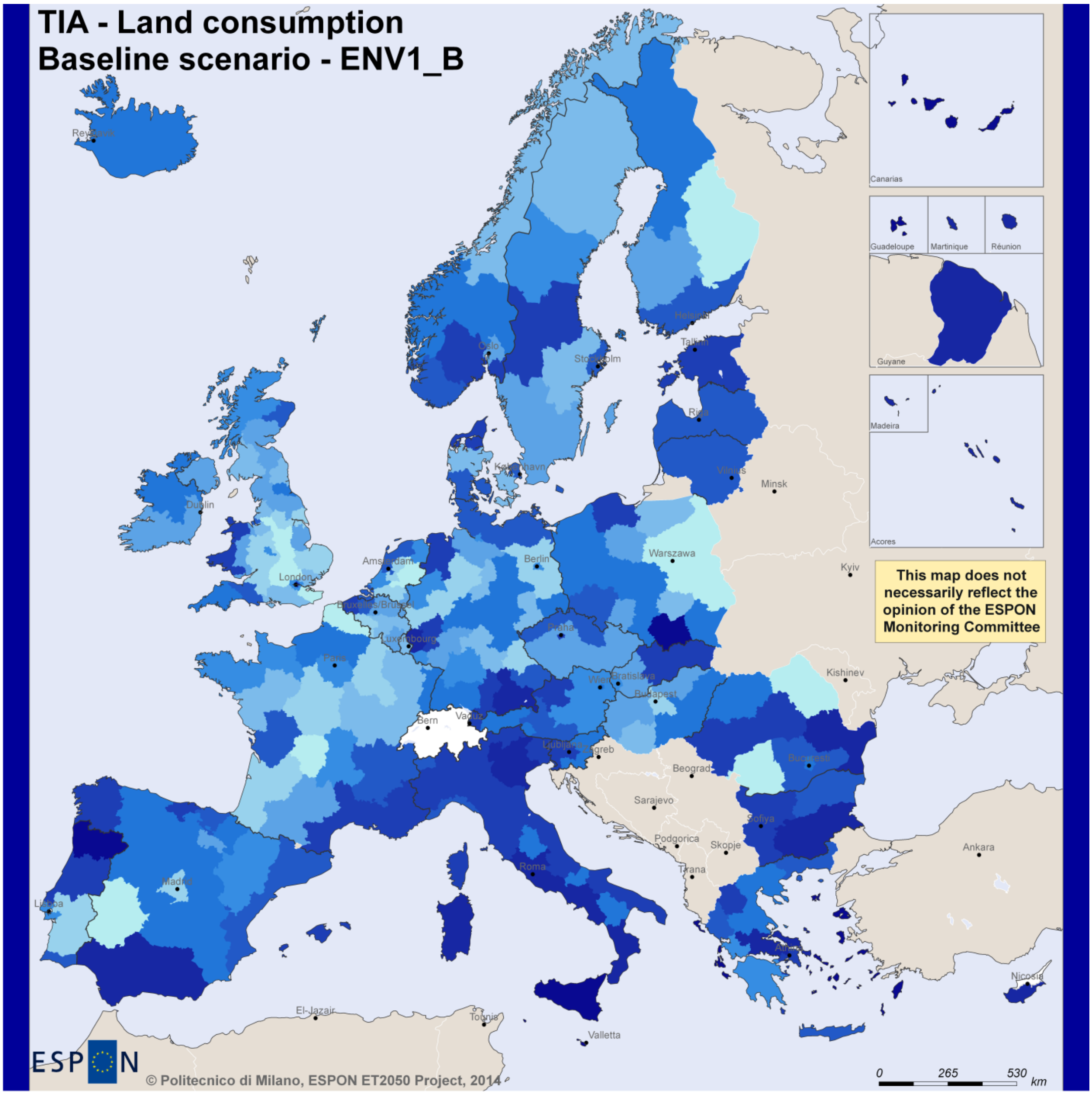
Legend

S4_M

- -13,233 - 0,000
- -21,466 - -13,234
- -28,550 - -21,467
- -33,102 - -28,551
- -37,891 - -33,103
- -43,444 - -37,892
- -50,604 - -43,445
- -59,319 - -50,605
- -72,618 - -59,320
- -100,000 - -72,619
- No data

Map 5. Impact on land consumption – Baseline scenario



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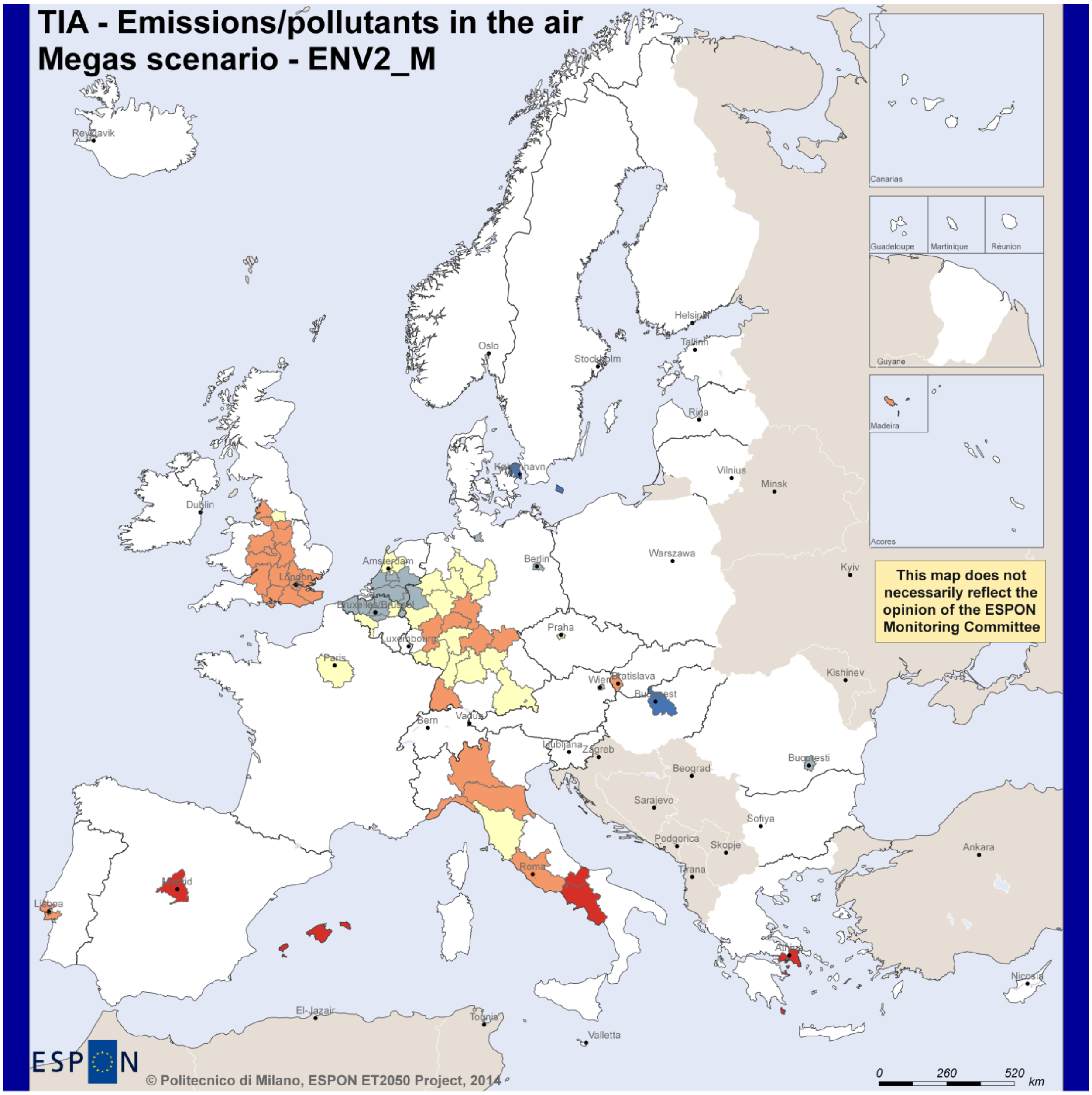
Legend

ENV1_B

- -16,855 - 0,000
- -23,950 - -16,856
- -30,960 - -23,951
- -37,235 - -30,961
- -43,381 - -37,236
- -50,687 - -43,382
- -60,361 - -50,688
- -70,587 - -60,362
- -86,420 - -70,588
- -100,000 - -86,421
- No data

Map 6. Impact on emissions – Megas scenario



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The map shows the change in CO_2 emissions only for the regions above the EU average in 2010.

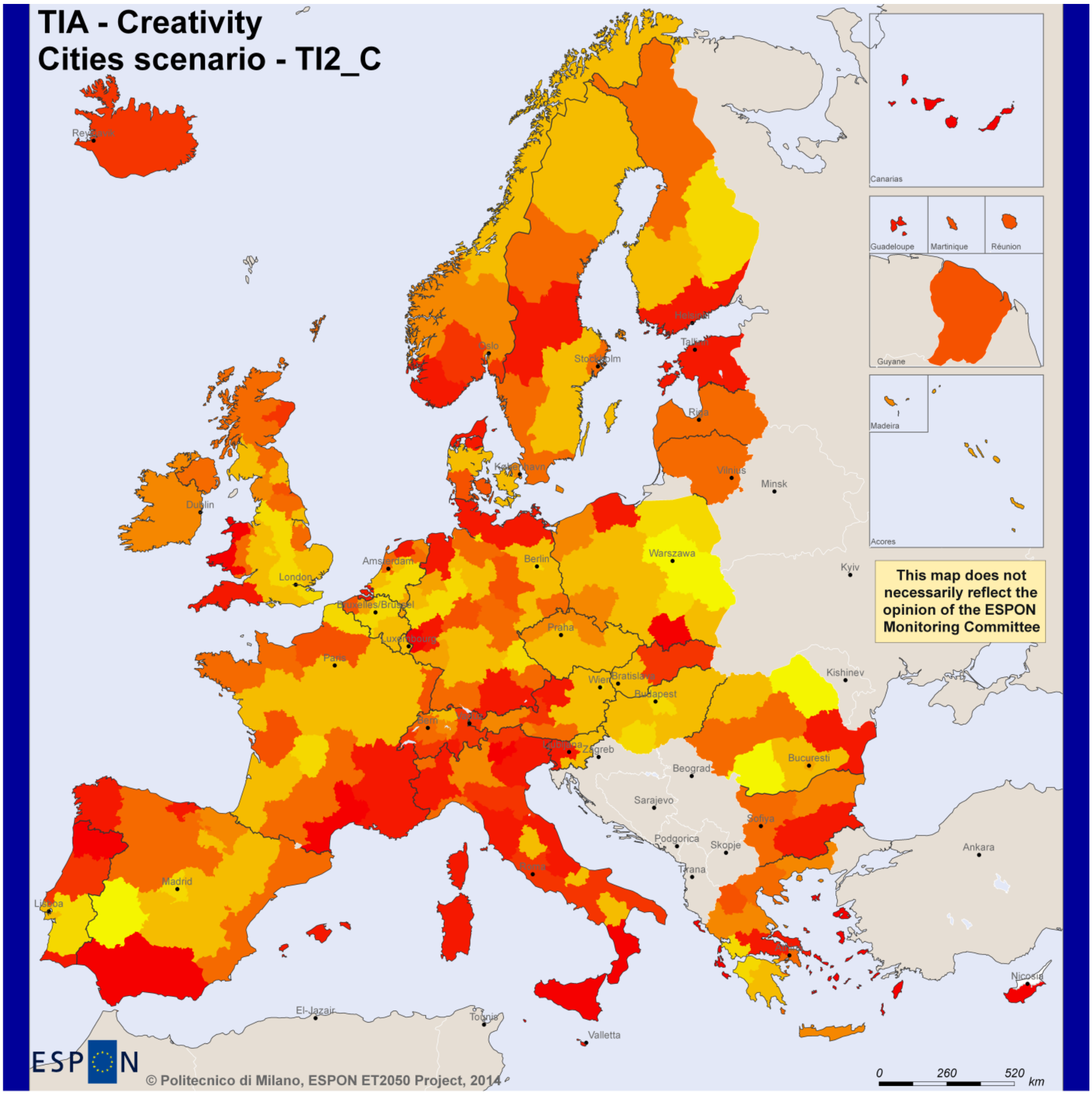
Note: values in the map are not normalized.

Legend

ENV2_M

- 0,298 - 1,048
- 0,090 - 0,297
- -0,058 - 0,089
- -0,252 - -0,059
- -0,514 - -0,253
- No data / below the EU average in 2010

Map 7. Impact on creativity – Cities scenario



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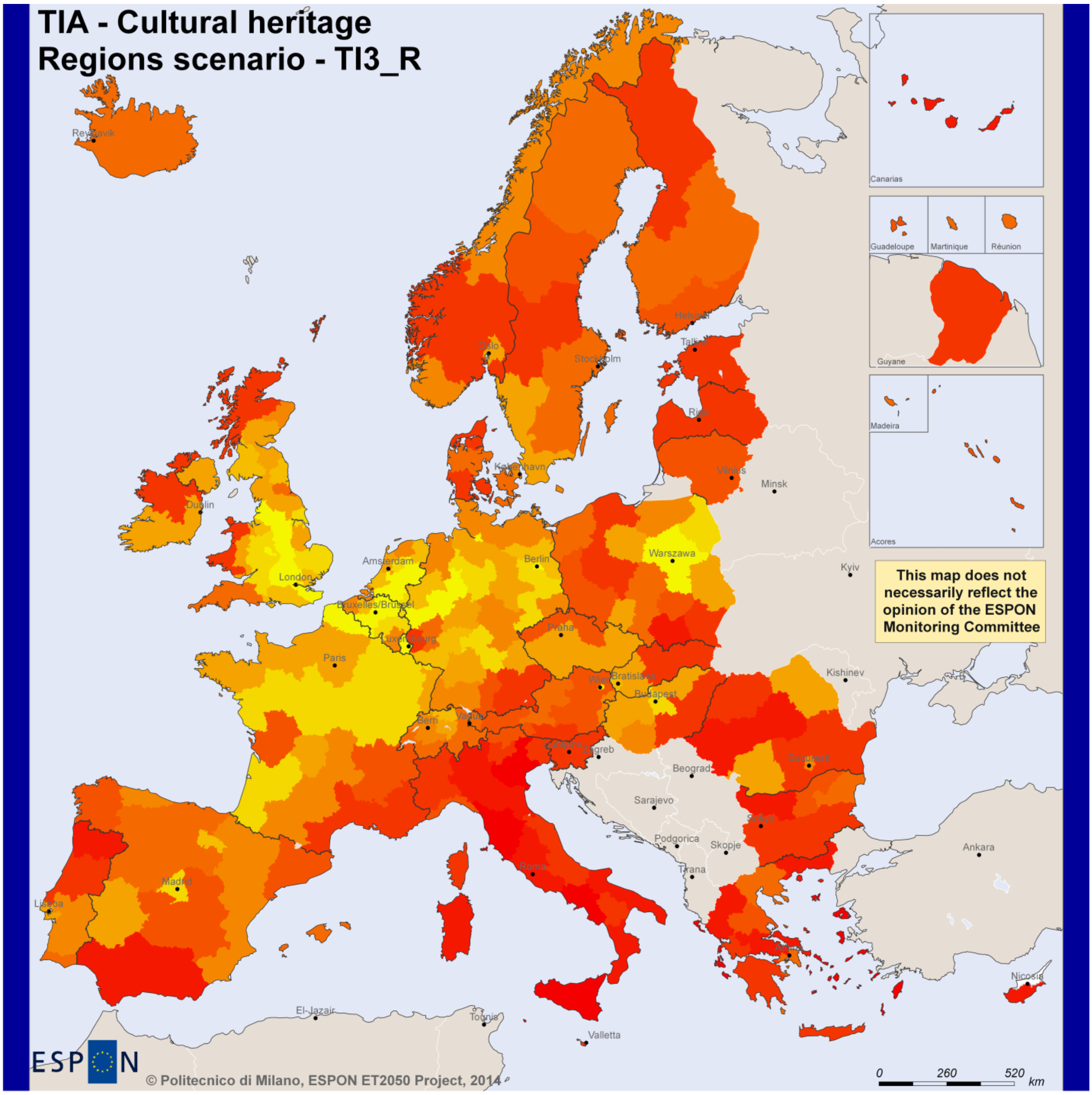
Legend

TI2_C

- 0,000 - 6,190
- 6,191 - 28,418
- 28,419 - 39,235
- 39,236 - 43,650
- 43,651 - 49,765
- 49,766 - 53,998
- 53,999 - 57,579
- 57,580 - 64,937
- 64,938 - 72,705
- 72,706 - 100,000
- No data

Map 8.Impact on cultural heritage – Regions scenario



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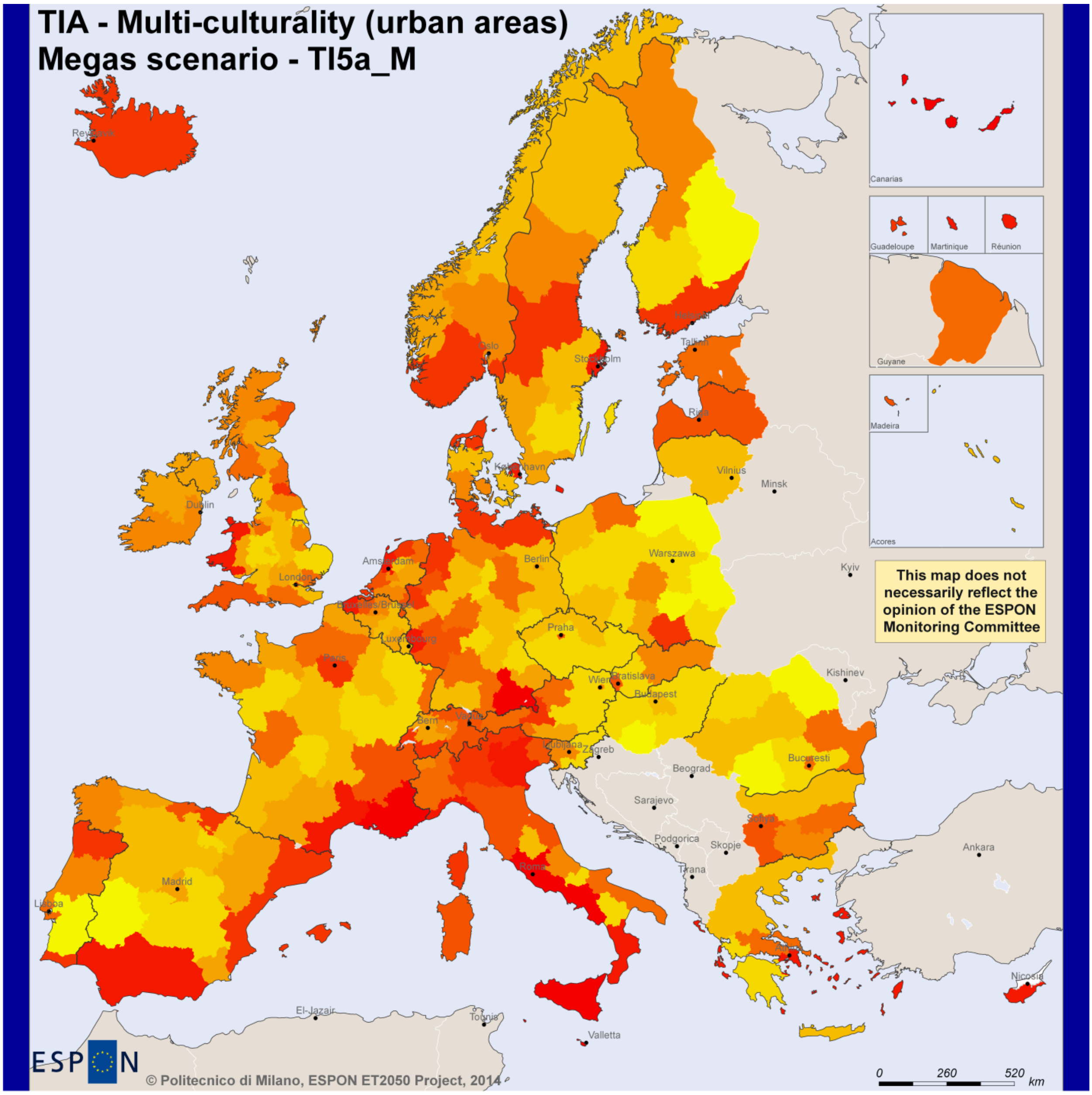
Legend

TI3_R

- 0,000 - 5,985
- 5,986 - 12,029
- 12,030 - 16,639
- 16,640 - 22,513
- 22,514 - 29,518
- 29,519 - 34,811
- 34,812 - 41,445
- 41,446 - 53,756
- 53,757 - 70,542
- 70,543 - 100,000
- No data

Map 9.Impact on multi-culturality – Megas scenario



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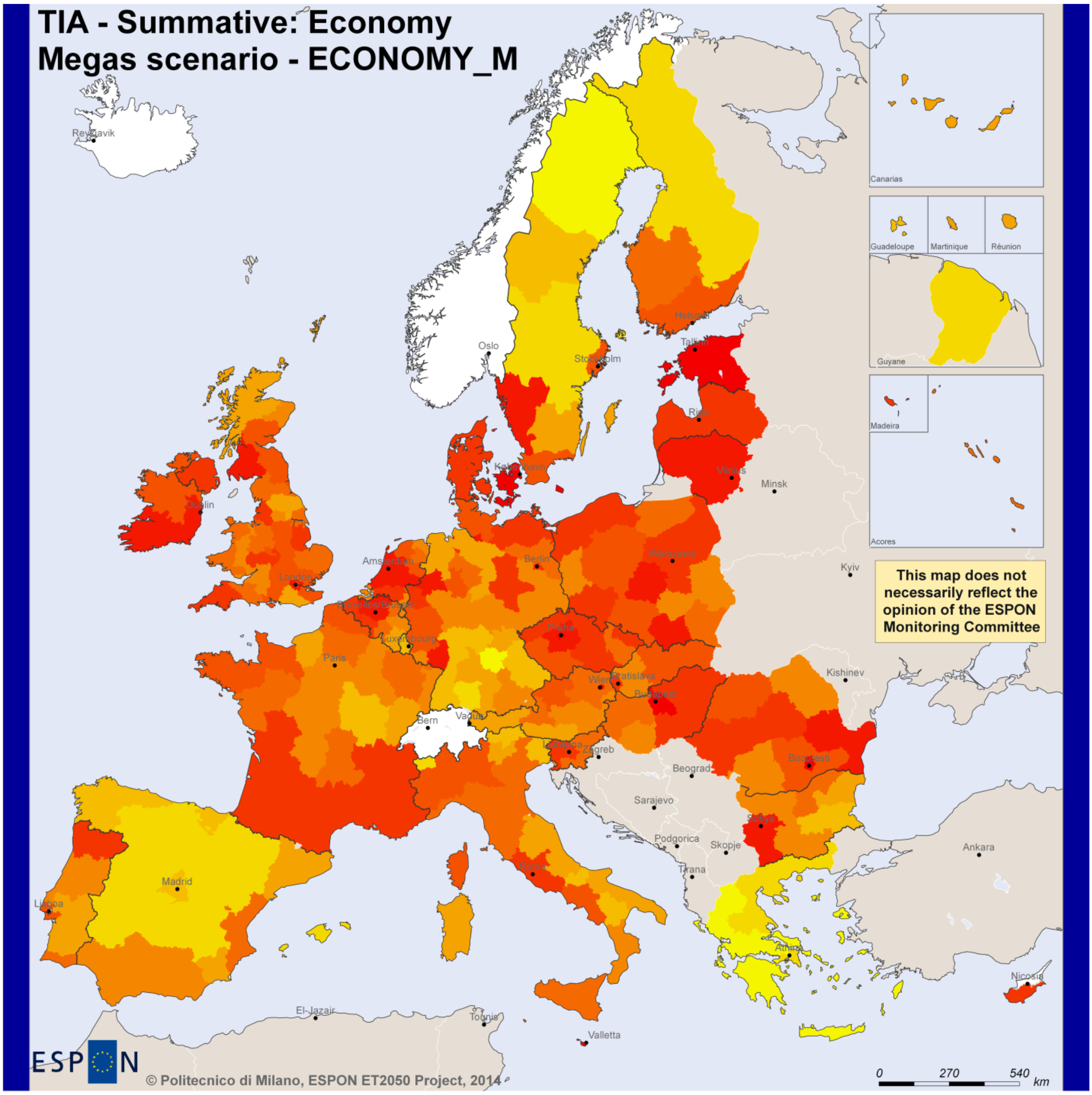
Legend

TI5a_M

- 0,000 - 17,650
- 17,651 - 36,981
- 36,982 - 46,781
- 46,782 - 52,743
- 52,744 - 57,612
- 57,613 - 63,146
- 63,147 - 69,949
- 69,950 - 75,500
- 75,501 - 87,298
- 87,299 - 100,000
- No data

Map 10. Summative impact on economy – Megas scenario



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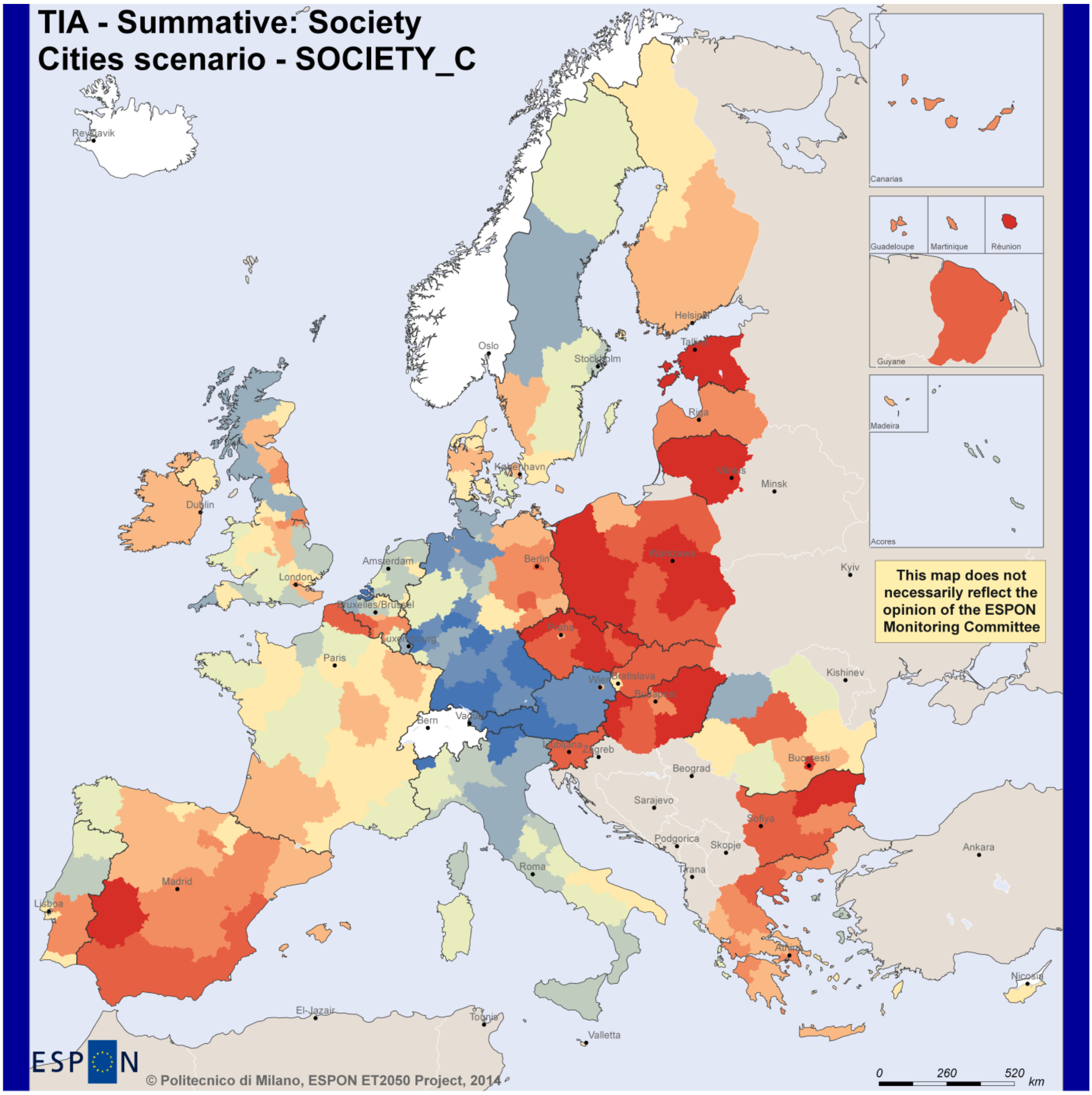
Legend

ECONOMY_M

- 20,106 - 30,186
- 30,187 - 37,856
- 37,857 - 42,624
- 42,625 - 46,759
- 46,760 - 49,985
- 49,986 - 52,435
- 52,436 - 56,535
- 56,536 - 60,231
- 60,232 - 66,599
- 66,600 - 86,763
- No data

Map 11. Summative impact on society – Cities scenario



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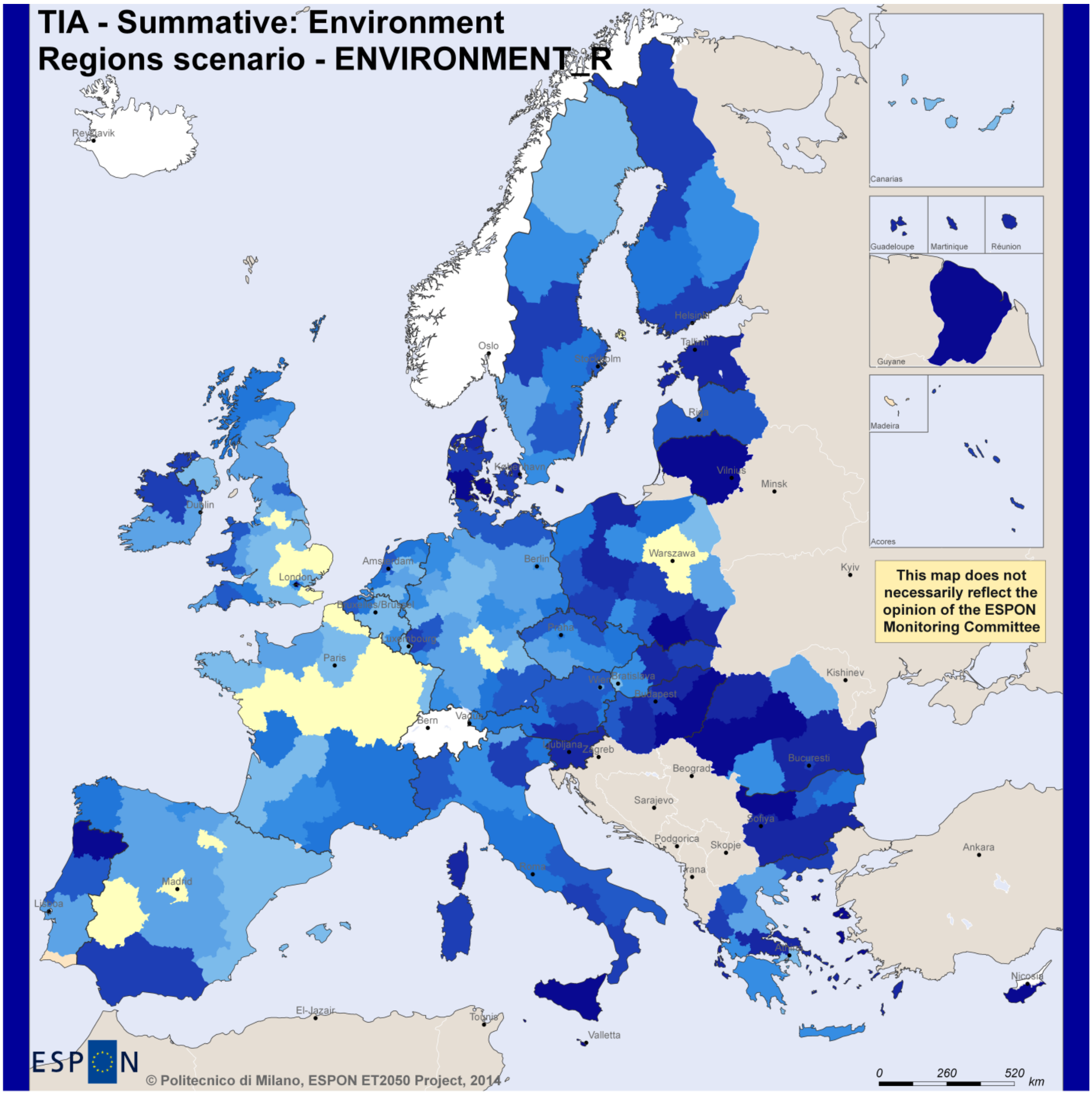
Legend

SOCIETY_C

- -31,778 - -24,253
- -24,252 - -15,397
- -15,396 - -6,923
- -6,922 - -1,685
- -1,684 - 2,249
- 2,250 - 5,924
- 5,925 - 9,283
- 9,284 - 13,955
- 13,956 - 19,652
- 19,653 - 30,042
- No data

Map 12.Summative impact on Environment – Regions scenario



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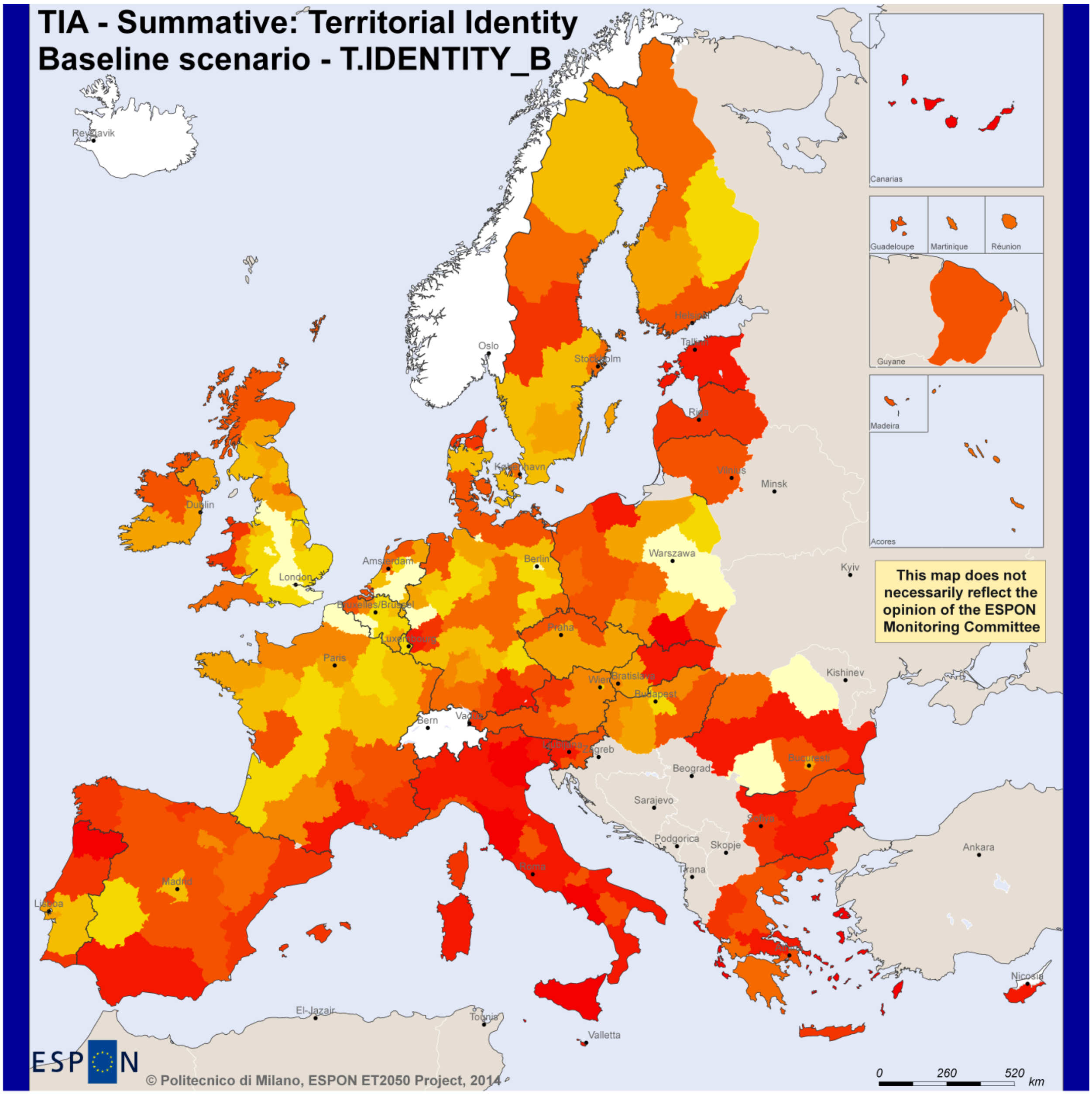
Legend

ENVIRONMENT_R

- 8,535 - 20,682
- -0,062 - 8,534
- -5,290 - -0,063
- -9,325 - -5,291
- -13,006 - -9,326
- -16,750 - -13,007
- -20,442 - -16,751
- -24,292 - -20,443
- -31,277 - -24,293
- -43,213 - -31,278
- No data

Map 13. Impact on territorial identity – Baseline scenario



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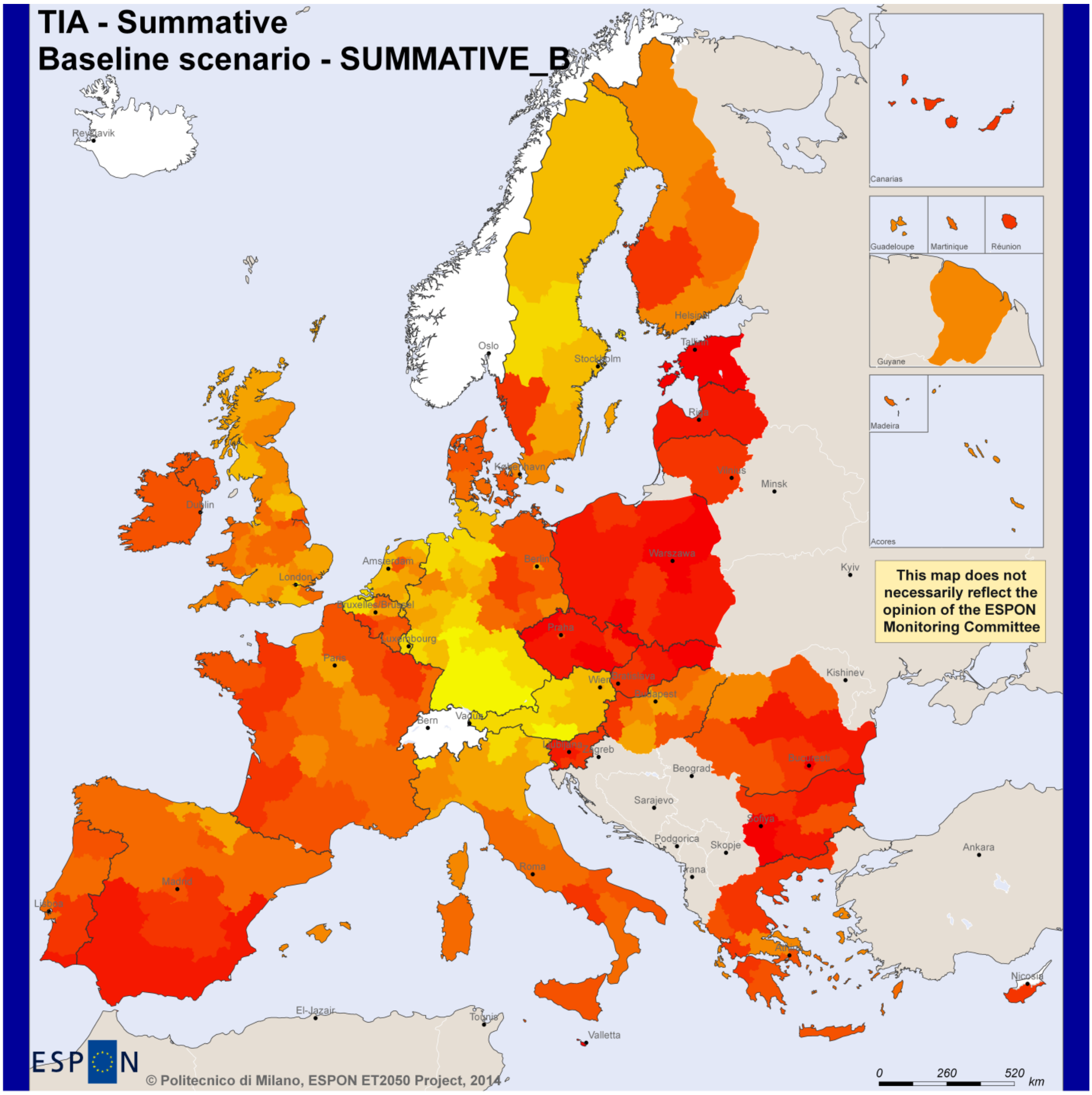
Legend

T.IDENTITY_B

- -8,253 - 5,250
- 5,251 - 10,907
- 10,908 - 15,293
- 15,294 - 18,256
- 18,257 - 20,819
- 20,820 - 24,866
- 24,867 - 30,210
- 30,211 - 35,829
- 35,830 - 44,592
- 44,593 - 59,872
- No data

Map 14. Summative impact – Baseline scenario



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Legend

SUMMATIVE_B

- -1,057 - 2,686
- 2,687 - 6,084
- 6,085 - 8,515
- 8,516 - 10,356
- 10,357 - 11,649
- 11,650 - 13,057
- 13,058 - 14,704
- 14,705 - 16,794
- 16,795 - 19,414
- 19,415 - 22,613
- No data

Annex 1. The Regional Sensitivity Matrix

Table A1 below shows the definition, measurement and source of the Regional Sensitivity Matrix (RSM) indicators for any of the 20 impact fields considered for the present TIA exercise.

As mentioned above, RSM is the one already adopted in the ESPON ARTS project. For the sake of clarity, we report here a few lines explaining the rationale and direction of impact of any of the chosen impact fields (source: ESPON ARTS Project, Scientific Final Report).

Economy

EC1 – GDP: regions with lower GDP per capita are expected to benefit more from scenarios leading to higher GDP levels. Sensitivity is thus inversely proportional to the level of GDP per capita.

EC2 – employment: regions with a greater share of employment in the secondary and tertiary sectors are likely to benefit more an increase in the level of employment in these sectors of employment. Sensitivity is thus proportional to the share of employment in the secondary and tertiary sectors.

EC3 –innovation: regions with greater share of enterprises engaged in product and/or process innovation activities are considered to be more sensitive to scenarios more favorable to innovation promotion.

EC4 – tourism: regions showing lower tourism influx (here measured as the total number of nights spent in accommodations on total population) may benefit more from an increase in tourism as compared to regions already congested by tourism. Sensitivity is thus inversely proportional to the total number of nights on population.

EC5 – accessibility: this is measured by potential accessibility by road/rail/air. Regions with lower potential accessibility will benefit more from its increase. Sensitivity is thus inversely proportional to accessibility by road/rail/air.

Society

S1 – unemployment: regions experiencing lower employment levels (i.e. higher unemployment rates) are likely to benefit more from a reduction of unemployment. Sensitivity is thus directly proportional to the unemployment rate.

S2 - disposable income per capita: regions with lower disposable income per capita (in PPS) are expected to benefit more in scenarios leading to disposable income increase. Sensitivity is thus inversely proportional to the level of disposable income per capita in PPS.

S3 – raod accidents/safety: regions already experiencing high rates of accidents in transport (here proxied as road fatalities per million inhabitants) are expected to benefit more from actions aimed at fatalities prevention. Sensitivity is thus directly proportional to road fatalities.

S4 – income distribution (poverty index): regions affected by greater income distribution disparities are likely also to experience greater poverty. Sensitivity is thus set as directly proportional to the poverty index developed in the 5th Cohesion Report.

S5 - out-migration/brain: regions already experiencing higher brain drain will benefit more from actions aimed at its reduction. Sensitivity is thus inversely proportional to the net migration balance (i.e. immigration minus outmigration on total population).

Environment

ENV1 – land consumption: regions showing a greater share of artificial areas are expected to be more sensitive to scenarios leading to a reduction of land consumption. Sensitivity is thus directly proportional to the share of artificial areas.

ENV2 – emissions/air pollutants: regions showing greater concentration of particular matter (PM10) on surface are expected to benefit more in scenarios that lead to its reduction. Sensitivity is thus directly proportional to PM10 concentration.

ENV3- congestion: regions showing greater density of vehicles fleet on population are expected to be more sensitive to its reduction. Here, we proxy vehicles density as by the average of the number of vehicles per 1000 inhabitants and population density. Sensitivity is thus directly proportional to this indicator.

ENV4 – flood hazard: regions showing a greater risk of flood hazard are expected to be more sensitive and benefit more in scenarios leading to a reduction of this risk. Sensitivity is thus directly proportional to the risk of flood hazard.

ENV5 – land erosion: regions showing a greater share of areas at risk of soil erosion are expected to be more sensitive to scenarios having some impact on its reduction. Sensitivity is thus directly proportional to the share of areas at risk of soil erosion.

Territorial Identity

TI1 – landscape fragmentation: regions showing a greater share of artificial areas are expected to be more sensitive to scenarios leading to a reduction of landscape fragmentation. Sensitivity is thus directly proportional to the share of artificial areas.
TI2 – creativity: all regions are expected to be equally sensitive to this field. Sensitivity is thus set at 1.
TI3 – cultural heritage: regions hosting a larger number of artistically and historically valuable monuments (as documented by 3 stars in the Italian Touring Club (TCI) guidebooks) are expected to be more sensitive to scenarios leading to cultural heritage conservation. Sensitivity is thus proportional to the number of sites showing 3 stars in the TCI guidebooks.
TI4 – natural heritage: regions showing greater area of protected biodiversity (such as areas in Natura2000 network) are expected to be more sensitive to scenarios having some impact on natural heritage. Sensitivity is thus proportional to the share of areas protected under the Natura 2000 program.
TI5a – multi-culturality (urban areas): all regions are expected to be equally sensitive to this field. Sensitivity is thus set at 1.
TI5b – multic-ulturality (rural areas): all regions are expected to be equally sensitive to this field. Sensitivity is thus set at 1.

The RSM includes normalized values of the chosen sensitivity indicators for the identified 20 impact fields.

Normalization follows a linear procedure and normalized values range from 0,75 up to 1,25. Basically, normalized sensitivity indicators represent coefficients that can increase (if greater than 1) or decrease (if lower than 1) each directive's impact on a specific field.

Let's introduce the following definitions:

$Xnorm_i$ the normalized value of the sensitivity indicator for impact field i

X_i the original value of the sensitivity indicator for impact field i

$Xmin_i$ the minimum original value of the sensitivity indicator for impact field i

$Xmax_i$ the maximum original value of the sensitivity indicator for impact field i

Then, normalization follows this formula (as in TEQUILA1 model):

$$Xnorm_i = 0,75+((1,25-0,75)*((X_i - Xmin_i)/(Xmax_i - Xmin_i)))$$

Table A1. The Regional Sensitivity Matrix (RSM) indicators

Impact field acronym	RSM indicator measurement	Source
EC1	1/GDP per capita	ESPON, ARTS project on ESPON DB
EC2	Employment	ESPON, ARTS project on ESPON DB
EC3	Share of product &/or process innovation	ESPON, KIT project on EUROSTAT
EC4	1/(Total overnight stay/ Tot POP))	ESPON, ARTS project on EUROSTAT and ESPON DB
EC5	Accessibility	ESPON, ARTS project on ESPON DB
S1	Unemployment rate	ESPON, ARTS project on 5th Cohesion Report
S2	1/ Disposable income per capita	ESPON, ARTS project on ESPON DB
S3	Road fatalities/safety	ESPON, ARTS project on 5th Cohesion Report
S4	Income distribution (Poverty index)	ESPON, ARTS project on 5th Cohesion Report
S5	Migration balance	ESPON, ARTS project on 5th Cohesion Report
ENV1	Share of artificial area	ESPON, ARTS project on Corinne Land Cover
ENV2	PM10 concentration	ESPON, ARTS project on 5th Cohesion Report
ENV3	Vehicle concentration = ((vehicles per 1000 inhab)+(dens pop))/2	ESPON, ARTS project on ESPON DB and EUROSTAT
ENV4	Flood hazard	ESPON, ARTS project on ESPON DB
ENV5	areas at risk of soil erosion	ESPON, ARTS project on Corinne Land Cover
TI1	Share of artificial area	ESPON, ARTS project on Corinne Land Cover
TI2	Creativity	1
TI3	Number of 3-star sites in TCI guidebooks	ESPON, ARTS on ESPON ATTREG project
TI4	Share of Natura 2000 areas	ESPON, ARTS project on 5th Cohesion Report
TI5a	Multiculturality (urban)	1
TI5b	Multiculturality (rural)	1

Annex 2. Missing data (missing imputation in parentheses)

	Impact field	**Assessment**	**MISSING**		
ACRONYM	**Economy**		**Regional Impact Matrix**	**Regional Sensitivity Matrix**	**Potential Impact**
EC1	GDP	QUANTITATIVE (MASST)			CH,IS,LI,NO
EC2	Employment (manufacturing + services)	QUANTITATIVE (MASST)	FR91-94, LI (no specialized)		CH,IS,LI,NO
EC3	Innovation	QUANTITATIVE (MASST)			CH,IS,LI,NO
EC4	Tourism	*QUALITATIVE*	ES63-64, FR91-94 (no touristic)	ES63-64, FR91-94 (min value, i.e. 0.75)	
EC5	Accessibility	QUANTITATIVE (SASI)			ES70, FR91-94, PT20-30 (average ES63-64)
	Society				
S1	Unemployment	QUANTITATIVE (MASST)			CH,IS,LI,NO
S2	Disposable income per capita	QUANTITATIVE (MASST)		CH,IS,LI,NO	CH,IS,LI,NO
S3	Road accidents/Safety	QUANTITATIVE (MCRIT)		CH,IS,LI,NO	
S4	Risk of poverty	*QUALITATIVE*		CH,IS,LI,NO FR91-94 (average ES63-64)	
S5	Net migration	QUANTITATIVE (SASI)		CH,IS,LI,NO	ES70, FR91-94, PT20-30 (average ES63-64)
	Environment				
ENV1	Land consumption	*QUALITATIVE*		CH FR91-94, PT20-30 (average ES63-64)	
ENV2	Emissions/pollutants in air	QUANTITATIVE (MCRIT)		CH,IS,LI,NO	
ENV3	Congestion	QUANTITATIVE (MCRIT)		IS	
ENV4	Flood hazard	*QUALITATIVE*			
ENV5	Land erosion	*QUALITATIVE*		CH,IS,LI,NO BE10 (average BE) CY00 (average GR) ES30-63-64-70 (average ES) FI (average DK) FR91-94 (average ES) GR30-41 (average GR) MT00 (average GR) PT20-30 (average PT)	

				SE (average DK) SK01 (average SK) UKI1 (UKI2)	
	Territorial identity				
TI1	Landscape fragmentation	QUANTITATIVE (MCRIT)		CH	
TI2	Creativity	*QUALITATIVE*			
TI3	Cultural heritage	*QUALITATIVE*			
TI4	Natural heritage	*QUALITATIVE*		CH,IS,LI,NO FR91-94 (average ES63-64)	
TI5a/TI5b	Multi-culturality	*QUALITATIVE*			

SCENARIOS ACRONYMS: BASELINE → BASE or 1, MEGA → A or 2, CITIES → B or 3, REGIONS → C or 4

Annex 3.Notes on specific indicators with unexpected results

- **EC3 (Innovation)**. All values (in each scenario) have been shifted upwards by adding to each region the maximum of the decrease in innovation registered in each scenario.

- **ENV2 (Emissions)**. Values for Hungary show very large increase whereas values for Spain and Greece show large decrease. The result for Hungary can be explained by the large increase in GDP which may induce, through a rebound effect, an increase in traffic. Differently, Greece and Spain experience a reduction of traffic, especially in the Cities and Regions scenario with respect to the Baseline, in consideration of the socioeconomic results from MASST model for creating the origin-destination matrices, coupled with changes in modal split that move some traffic to other modes.

- **ENV3 (Congestion)**. Values for Hungary show very large increase whereas values for Spain and Greece show large decrease. The result for Hungary can be explained by the large increase in GDP (probably over-estimated) which may induce, through a rebound effect, an increase in traffic. Differently, Greece and Spain experience a reduction of traffic, especially in the Cities and Regions scenario with respect to the Baseline, in consideration of the socioeconomic results from MASST model for creating the origin-destination matrices, coupled with changes in modal split that move some traffic to other modes.

- **TI1 (Landscape fragmentation)**. In the cities scenario, new infrastructures are built only in Eastern European countries. Each infrastructure scenario is built considering that there is a maximum budget and that this budget is allocated depending on the socioeconomic profitability of each project. For the different scenarios more or less importance is given to economic profitability or social profitability. In the case of the Cities scenario this results in only new infrastructure being built in the Eastern Europe. Also, upgrading of some roads do not have an impact on landscape fragmentation, as they already exist in the territory. This is the normal case for western countries where the road/rail is already there and is upgraded later, whereas in eastern countries roads/rails have to be built anew.

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