



RESIN

SUPPORTING DECISION –
MAKING FOR RESILIENT CITIES

Options for certification in urban climate adaptation

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Reviewed by (if applicable)	Micha de Jong (NEN), Jorge Paz Jimenez (Tecnalia).

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CONTACT:

Email: resin@tno.nl
Website: www.resin-cities.eu



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Executive Summary

As part of the H2020 RESIN project, this report investigates the need and opportunities for certification of adaptation products, services and processes. Certification is the independent quality assessment of a product, service or person. The resulting certificate demonstrates compliance with predefined standards. In addition to standardisation, certification is seen as a way to stimulate the uptake of technologies or practices that improve the climate resilience of European cities.

In urban climate adaptation only few standards exist, and certification examples are thus scarce. With regard to product certification, it seems that products with a high complexity, with many factors influencing performance (such as green roofs) or products that are able to prevent a lot of damage if properly manufactured (such as flood barriers), are the first for which standards have been developed and certification schemes have been introduced. With the expected increase of climate change impacts and possible damages, certification may spread to more product categories.

There are signs that standards and possibly certification schemes are increasingly developed for adaptation products, for instance for green facades. Also certification that is currently limited to one or two countries may spread to more European countries.

With regard to the certification of processes in urban climate adaptation, no evidence has been found of existing certification schemes. A systemic review reveals that possible processes where certification could have a value added include the production of vulnerability assessments, the development of adaptation strategies or heatwave emergency plans.

The development of process certification in urban adaptation will probably depend on legislative or financial requirements by (funding) authorities. Similar to national administrations, EU institutions such as the EIB, can play a role to encourage standardisation and certification in urban climate adaptation by recommending the use of standardised procedures and products.

1. Introduction

In the EU Strategy on adaptation to climate change¹ the EU Commission announced that it will request to European Standardisation Organisations to identify industry-relevant standards to be revised for better inclusion of adaptation considerations. This reflects the importance of standards in ensuring that physical infrastructures can cope with extreme weather and other climate impacts. Standardisation can also play a role to enhance the uptake of typical adaptation products and services and as such increase climate resilience.

RESIN is an Horizon 2020 research project on climate adaptation in cities, including their infrastructures². The RESIN research project pays specific attention to harmonisation and standardisation in the area of adaptation to climate change in cities. This occurs by providing proposals, for instance to the scientific community on using harmonised units for reporting on the effectiveness of adaptation measures and by providing standardised procedures to cities, for instance for undertaking risk and vulnerability assessments. Part of this information may be used to inform the formal standardisation process guided by national and international standardisation bodies.

Currently, following the request of the European Commission, a European inventory is made on the existing standards that have a relation with climate change and adaptation to climate change for the sectors energy, infrastructure and construction (see Section 3.2). It seems that relatively few standards pertaining to specific adaptation products and services exist. With the rise in attention for climate adaptation and the increase in market volume, these may be developed in the coming years, however.

This report takes this line of thought one step further: assuming standards will be developed, would there be a need and/or a market for certification of the related adaptation products and services? In line with the topic of the RESIN research project we have limited ourselves to adaptation in urban areas.

Chapter 2 provides an introduction on certification and provides some examples of existing certification in related areas. Chapter 0 takes stock of ongoing standardisation work, as this forms the basis for future certification. The main part of this report, Chapter 0, consists of an inventory and discussion on existing and possible areas for product and process certification in urban adaptation. The findings are summarised in Chapter 0.

¹ Action 7 in COM(2013)216 Final. An EU strategy on adaptation to climate change.

² www.resin-cities.eu

2. On Certification

This Chapter provides an introduction into certification and standardisation and gives an overview of the state of the art for the topic urban adaptation. Readers familiar with the principles of standardisation and certification may jump immediately to Chapter 0.

2.1. What is certification?

Certification is an independent quality assessment of a final result, which can be a tangible product or an intangible service. It results in a certificate that demonstrates that a product, a service, a process or system, or even a person conforms to certain standards. Such standards are generally produced by standardisation organisations with the participation of market parties. Next to the formal standardisation organisations in Europe, such as DIN, NEN, AFNOR, BSI etc, there are a large number of informal standardisation bodies often industry organisations, that develop standards and guidelines for their members.

In areas where standards have been formulated, often the need arises to demonstrate that products, services, processes or persons comply to these standards. It is here certification comes in. In a certification audit, a product, service or process is judged on its compliance with the requirements as formulated in a certain standard. The rules for the uniform testing of compliance to the standards are documented in a, so called, certification scheme. A certification scheme includes requirements with regard to the certifying institution, the competencies of the auditor, the testing methodology, the assessment of the results and the control of the certification process.

Similar to the development of standards, the setting-up a certification scheme is a voluntary action often on demand of industry partners, for whom a standard or a certificate provides commercial value.

Standardisation organisations may facilitate the certification process (as an independent platform) by the development of certification schemes. There are several forms of a certification audit, with increasing independence and quality of the audit: (a) A person or organisation may declare itself that the product or service they deliver conforms to the standards; (b) the buyer or organisation of buyers, that have an interest in the quality of the product or service may issue a certificate; (c) an independent organisation or company (also called certification body) may issue an independently checked certificate and finally, (d) an independent organisation or company that is under supervision of an accreditation body issues the certificate. In all cases market parties are in the lead for the certification audit.

The certificate is important for market parties because:

- Customers/ Clients are ascertained that a product complies with certain requirements
- In situations that a certain law requires certification
- Customers are willing to pay extra for certified products
- Certification improves the chance of winning tenders
- Certification gives PR benefits and raises the image of a company

Normally the request for certification originates from the market.

When we are now considering urban climate adaptation, we can think of examples of certification of products/services: a green roof; a vulnerability map, a water storage facility. Examples of certification of processes would be: the development of an adaptation strategy; the development of a vulnerability

assessment. In the latter cases the organisation involved is audited on the proper execution of the process.

Thus this report will need to answer the questions:

- What aspects of such products or services would be needed to certify?
- What are the advantages of certifying?
- For whom is certification needed or advantageous?

Before going into these questions we will provide first (in Section 2.2) some illustrative examples of certification to further clarify what it means and (in Chapter 3) an overview of the state of the art in standardisation in the area of urban adaptation, because any certification is dependent on the standards available.

2.2. Certification examples from related areas

2.2.1. Certification of safety helmets used in industry

The American national Standards Institute (ANSI) maintains a standard for Industrial Head Protection (ANSI/ISEA Z89.1-2014). Already in its seventh revision, the standard describes characteristics of the helmets, and includes the testing for impact attenuation and penetration resistance. Among these are specific testing protocols and marking for products that have high-visibility properties.

The Safety Equipment Institute (SEI) is a private, non-profit organization in the US that tests and certifies (among many other equipment) safety helmets against the ANSI/ISEA Z89.1-2009 standard. SEI is accredited by the ANSI and the Standards Council of Canada for executing certification work in accordance with ISO/IEC 17065, Conformity assessment — Requirements for bodies certifying products, processes and services.

The certification is voluntary and a number of manufacturers of helmets have submitted their products for certification. The products that meet the requirements are listed on the SEI website and receive the SEI label testifying that the helmets meet the quality and performance requirements of the standard.

The advantages of certification are clear in this case: workers and their employers are sure that they are properly protected in case of accidents (and will be keen and are trained to use certified safety products). Producers of certified helmets have a competitive advantage above those producing non-certified helmets.

2.2.2. Certification of ISO 37120 Indicators for sustainable cities

The full name of ISO 37120 is “Sustainable Development of Communities, Indicators for City Services and the Quality of life”. This standard prescribes the use of a certain set on indicators to express the sustainability of cities. Currently there is one body that certifies cities worldwide and that is the World Council on City Data (WCCD)³. Certification comes down to an independent verification of the data

³ <http://www.dataforcities.org/>

supplied by cities for the ISO 37120 indicators. Cities certified in accordance with the WCCD certification system are listed for one year in the WCCD Global Cities Registry™.

It is unclear from WCCD information what the added value of the certification for cities is. For the WCCD it seems a quality check on the data that they include in their database (the World Council on City Data Open Data Portal).

2.2.3. Certification of sustainable development projects

The last example is taken from the growing family of informal sustainable development standards, that includes standards for e.g. sustainable forestry, fair trade, or seafood. Gold Standard was established in 2003 by international environmental NGOs as a best practice standard to ensure projects that reduced carbon emissions under the United Nation's Clean Development Mechanism (CDM) also fostered sustainable development. So it is an informal standard, not generated by national or international standardisation organisations. It goes further than just certifying the CO₂ emission reduction according to ISO 14064 Greenhouse Gas Emissions, but includes compliance with other sustainable development objectives. Many projects around the world have been following the criteria. Gold Standard as an organisation also certifies projects according to the Gold Standard, thereby not only considering the amount of verified CO₂ emission reductions, but also assessing the process of stakeholder consultation and if the project safeguards social, economic and environmental principles.

The advantage for project developers is that this kind of project certification confirms that the project has the ability to report on its climate and development impacts, and thus qualifies for selling the CO₂ credits on a carbon market or through other financial structures. Specific for Gold Standard are the additional sustainability features that make it attractive for (international) financing bodies that aim to support sustainable development projects.

2.2.4. Observations

The last example shows that, apart from the formal development of standards and certification, there is a whole universe of informal standards, that have not been created through national or international standardisation organisations. In some cases the institution that created the standards also performs the certification, which might lead to a conflict of interests. Sometimes the value of existing certification is not fully clear, as in the case of ISO37120. However, also a certificate based on informal standards may be attractive for those involved.

3. State of the art in standardisation in the area of urban adaptation

3.1. Activities by ISO and CEN

Building on the standard for indicators for sustainable cities⁴ the ISO Technical Committee 268 “Sustainable cities and communities” has started the development of a standard for resilient cities. At the moment of writing, a first proposal for a list of indicators is being discussed (ISO/TR 37121:2017). The draft encompasses indicators for resilience in economy, environment, infrastructure and society. Another activity of this working group is the development of a Management system for sustainable development of communities. It outlines management requirements and includes guidance for resilience and smartness of cities (ISO 37101:2016). This work is linked with more general work of ISO on adaptation discussed in Technical Committee 207.

ISO/TC 207 “Environmental management”, originally mainly involved in the development of standards for the reporting of greenhouse gas emissions, has embarked on the development of general management standards for climate adaptation. They are thus less focused on cities and communities. In this respect ISO/TC 207 is developing a framework standard for adaptation to climate change (ISO 14090), a standard for vulnerability assessment (ISO 14091), and a standard on adaptation planning for organizations including local governments and communities (ISO 14092). The last is currently being developed into a Technical Specification. There are plans for standards on monitoring and evaluation of adaptation projects. Also more general is the development of a framework and principles for assessing and reporting investments and financing activities related to climate change (ISO/NP 14097).

In Europe standards are developed by three organisations: the European Committee for Standardization (CEN), the European Committee for Electrotechnical Standardization (CENELEC) and the European Telecommunications Standards Institute (ETSI). CEN/CENELEC have become involved in standardisation in climate adaptation by a request by the European Commission (see Section 3.2).

3.2. The standardisation request of the EU commission to the European standardisation organisations

The EU Strategy on Adaptation to Climate Change (COM(2013) 216 final) includes an invitation to the European Standardization Organizations to identify technical standards that can be used as an effective instrument for improving the climate resilience of infrastructures across Europe. The strategy identified priority sectors: Transport, Energy infrastructure; Buildings/construction and ICT as supporting infrastructure.

In response, CEN and CENELEC established the Adaptation to Climate Change Coördination Group. In 2015 and 2016 a long list of technical standards for the priority sectors with climate relevance has been produced. At the end of 2016 this has led to the identification of a priority list of 13 standards to be revised or developed to take into account climate change. These standards are then expected to become examples for addressing climate change adaptation aspects in standards. CEN and CENELEC have also published a 'Guide for addressing climate change adaptation in standards',

⁴ (ISO 37120:2014, official name: Sustainable development of communities -- Indicators for city services and quality of life),

intended for standard writers. It includes a checklist to help establish whether climate change adaptation is relevant to a particular standardization activity.

4. Certification of Urban Adaptation

This chapter includes an assessment of the possibilities for certification of products and processes in the area of urban climate adaptation. It is based on a systematic review of possible products, services and processes, their characteristics and advantages of certification for users or for the market.

4.1. Approach

As certification has to have either clear advantages for customers and/or market value, an investigation into certification needs to start with the value of a certain certificate for customers. To arrive there it is necessary to find out who the customers are, what the specific advantage of a certificate would be, and how the certification should be defined (in other words: which standard is it that should be certified). See figure 3.1.

Our starting point was our knowledge of possible topics for certification as they emerge from elements of the RESIN research project, such as the RESIN database of adaptation options or the development of a decision support system. Taking these as entry we have identified possible advantages of certification for certain customer groups. By interviewing these customer groups we have tried to get an impression of the possible value that certification of a product or service would have for them. As shown by the example in Figure 3.1 we move from left to right in the steps and then back again to the left side describing more precisely the customer and the topic that could be certified.

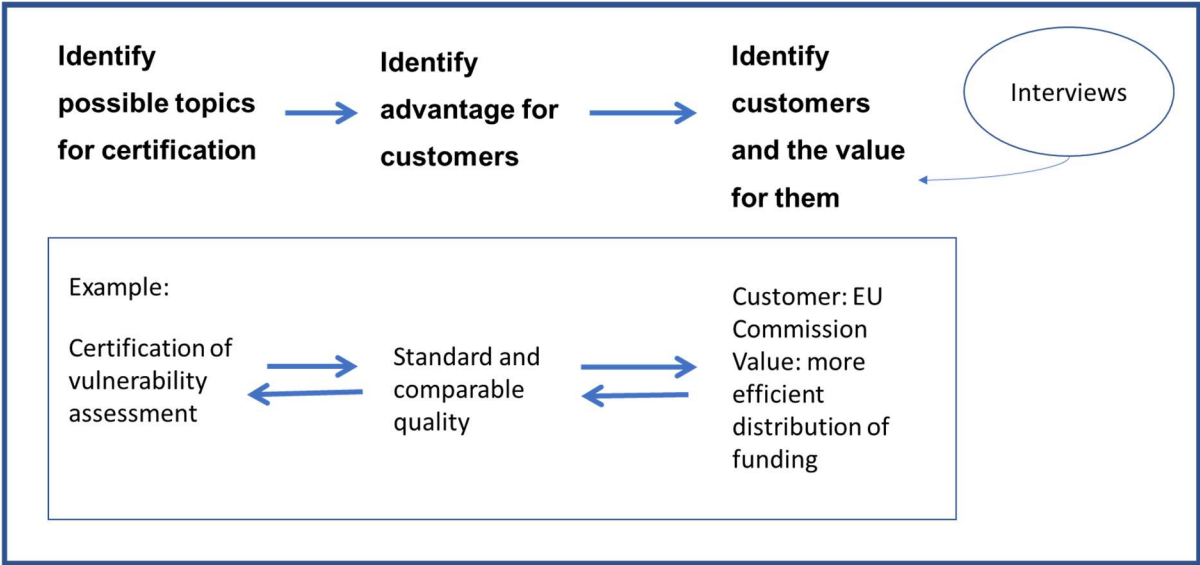


Figure 3.1 Methodology for Chapter 0.

Annex A lists the persons that have been interviewed to improve the information on the value of certification for customers.

In this report we have made a subdivision in certifiable products and certifiable services. With regards to climate adaptation, ‘products’ are manufactured articles that serve to prevent, protect or repair in case of an extreme weather event of other climate impact. The inventory of products, therefore, takes

as a starting point the RESIN database of adaptation options⁵. It is assumed that certification could be useful for products that are regularly procured and of which there is a wide variety in effectiveness depending on the quality of the product.

Adaptation ‘services’ can be described as processes supporting the implementation of adaptation options. The inventory of services is based primarily on the decision steps in the RESIN decision support system⁶. In addition, services have been added that are being discussed in various reports on adaptation (references mentioned in the respective sections below).

For each of the products and services identified, a table summarising the conclusions is given according to the model below (Table 3.1):

Possible topics for certification	Description	Potential customers	Advantage for customers	Value for customers

Table 3.1

4.2. Possible topics for certification

4.2.1. Product certification

It is assumed that primarily those products will qualify for certification that display a wide range of effectiveness according to their design. For instance, the amount of rainwater that green roofs can store depends on the thickness of the substrate and the presence of additional features for water storage. Providing buyers with a certificate that the product complies to certain performance norms could stimulate the market, providing certainty to the buyers and potential benefits to the suppliers.

The following selection of products is based on the RESIN database of adaptation options, whereby a selection was made of products with varying effectiveness, that are purchased in large quantities.

Green roofs

Green roofs serve to buffer rainwater in case of extreme rainstorms. They have additional benefits for biodiversity, and the visual impression of the city (for those looking on the roofs). Depending on the construction of the roof below they may add extra isolation to the building. Their effect on temperature on street level can be neglected, unless green roofs are applied on all roofs in a city. Depending on substrate thickness and vegetation, a distinction is made in extensive and intensive green roofs. Within these types there is a range of technologies and ways to build a green roof, which considerably influences the buffering capacity.

⁵ Maddalen Mendizabal, Beñat Abajo, José Antonio Martínez, Laura Gutiérrez, Gemma García, Jorge Paz, Efre Feliu, 2015. Library structure online. Adaptation options database model.
⁶ Albert Nieuwenhuijs, Vera Rovers, Tara Geerdink, Rene Willems, Oskar Baksalary, Jeremy Carter, 2016. Framework for adaptation planning process.

The German FFL has developed since 1992 guidelines and standards for green roofs⁷. Also in other countries, guidelines or codes of best practice have been developed by the industry, among which the UK and France⁸. In Portugal and Scandinavia a guideline is in development. The Netherlands has a technical guideline for the determination of water retention (and wind and fire resistance) of extensive green roofs⁹. There are only a few countries with a formal standard for green roofs. The Austrian standard (ÖNORM L1131, 2010)¹⁰ is one of those. It distinguishes four types of green roofs and follows essentially the FLL guideline. Also Italy has a national standard for green roofs¹¹. Switzerland has developed a standard that stands out in its attention for the quality of the vegetation on the roof. Recently a standard has been published in the Czech Republic

In annex A to the ÖNORM L1131 an assessment model for green roofs is proposed. On the basis of the availability of space for roots basic points are given per m². In a next step points are given for water buffering capacity, organic content of the substrate, number of plant species and volume of the vegetation (for intensive green roofs). These values should be above certain thresholds, which forms the basis for certification¹². In Austria this certification is done by the “Verband für Bauwerksbegrünung¹³”. Elements of roofs and complete roof systems can be certified, but also completed projects can apply for a certificate. The major producers of green roofs have applied for the certificate. Trustworthiness appears to be an important reason for applying. The certificate is, however, still relatively unknown even among the smaller green roof producers that are not members of the association.



ZINCO, a large producer of green roofs active in several European countries has been active to establish a testing procedure for the quality of materials for green roofs, so that the well-known CE mark could be used for materials for the production of green roof systems, such as root barriers,

⁷ Dachbegrünungsrichtlinie 2008. <http://www.fll.de/shop/bauwerksbegruenung.html>. The FLL has also developed specific tests (1) To determine the root resistance of waterproofing materials and root-barriers; (2) To evaluate water-holding capacity of media, and (3) To estimate maximum weight of green roof media.

⁸ Green Roof Code of Best Practice for the UK 2014. <https://livingroofs.org/wp-content/uploads/2016/03/grocode2014.pdf>

⁹ NTA8292: <https://www.nen.nl/NEN-Shop/Norm/NTA-82922016-nl.htm>

¹⁰ Austrian Standard applying to planning, design and care of green areas on buildings: ÖNORM L 1131 - Gartengestaltung und Landschaftsbau - Begrünung von Dächern und Decken auf Bauwerken - Anforderungen an Planung, Ausführung und Erhaltung.

¹¹ UNI 11235:2015 Istruzioni per la progettazione, l'esecuzione, il controllo e la manutenzione di coperture a verde.

http://www.uni.com/index.php?option=com_content&view=article&id=4210%3Aroof-garden-pubblicata-la-norma-nazionale-uni-11235&catid=170&Itemid=2612

¹² Vera Enzi, 2011. ÖNORM L 1131 Österreichische Norm zur Dachbegrünung im Vergleich zur deutschen FLL-Dachbegrünungsrichtlinie. In: Tagungsband, 9. Internationales FBB Gründachs-symposium, 3. Februar 2011 in Ditzingen.

http://www.gebaeudegruen.info/fileadmin/website/downloads/fbb-symposien/Gruendachs-symposium/9_FBB-Gruendachs-symposium_2011.pdf

¹³ <http://gruenstattgrau.at/>

protection mats, drainage elements and substrate layers¹⁴. This gives those products an unimpeded access to the European Market. Also other European producers (e.g. Optigreen) have received the European Technical approval for their materials. So far, there are few certifying institutions for this, the main one being the Deutsches Intsitut für Bautechnik (DIBt). Strictly speaking, this is just a quality mark and not specific for climate adaptation.



Although the green roof industry (with a few European players) is active in promoting technical guidelines and standards for green roofs in EU countries, certification has not spread widely yet. It would seem an advantage for the industry to be able to advertise as being a certified provider or delivering certified green roofs, but obviously it is still early days. This might change if municipalities, through their subsidy programs, or other purchasers would require more or better proof of the water buffering capacity.

Possible products for certification	Description	Potential customers	Advantage for customers	Value for customers
Green roofs	Certificate for various types of green roofs with guaranteed effectiveness with regard to water storage	Buyers of green roofs (builders, administrations, housing corporations, individual households)	Guaranteed quality of the components and performance	If it would be a requirement for a subsidy or building certificate

Green facades

Green facades are constructions to provide vertical green up and across the facade of a building. It can be created by growing climbing plants rooted in the ground from the base using a trellis system or by plants rooting in modules mounted to the wall. The last are often called “living wall systems”. Green facades provide cooling on street level as they hide stony building walls that accumulate heat during the day in the shadow. In addition they may provide habitats for natural species, absorb fine particulate air pollutants, and beautify the building. Depending on the type, the construction, the species used and the irrigation system, the effectiveness for cooling or for air quality improvement varies.

¹⁴ European Technical Approval for “kits for green roofs”.

The German FFL has developed guidelines and standards for green facades¹⁵. These have not been transformed into formal standards so far¹⁶. In the article cited in note 16 states that formal standardisation of the technical requirements would support the market for green facades. In Austria, discussions on developing a standard for green facades have started in the Verband für Bauwerksbegrünung.

Certification, following those standards, would benefit the buyers of green walls (project developers, housing corporations) by providing a clear proof of value for money. Certification might also stimulate the market by taking away uncertainty on environmental (and technical) performance.

Possible products for certification	Description	Potential customers	Advantage for customers	Value for customers
Green facades	Certificate for various types of green facades with guaranteed cooling capacity	Buyers of green facades (builders, administrations, housing corporations, individual households)	Guaranteed performance (and compliance to standards for safety etc)	If it would be a requirement for a subsidy or building certificate

Reflective materials/coatings

Reflective materials and coatings, usually to be applied on roofs, lower the surface temperature and hence contribute to less overheating in cities. Sometimes they are called “cool” materials. An important benefit is that for less-isolated buildings in a warm climate zone, they contribute to lower inside temperatures and hence save energy for mechanically cooling the building.

Due to the last characteristic, the US Energy Star has already developed a certification scheme for reflective roof products. The scheme specifies requirements with regard to reflectivity at installation and after three years¹⁷. The US energy star has well documented certification and testing criteria¹⁸.

Reflective roof certification is important for architects, property owners, building code bodies, energy service providers, and community planners. In the US where cool roof credits, federal tax credits, or rebate incentives are more important than in Europe, a certificate plays a key role. In addition, a building owner might want to verify that a certain product meets a code requirement, an architect

¹⁵ Fassadenbegrünungsrichtlinie, 2000. <http://www.fil.de/shop/bauwerksbegrueung.html>

¹⁶ Silvia Tedesco, Roberto Giordano, Elena Montacchinia, 2016. How to measure the green façade sustainability? A proposal of a technical standard. Energy Procedia 96 (2016) 560 – 567

¹⁷ https://www.energystar.gov/products/building_products/roof_products/key_product_criteria

¹⁸

https://www.energystar.gov/sites/default/files/specs//Roof%20Products%20V3%20Program%20Requirements_0.pdf

might be looking to obtain a point for a LEED (the US Leadership in Energy Efficiency Design) credit, or a utility company might need accurate information to implement a rebate program¹⁹.

In large parts of Europe energy savings by white roofs are very limited due to better insulation of roofs and climatic conditions. Thus, where the incentive for installing a “white roof” in hot climates is partly from energy savings, there is no direct benefit for the building owner of a white roof that only provides cooling for the wider city. Although the criteria for certification (reflectivity above a threshold now and over time) are the same if reflective materials are applied for reducing outdoor heat only, there will be less demand for reflective products and hence less demand for certified reflective products.

Possible products for certification	Description	Potential customers	Advantage for customers	Value for customers
Reflective materials/coatings	Certificate for materials/coatings with a minimum level of reflectivity and long term performance (should be above a threshold and remain so over time)	Builders, administrations, housing corporations, individual households	Guaranteed performance	Expressed in energy savings (Most in warm climate zones with poorly isolated buildings)

Permeable pavement

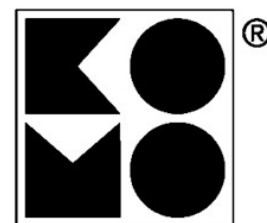
Permeable paving allows the infiltration of stormwater through the surface. The high porosity reduces runoff and prevents pluvial flooding damage. A special category is paving that allows water to pass immediately through large holes in the material. It contributes to the concept of a “city sponge” that keeps rainwater within the city and maintains groundwater levels also in dry periods. It is applied on roads, paths, and surfaces that are subject to light traffic, such as car parking lots, cycle-paths, emergency access lanes, and some residential roads. There are many different types of permeable pavement, ranging from permeable materials (stones, asphalt), to interlocking concrete and aggregates of different materials with and without a binding substance. Also within a category the performance may vary.

¹⁹ Michelle van Tijen, Rebecca Cohen, 2008. Features and Benefits of Cool Roofs: The Cool Roof Rating Council Program. Journal of Green Building: Spring 2008, Vol. 3, No. 2, pp. 13-19. http://coolroofs.org/documents/JGB_V3N2_a02_vanTijen.pdf

The American Society for Testing and Materials (ASTM) has a set of testing standards to determine the void content in pervious concrete²⁰, but not immediately related to effectiveness with regard to the amount of water passing through. This is better covered in technical standards in some European countries. In, at least, The Netherlands²¹, Germany²² and Belgium²³ technical standards exist for permeable pavement, with a standard value in all countries of 540 l/sec/ha. In Belgium pervious concrete stones can be certified by Probeton with the BENOR certificate according to the requirements of the Technical Prescriptions in PTV 122²⁴. In the Netherlands concrete stones can get a KOMO product certificate from KIWA. In all countries this certification is just beginning, with, for example, no certificates handed out yet in the Netherlands.

Also for stones that pass water immediately through large holes, or that are used for creating pavement with large holes, certificates exist in The Netherlands, Germany and Belgium. An example from The Netherlands is: BRL K11001 Grass concrete tiles²⁵.

The examples above pertain to stones. In the standardization discussions the possibilities to certify complete systems of permeable pavement, including the various base layers, or to certify the process of construction of permeable pavement, have been mentioned as a possibility for the future. In the US several courses are already provided for becoming a “certified” permeable paver²⁶, which also pay a lot of attention to constructing the base layers. In Europe this has not yet been elaborated.



In principle, there is a clear market for standardisation and certification. It has developed in a few countries where extreme rainwater has created nuisance or damage, but has potential to spread in more European countries. In many countries, there is a body of existing standards and certification for technical aspects of all kinds of building materials, and permeable pavement certification can build on this.

Possible products for certification	Description	Potential customers	Advantage for customers	Value for customers
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²⁰ <https://www.astm.org/Standards/C1688.htm>

²¹ BRL2317. Beoordelingsrichtlijn voor het KOMO® productcertificaat voor Waterdoorlatende bestratingselementen van beton, 21 maart 2014.

<https://www.kiwa.nl/upload/BRL/BRL%202317%2021-03-2014.pdf>

²² FGSV (1998): Merkblatt für wasserdurchlässige Befestigungen von Verkehrsflächen.- Forschungsgesellschaft für Straßen und Verkehrswesen e.V.; Köln

²³ PTV 122 – Technische voorschriften voor waterdoorlatende betonstraatstenen en -tegels, uitgave 3, 2009. This technical specification is considered a precursor to a Belgian or even European standard.

²⁴ <http://www.probeton.be/>

²⁵ <https://www.kiwa.nl/upload/BRL/BRL%20K11001.pdf>

²⁶ E.g. from the Interlocking Concrete Pavement Institute. <https://www.icpi.org/certification/CCPI> or NRMCA: https://www.nrmca.org/Education/Certifications/Pervious_Contractor.htm

Permeable pavement	Certificate based on a threshold in water permeability.	City departments, Building companies	Pavement that is and will remain porous over the years	Certainty on investment over time.
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Evaporative cooling spray systems

Evaporative cooling by spraying water is seen as an efficient approach to enhance thermal comfort in on streets and squares. In a water spray system a cloud of very fine water droplets is produced by atomization nozzles, generating a large contact surface and a high rate of evaporation.

Turning this principle into products has resulted in a variety of misting fans, pad based coolers and the like. Several products for gardens and terraces have appeared on the market in Southern Europe²⁷.

The development of standards for the effectiveness of these systems is complicated by the fact that their effectiveness is hugely dependent on local conditions. The effect of evaporative cooling depends on the dew point temperature²⁸ and relative humidity of the ambient air. With a relative humidity above about 70% the effect of evaporative cooling will be nihil.

ANSI/ASHRAE has developed a standard method for testing direct evaporative air coolers²⁹. The standard includes testing for saturation effectiveness, airflow rate and total power, as well as measuring static pressure of the direct evaporative air cooler, density of the air and rotation speed of the fan. Equally, standards exist for the energy efficiency of evaporative cooling systems. However, a standard on effectiveness may be hampered by the complex behaviour depending on the local microclimate, although a test under standard conditions might be developed.

Hence certification based on effectiveness of these products is not likely for the near future.

Possible products for certification	Description	Potential customers	Advantage for customers	Value for customers
Evaporative cooling spray systems	Certificate based on cooling capacity (difficult)	Households, Recreation establishments	Clarity on performance	Clarity on performance

Flood barriers/screens

Flood barriers are fixed, moveable or temporary structures to protect parts of a city against flooding. Important characteristics include their height and the water pressure they are able to withstand.

²⁷ E.g. IDROBASE DUETTO: http://www.perfectcool.it/perfect_prodotti.asp?ID=68, KIT FOG: http://www.perfectcool.it/perfect_prodotti.asp?ID=7. Example US supplier: <http://www.mistcooling.com/>

²⁸ The temperature at which water in the air condenses

²⁹ <http://webstore.ansi.org/RecordDetail.aspx?sku=ANSI%2FASHRAE+Standard+133-2015>

The British Standards Institution offers the BSI Kitemark for Flood Protection products³⁰ and a Kitemark for the Installation of Flood Protection Products. The product certification is related to a variety of standards for different flood protection products. It extends from products as they leave the factory to certification of the installation. A producer indicated that “the BSI Kitemark gave the added trust in their products that they needed. BSI Kitemark certification has also proved highly influential in helping to win new business, particularly in the local authority sector and via the Environment Agency frameworks”³¹. The UK Government stimulates the use of certified products by stating in the 2014 Flood Supports Systems Guidance: “Where appropriate, we recommend that homeowners and businesses use products that carry the BSI Kitemark for flood protection products (PAS 1188) or similar standards”³².



Recently BSI has introduced another Kitemark to cover the installation of Kitemark flood protection products to further help property owners. A BSI Kitemark certified organisation can issue a certificate to competent installers. As BSI provides services globally, not only in the UK, they are able to offer a Kitemark for Flood Protection in other countries.

Also in the US comparable certification exists³³. In some other European countries standards for mobile flood protection products have been developed. E.g, in Germany, the “Bund der Ingenieure für Wasserwirtschaft, Abfallwirtschaft und Kulturbau (BWK)” has developed a technical standard for mobile flood protection, dealing with technologies and the installation³⁴. The ‘European Flood Protection Association’ an alliance of companies from five European countries working in the area of flood protection published in 2014 a standard for quality labelling³⁵. This standard concerns three categories of products: temporary flood barriers, aperture flood barriers and pre-installed/demountable perimeter flood barriers. Certification has not been developed yet.

Obviously there is a market for certification in this area, which is not surprising seen the possible damage in case of failure.

³⁰ <https://www.bsigroup.com/en-GB/our-services/product-certification/industry-sector-schemes/construction/flood-protection-and-waterproofing-materials/>

³¹ <https://www.bsigroup.com/Documents/product-certification/UKFB-Case%20Study-UK-EN.pdf>

³² Department for Communities and Local Government. Flood Support Schemes, Guidance Note: Updated December 2014.

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/387976/Flood_Support_Schemes_revised_guidance.pdf

³³ <http://nationalfloodbarrier.org/docs/NationalFloodBarrierTestProgramDocumentDraft.pdf>

³⁴ BWK, 2005. Mobile Hochwasserschutzsysteme Grundlagen für Planung und Einsatz. ISBN 3-936015-19-8

³⁵ <https://www.europaverband-hochwasserschutz.eu/eng/index.htm>

Possible products for certification	Description	Potential customers	Advantage for customers	Value for customers
Flood Barriers and screens	Certificate based on a threshold in water permeability.	City departments, Building companies, Infrastructure managers	Demonstrated by the existence of the certification scheme	Limitation of possible damage as demonstrated by the existence of a certification scheme

Conclusions

For a few adaptation products standards and certification have been developed. Most of the standardisation work started by, so called, informal standardisation organisations. These are often member organisations in a certain economic sector providing technical guidance. Some have taken the standardisation process further into certification. An important factor in the development of a certificate is the amount of direct damage in case of failure of the product, which explains the existence of certification for flood barriers. For the other products investigated here, the damage happens indirect (such as extra mortality during a heatwave) and often at a distance from the material applied (permeable pavement uphill prevents flooding downhill). Nevertheless with the projected increase in impacts from climate change and possible damage incurred, the demand for certificates for adaptation products may grow.

Green roofs and Flood barriers may be the first of a series of adaptation products for which standards and certification will be developed (See table 4.1). As the market is still in development for many of these products, there could be a role for cities and other authorities, as purchasers of large amounts of permeable pavement and urban green, to stimulate quality certificates.

Possible products	Description	Potential customers	Advantage for customers	Value for customers	Future certification likely?
Green roofs	Certificate for various types of green roofs with guaranteed effectiveness with regard to water	Buyers of green roofs (builders, administrations, housing corporations, individual	Guaranteed quality of the components and performance	If it would be a requirement for a subsidy or building certificate	+++

	storage	households)			
Green facades	Certificate for various types of green facades with guaranteed cooling capacity	Buyers of green facades (builders, administrations, housing corporations, individual households)	Guaranteed performance (and compliance to standards for safety etc)	If it would be a requirement for a subsidy or building certificate	+++
Reflective materials/coatings	Certificate for materials/coatings with a minimum level of reflectivity and long term performance (should be above a threshold and remain so over time)	Builders, administrations, housing corporations, individual households	Guaranteed performance	Energy savings (Most in warm climate zones with poorly isolated buildings)	+
Permeable pavement	Certificate based on a threshold in water permeability.	City departments, Building companies	Pavement that is and will remain porous over the years	Certainty on investment over time.	+++
Evaporative cooling spray systems	Certificate based on cooling capacity (difficult)	Households, Recreation establishments	Clarity on performance	Clarity on performance	+
Flood Barriers and screens	Certificate based on a threshold in water permeability.	City departments, Building companies, Infrastructure managers	Certainty on performance	Limitation of possible damage as demonstrated by the existence of a certification scheme	+++

Table 4.1: Overview product certification

4.2.2. Process certification

For the certification of processes in urban adaptation we have considered the main processes that happen within a city in this respect. These are essentially: finding answers to the questions (1) how vulnerable is the city or our company/institution for climate change impacts? and (2) what do we plan to do about it? A number of specific applications are discussed below.

Risk/Vulnerability mapping

In ISO context (see Section 3.1) discussions have started to develop a standard for vulnerability or risk assessment. It is likely that it will consist of a series of steps that have to be followed to arrive at a vulnerability assessment of an area or an organisation or a project that is complete and reliable.

Once such a standard would be in place, there could be a market for certification. The certificate could be issued on a check if all process steps in creating the vulnerability assessment have been executed according to the standard. Having a certified vulnerability assessment has only an advantage in situations where there is a comparison between the certified objects. The most likely situation in which this occurs is in funding decisions whereby the funding authority has a choice between locations or projects.

Thus a market for certification of city risk/vulnerability assessment might appear if European or national funding bodies require that proposals for funding are based on the standard procedure. Or, if a national government would require cities participating in a scheme to have a certified vulnerability assessment in place. Regulation, in one way or another, can thus be a stimulating factor for certification in this area.

Possible process for certification	Description	Potential customers	Advantage for customers	Value for customers
Risk/Vulnerability mapping	Certificate based on proper completion of all process steps.	City departments, Infrastructure managers, adaptation project managers	Access to competitive funding	Possibly large if large investments are at stake

Overheating in homes

Especially for residential buildings, high temperatures in the bedroom contribute to sleep deprivation during warm weather. Under future climate conditions these issues may grow in importance and pertain to a large share of the building stock³⁶. Improving the isolation of buildings can contribute to

³⁶ Department for Communities and Local Government and AECOM, 2012. Investigation into Overheating in Homes. Literature Review. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/7604/2185850.pdf

further overheating³⁷. This issue has also been identified by the CEN/CENELEC coordination group mentioned in Section 3.2, who included “Hygrothermal performance of buildings -- Calculation and presentation of climatic data (ISO 15927-4:2005) on their shortlist.

An UK report³⁸ proposes the development of a standard for the operative temperature in bedrooms of new-built dwellings. The report acknowledges that further research, modelling and/or piloting is needed to be able to create the standard in all its detail. In the meantime the Chartered Institution of Building Services Engineers (CIBSE) has published a Technical Memorandum on the determination and prediction of the risk of overheating in buildings³⁹. Currently AECOM is commissioned by the British Government to do research for the preparation of a standard. Such a standard should ensure that dwellings being designed and built now will be able to protect occupants from higher external temperatures than the current climate.

However, if and when a standard has been developed there are options for certification. Buildings can be certified, but also the method used to assess the risk of the property overheating and to demonstrate compliance with a “Bedroom Temperature Threshold” can be certified. Certification can become important when public authorities or investors will require that in the design of new built, well isolated houses attention has been given to the overheating issue. Certification may have a value in preventing complaints and (costly) adaptations later on.

Possible topics for certification	Description	Potential customers	Advantage for customers	Value for customers
New built homes with low risk of overheating	Certification of the property design as having a low risk of overheating	Buyers of property, Housing corporations.	Guarantee of comfort during heatwaves	More comfort
Method for assessing overheating in homes	Certification of the risk assessment method	Building companies, technical advisors	Demonstrates that the building design has been verified with a standardised method	Prevention of complaints afterwards

³⁷ T. van Hooff, B. Blocken, J.L.M. Hensen, H.J.P. Timmermans, 2014. On the predicted effectiveness of climate adaptation measures for residential buildings. *Building and Environment*, 83, 142-158.

³⁸ Zero Carbon Hub, 2016. Next steps in defining overheating, discussion paper. <http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCH-Overheating-NextStepsDefinitions-Final.pdf>

³⁹ CIBSE, 2013. Technical Memorandum TM52 “The Limits of Thermal Comfort: Avoiding Overheating in European Buildings” <http://www.cibse.org/Knowledge/knowledge-items/detail?id=a0q2000000817f5AAC>

Floodproofing buildings

Flood proofing means any combination of structural and non-structural additions, changes, or adjustments to buildings which reduce or eliminate flood damage. In the USA the Federal Emergency Management Agency has developed guidelines for floodproofing resulting in a statement (certificate) issued by a design professional. The certificate plays a role in insuring properties in flood prone zones⁴⁰. In Europe, the FP7 project SMARTeST has made an inventory of existing standards for flood resilience technology and floodproofing, concluding that apart from a host of standards for individual building components, there is no overall framework standard for floodproofing. The SMARTeST report contains recommendations for developing such a (set of) standards⁴¹.

If such standards would be developed, and adherence to these would become recommended or obligatory for building in dedicated areas or for getting a property insurance, then there would certainly be a market for certification.

Possible topics for certification	Description	Potential customers	Advantage for customers	Value for customers
Floodproofing buildings	Certification of the property design as being resistant in case of flooding	Buyers of property, Housing corporations.	Guarantee of no or limited damage during flooding	Insurance premiums

Planning outdoor adaptation options

The actual effectiveness of adaptation options, especially of blue-green infrastructure, depends heavily on the local context. The Austrian company Green4Cities, a spin off from BoKu, has developed a methodology based on, among others, the use of EnviMet for microclimatological simulations. In addition also an economic assessment is made. Apart from offering the suite of tools, they are also offering the Greenpass® certificate for projects that have been well planned⁴². The tools (and thus the certificate) can be applied to individual objects and on city-district level.

Although the certificate guarantees a certain performance and demonstrates that the investment can be justified, it is difficult to translate that in a value for the customer. Of course, a nature based solution may be cheaper than a traditional “gray” solution, but that is part of the assessment methodology and is not necessarily connected with the certificate. The value of the certificate itself is thus more in the appreciation of stakeholders that a good and well researched choice has been made.

⁴⁰ <https://www.fema.gov/media-library-data/20130726-1511-20490-5294/job6.pdf>

⁴¹ https://www.ioer.de/fileadmin/internet/IOER_Projekte/PDF/FB_R/Flood-Resilience-Technologies_SMARTeST-Project_D23-final-July13.pdf

⁴² <https://www.green2pass.com/>

Possible process for certification	Description	Potential customers	Advantage for customers	Value for customers
Planning adaptation options	Certificate for well-planned adaptation measures	Cities, companies	Documented effectiveness	Appreciation

City adaptation strategies

Like the RESIN project, a couple of recent EU research projects pay attention to standardization and certification. The EU horizon 2020 project SMR (Smart Mature Resilient) includes a workpackage on Promotion of a draft standard (CEN Workshop Agreement) on a Resilience Management Guideline (for cities)⁴³. Worldwide, the 100Resilient Cities project⁴⁴ is stimulating cities to develop a resilience strategy (not limited to climate change). Common formats and tools are being developed, and these may develop into a standard approach.

Given these developments, it could well be that in the coming years a formal or informal standard or standards for developing a city climate adaptation strategy or a city resilience strategy will be developed. Certification could become interesting if there would be international processes, for instance instigated by the C40 or the Covenant of Majors, that favour cities with a certified strategy. Currently it is difficult to imagine what kind of processes this would be, as most international work is aimed at stimulating the ones that lag in a process, and less at working only with the best in class. Similar to ‘vulnerability assessment’, situations are thinkable in which a certificate could provide advantage in getting (inter)national funding.

On a sideline, the Spanish company Opticits provides courses and on-line tools for developing strategies for resilient cities. They provide a certificate to training participants who have shown to be able to work with the tools and follow the guidelines.

Possible process for certification	Description	Potential customers	Advantage for customers	Value for customers
City adaptation strategy	Certificate based on proper completion of all process steps.	Cities	Access to competitive funding	Possibly large if large investments are at stake

⁴³ <http://smr-project.eu/home/>

⁴⁴ <http://www.100resilientcities.org/>

Heat wave emergency planning

For emergency situations in general ISO has developed in 2011 a standard for requirements for incident response in emergency management (ISO 22320:2011). This outlines information and communication requirements for being prepared for emergencies. Keywords are information management, decision support, interoperability, coordination and cooperation. Some countries have similar standards in place, such as the National Health Service England's 'Core Standards for Emergency Preparedness, Resilience and Response'. Emergency preparedness often includes flooding events for areas at risk.

One of the specific threats to cities related to climate change are heatwaves. Following the disastrous August 2003 heatwave in central Europe, with many casualties in e.g. Paris, countries and cities have developed specific heatwave preparedness plans. Examples are the Plan Canicule in Paris⁴⁵ and Brussels⁴⁶, the England Heatwave plan, the Hitteplan in The Netherlands. These contain guidance for ensuring that vulnerable groups like elderly in their own homes are regularly contacted during a heatwave, guidance for care institutions, or for organisers of events with thousands of participants. With the expected increase in occurrence and duration of heatwaves, it could be possible that also large companies will develop heatwave preparedness plans, to maintain labour productivity and prevent accidents due to heat fatigue.

For ISO 22320 certification services are available, but only for certifying persons that are able to organise emergency management⁴⁷. If there would be a standard for heat wave preparedness plans, these could be certified. If it would be only for countries or even cities, then the target group would be probably too small to be commercially interesting. However, if companies would start to develop heatwave preparedness plans then there would be a market for certification (of the plans or the experts). The advantage of such certification would seem to lie in public appreciation and status as a good employer/city.

Possible process for certification	Description	Potential customers	Advantage for customers	Value for customers
Heatwave emergency planning	Certificate for developing heat wave preparedness plans based on future standard	Cities, companies	Protection of vulnerable citizens or workers	Appreciation. PR value.

⁴⁵ https://www.paris.fr/services-et-infos-pratiques/sante/prevention-et-depistage/prevenir-les-effets-d-une-canicule-2711#le-plan-canicule_3

⁴⁶ <http://www.cpasbru.irisnet.be/fr/index.asp?ID=29>, in fact a simple arrangement guaranteeing a daily check of vulnerable persons.

⁴⁷ PECB, a global provider of certification provides a certification of professionals in the field of incident response: <https://pecb.com/en/iso-22320-certification>

Conclusions

Process certification in urban adaptation is still many steps further away than product certification (see Table 4.2). As there is no direct market, it seems that requirements with regards to the quality of adaptation processes from national authorities, funding organisations and the like will be important to stimulate the development of certification schemes.

Possible services	Description	Potential customers	Advantage for customers	Value for customers	Future certification likely?
Risk/Vulnerability mapping	Certificate based on proper completion of all process steps.	City departments, Infrastructure managers, adaptation project managers	Access to competitive funding	Possibly large if large investments are at stake	+
New built homes with low risk of overheating	Certification of the property design as having a low risk of overheating	Buyers of property, Housing corporations.	Guarantee of comfort during heatwaves	More comfort	++
Method for assessing overheating in homes	Certification of the risk assessment method	Building companies, technical advisors	Demonstrates that the building design has been verified with a standardised method	Prevention of complaints afterwards	++
Floodproofing buildings	Certification of the property design as being resistant in case of flooding	Buyers of property, Housing corporations.	Guarantee of no or limited damage during flooding	Insurance premiums	++
Planning adaptation options	Certificate for well-planned adaptation measures	Cities, companies	Documented effectiveness	Appreciation	++

City adaptation strategy	Certificate based on proper completion of all process steps.	Cities	Access to competitive funding	Possibly large if large investments are at stake	+
Heatwave emergency planning	Certificate based on future standard	Cities, companies	Protection of vulnerable citizens or workers	Appreciation. PR value.	+

Table 4.2 Overview process certification

5. Discussion and conclusions

In urban climate adaptation only few standards exist, and certification examples are equally scarce. This report is based on an inventory of existing certification schemes and an exploration into possibilities for certification in urban adaptation.

With regard to product certification, it seems that products with a high complexity and many factors influencing performance (such as green roofs or permeable stones) or products that are able to prevent a lot of damage if they do not fail (such as flood barriers) are the first for which standards have been developed and certification schemes have been introduced. Certification schemes are often still limited to one country in Europe. For a couple of products, standards and possibly certification schemes are being developed, for instance for green facades.

With the expected increase of climate change impacts and possible damages, not only for flooding, but also for heat, certification may spread to more product categories and to more countries. Permeable pavement and green facades seem obvious candidates.

With regard to the certification of processes in urban climate adaptation, no evidence has been found. Possible processes that could be certified include the production of vulnerability assessments, the development of adaptation strategies or heatwave emergency plans. The development of process certification in urban adaptation will probably depend on legislative or financial requirements by (funding) authorities.

Annex A: persons interviewed (between brackets topic for certification)

Vera Enzi, European Federation of Green Roof Associations -EFB. (green roofs and facades)

Lisa Jesner, Austrian "Verband für Bauwerksbegrünung" [Association for greening buildings] (green roofs and green facades)

Rianne Sloomweg, Sempergreen (green roofs and facades)

Jan Willem Bosma, KIWA (pervious pavement)

Jenny Lambert, BSI (flood protection)

Robert Pannel, NHBC/Zero Carbon Hub (overheating in homes)

Nicola O'Connor, Mandarin Research, UK (overheating in homes)

Ester Vendrell, Opticits (city adaptation strategies),