# Horizon 2020

# Call: H2020-SC5-2015-two-stage

# Topic: SC5-04-2015

# Type of action: RIA

# Proposal number: 689135-1

# Proposal acronym: BAQUET

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### *How to fill in the forms*

The administrative forms must be filled in for each proposal using the templates available in the submission system. Some data fields in the administrative forms are pre-filled based on the previous steps in the submission wizard.

*Proposal ID* **689135-1** *Acronym* **BAQUET**

# 1 - General information

Topic SC5-04-2015 Type of action RIA

Call identifier H2020-SC5-2015-two-stage Acronym BAQUET

Proposal title* Better Air Quality for European Towns

*Note that for technical reasons, the following characters are not accepted in the Proposal Title and will be removed: < > " &*

Duration in months *60*

| | | | |
|---|---|---|---|
| Fixed keyword 1 | *Atmospheric chemistry, atmospheric composition, air pollution* | Add | |
| Fixed keyword 2 | *Environment, Pollution & Climate* | Add | Remove |
| Fixed keyword 3 | *Public and environmental health* | Add | Remove |
| Fixed keyword 4 | *Environmental impact assessment* | Add | Remove |
| Fixed keyword 5 | *Low/zero carbon communities* | Add | Remove |
| Fixed keyword 6 | *Climatology and climate change* | Add | Remove |

Free keywords *Thermal comfort, Heat Stress, Pollen, Allergic Disorder, Environment, Health and Well-Being*

## *Abstract*

*BAQUET proposes to develop and apply a set of tools that will help city developers, governments, and other stakeholders to design air pollution and climate mitigation strategies for their city and evaluate the environmental benefits. This will be accomplished by embedding the tools in a multi criteria assessment methodology, valuating different strategies according to (1) exposure of citizens to air pollution and heat stress (2) greenhouse gas emissions (3) economic costs and benefits (4) stakeholders' evaluation, and (5) climate change impacts on air quality, allergic disorders, and heat stress. BAQUET will apply the governance tools in Kraków and Zagreb. These cities face different challenges regarding sustainable urban governance and formulated plans to deal with them. Use of advanced touch tables in interactive workshops will facilitate discussions, enhance communication between actors and help to raise awareness.*
*BAQUET will integrate, evaluate, and apply advanced scientific models to quantify personal exposure to air pollution and heat stress at street level. The tools will focus on observed diurnal and seasonal patterns, which is important for health-related exposure calculations. Targeted measurements in Kraków and Zagrab will allow assessment of the accuracy of the BAQUET tools to link sources of air pollutants to atmospheric concentrations (source apportionment). Personal monitoring equipment will be used to evaluate the downscaling to personal exposure. In eight other cities throughout Europe BAQUET will analyse observational records that reflect the effects of past air quality and greenhouse gas legislation. This includes a unique retrospective analysis of aerosol material stored on filters.*
*BAQUET objectives and methods match the work program, through the use of an integrated approach, considering environment and climate, addressing different regions in Europe, and using advanced tools for the assessment, monitoring and modelling.*

Remaining characters 22

*Proposal ID* **689135-1** *Acronym* **BAQUET**

Has this proposal (or a very similar one) been submitted in the past 2 years in response to a call for proposals under the 7th Framework Programme, Horizon 2020 or any other EU programme(s)? ○ Yes ◉ No

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## *Declarations*

| | |
|---|---|
| 1) The coordinator declares to have the explicit consent of all applicants on their participation and on the content of this proposal. | ☒ |
| 2) The information contained in this proposal is correct and complete. | ☒ |
| 3) This proposal complies with ethical principles (including the highest standards of research integrity — as set out, for instance, in the European Code of Conduct for Research Integrity — and including, in particular, avoiding fabrication, falsification, plagiarism or other research misconduct). | ☒ |

4) The coordinator confirms:

| | |
|---|---|
| - to have carried out the self-check of the financial capacity of the organisation on https://ec.europa.eu/research/participants/portal/desktop/en/organisations/lfv.html or to be covered by a financial viability check in an EU project for the last closed financial year. Where the result was "weak" or "insufficient", the coordinator confirms being aware of the measures that may be imposed in accordance with the H2020 Grants Manual (Chapter on Financial capacity check); or | ○ |
| - is exempt from the financial capacity check being a public body including international organisations, higher or secondary education establishment or a legal entity, whose viability is guaranteed by a Member State or associated country, as defined in the H2020 Grants Manual (Chapter on Financial capacity check); or | ◉ |
| - as sole participant in the proposal is exempt from the financial capacity check. | ○ |

5) The coordinator hereby declares that each applicant has confirmed:

| | |
|---|---|
| - they are fully eligible in accordance with the criteria set out in the specific call for proposals; and | ☒ |
| - they have the financial and operational capacity to carry out the proposed action. | ☒ |

The coordinator is only responsible for the correctness of the information relating to his/her own organisation. Each applicant remains responsible for the correctness of the information related to him and declared above. Where the proposal to be retained for EU funding, the coordinator and each beneficiary applicant will be required to present a formal declaration in this respect.

According to Article 131 of the Financial Regulation of 25 October 2012 on the financial rules applicable to the general budget of the Union (Official Journal L 298 of 26.10.2012, p. 1) and Article 145 of its Rules of Application (Official Journal L 362, 31.12.2012, p.1) applicants found guilty of misrepresentation may be subject to administrative and financial penalties under certain conditions.

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Your reply to the grant application will involve the recording and processing of personal data (such as your name, address and CV), which will be processed pursuant to Regulation (EC) No 45/2001 on the protection of individuals with regard to the processing of personal data by the Community institutions and bodies and on the free movement of such data. Unless indicated otherwise, your replies to the questions in this form and any personal data requested are required to assess your grant application in accordance with the specifications of the call for proposals and will be processed solely for that purpose. Details concerning the processing of your personal data are available on the privacy statement. Applicants may lodge a complaint about the processing of their personal data with the European Data Protection Supervisor at any time.

Your personal data may be registered in the Early Warning System (EWS) only or both in the EWS and Central Exclusion Database (CED) by the Accounting Officer of the Commission, should you be in one of the situations mentioned in:
-the Commission Decision 2008/969 of 16.12.2008 on the Early Warning System (for more information see the Privacy Statement), or
-the Commission Regulation 2008/1302 of 17.12.2008 on the Central Exclusion Database (for more information see the Privacy Statement) .

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# 2 - Administrative data of participating organisations

| ***PIC*** | ***Legal name*** |
|---|---|
| *999981634* | *WAGENINGEN UNIVERSITY* |

*Short name: WU*

*Address of the organisation*

Street DROEVENDAALSESTEEG 4

Town WAGENINGEN

Postcode 6708 PB

Country Netherlands

Webpage http://www.wageningenur.nl/nl.htm

*Legal Status of your organisation*

**Research and Innovation legal statuses**

Public body ..... yes
Non-profit ..... yes
International organisation ..... no
International organisation of European interest ..... no
Secondary or Higher education establishment ..... yes
Research organisation ..... no

Legal person ..... yes

**Enterprise Data**

SME self-declared status ..... 2013 - no
SME self-assesment ..... unknown
SME validation sme ..... unknown

**Based on the above details of the Beneficiary Registry the organisation is not an SME (small- and medium-sized enterprise) for the call.**

NACE code 853 -

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## *Department(s) carrying out the proposed work*

**Department 1**

| | |
|---|---|
| Department name | Wageningen University, Meteorology and Air Quality |
| | ☐ Same as organisation address |
| Street | Droevendaalsesteeg 3 |
| Town | Wageningen |
| Postcode | 3708 PB |
| Country | Netherlands |

## *Dependencies with other proposal participants*

| ***Character of dependence*** | ***Participant*** | |
|---|---|---|

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## *Person in charge of the proposal*

The name and e-mail of contact persons are read-only in the administrative form, only additional details can be edited here. To give access rights and basic contact details of contact persons, please go back to Step 4 of the submission wizard and save the changes.

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Last name: **Krol**
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Department: Meteorology and Air Quality
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*Proposal ID* **689135-1** *Acronym* **BAQUET**

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*Proposal ID* **689135-1** *Acronym* **BAQUET**

# 3 - Budget for the proposal

| Total requested amount / € | 7 000 000 |
|---|---|

COVER PAGE

**Title of Proposal**

# *Better Air QUality for European Towns*

(BAQUET)

**List of participants**

| Participant No | Participant organisation name | Country | Kind |
|---|---|---|---|
| **1** | Wageningen University | NL | University |
| **2** | Alterra, Wageningen | NL | Research Institute |
| **3** | University of Helsinki | FI | University |
| **4** | University of Reading | UK | University |
| **5** | Groningen University | NL | University |
| **6** | EMPA | CH | Research Institute |
| **7** | Paul Scherrer Institute | CH | Research Institute |
| **8** | Children's Hospital Srebrnjak | HR | Hospital |
| **9** | ECPL, University of Crete | GR | University |
| **10** | AGH University of Science and Technology, Kraków | PL | University |
| **11** | Barcelona Supercomputing Centre | EA | Research Institute |
| **12** | University of Aveiro | PT | University |
| **13** | State Scientific Research Institute, Vilnius | LT | Research Institute |
| **14** | Noveltis, Toulouse | FR | SME |
| **15** | Aria, Paris | FR | SME |
| **16** | Municipality of Kraków | PL | Government |
| **17** | Andrija Stampar Teaching Institute of Public Health | HR | Research Institute |
| **18** | Kings College London | UK | University |

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## List of acronyms used

| | |
|---|---|
| ACCMIP | Atmospheric Chemistry and Climate Model Intercomparison Project |
| AMS | Aerosol Mass Spectrometer |
| AQ | Air Quality |
| ATOPICA | Atopic diseases in changing climate, land use & air quality |
| BAQUET | Better Air QUality for European Towns |
| BC | Black Carbon |
| BRIDGE | sustainaBle uRban plannIng Decision support accountinG for urban mEtabolism |
| CHIMERE | A multi-scale model for air quality forecasting and simulation |
| CMAQ | Community Multi-scale Air Quality model |
| CMIP5 | Coupled Model Intercomparison Project Phase 5 |
| CoM | Covenant of Mayors |
| DSS | Decision Support System |
| EHWB | Environment, Health, and Well Being |
| ESCAPE | European Study of Cohorts for Air Pollution Effects |
| GHG | Green House Gas |
| ICOS | Integrated Carbon Observation System |
| MACC | Monitoring Atmospheric Composition and Climate |
| MCA | Multi Criteria Analysis |
| PM | Particulate Matter |
| ROS | Reactive Oxygen Species |
| UAV | Unmanned Aerial Vehicle |
| VOC | Volatile Organic Compound |
| WHO | World Health Organisation |
| WP | Work Package |
| WRF | Weather Research & Forecasting model |
| ZEV | Zero Emission Vehicles |

# 1 Excellence

## 1.1 Objectives

"Better Air QUality for European Towns" (BAQUET) proposes to develop and apply a series of tools in support of governance. These tools will help city developers and governments to evaluate the environmental benefits of air pollution and climate mitigation strategies, and to assess how these strategies stimulate sustainable urban development. BAQUET's key objectives will be to provide:

- Tools to evaluate the environmental impact of sustainable urban development strategies, including air pollution and GHG mitigation strategies
- Assessment of sustainable urban development strategies, using a multi criteria methodology, combining simulated impacts on personal exposure with valuation by the stakeholders
- Quantification of personal exposure to air pollution and heat stress at street level in urban environments
- Estimates of effects of sustainable urban development on personal exposure, with and without considering future climate change

Another objective is to demonstrate and evaluate the tools in real-world applications, through:

- Two well-validated case studies in the cities of Kraków and Zagreb, focussing on societal and technological changes towards a low carbon society with better air quality
- Analyses of existing measurements in eight EU cities throughout Europe and dedicated observations in Kraków and Zagreb (Figure 1)

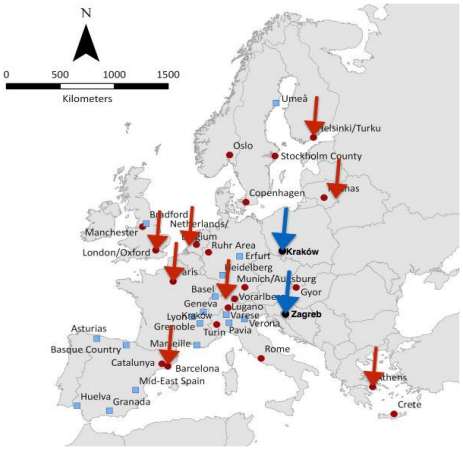


*Figure 1: Map from the ESCAPE study[1]. BAQUET will focus on Level 1 cities Kraków & Zagreb (blue arrows) with governance support and atmospheric measurements (section 1.3.6), and on Level 2 cities Athens, Barcelona, Zurich, Paris, London, Rotterdam, Vilnius & Helsinki (red arrows) for evaluation of BAQUET tools (section 1.3.7)*

### 1.1.1 Scientific rationale

Despite European emission reduction strategies, exposure to air pollution still leads to adverse health effects in Europe[2]. Clear health impacts are found for particulate matter with diameters less than 2.5/10 μm ($PM_{2.5}$/$PM_{10}$) and ozone. For some air pollutants, like $PM_{2.5}$ and $PM_{10}$, exposure is spatially quite homogeneously distributed. For others, like ultrafine particulates ($PM_{0.1}$) and $NO_2$, highest exposure is found near the sources[3]. The 2013 report of the European Environment Agency states[4]: "Around 90% of city dwellers in the European Union are exposed to one of the most damaging air pollutants at levels deemed harmful to health by the World Health Organisation (WHO)". As an example, the "European Study of Cohorts for Air Pollution Effects (ESCAPE)" investigated long-term effects of exposure to air pollution on human health in Europe[1,5]. The study found significant contrasts in annual average $NO_2$ concentrations between and especially within 36 study areas across Europe (Figure 1). The study concludes that epidemiological long-term studies should consider different approaches for better characterization of the intra-urban contrasts, for instance by using advanced modeling tools. BAQUET will further develop such advanced modeling tools for use in city governance.

The WHO guidelines[6] are stricter than current EU legislation for ambient air quality (e.g. EU requires $PM_{2.5} < 25\ \mu g.m^{-3}$ on an annual basis) and also stress the detrimental effects of short-term exposure to high levels of $PM_{2.5}$ and other air pollutants. BAQUET will therefore focus on time-resolved exposure of citizens to air pollutants at street level.

Air pollution is a very serious problem also linked to other environmental issues. Epidemiological studies have demonstrated that high levels of vehicle emissions are correlated with an increase in pollen-induced respiratory allergy (allergic rhinitis) for people who live in urban areas[7]. In the remainder, BAQUET therefore considers pollen as an air pollutant. Another important example is the enhanced mortality during the European heatwave in 2003, which could be related to both heat stress and air pollution[8,9]. This illustrates the importance of the concept "Environment, Health and WellBeing (EHWB)" in city environments, and the need for an integrated approach to improve EHWB in European towns.

Why is an integrated approach needed when societal and technological solutions are considered that build a low carbon urban society with less air pollution? We provide two examples: (1) Urban transportation systems (e.g. zero emission vehicles (ZEV)) are not only related to air pollution[10], but also impact the carbon footprint as well as physical wellbeing and health (stimulating walking and cycling). (2) Stimulating urban agriculture using rooftop gardens[11] also impacts the heat balance of the urban environment[12] and the GHG balance.

It is also essential to take climate change into consideration in sustainable urban development strategies. First, in emissions reduction strategies to abate air pollution, win-win strategies are sought that also reduce GHG emissions[13]. Second, climate change itself will also affect the exposure to air pollution[14] and will also influence EHWB through effects on thermal comfort and pollen exposure, due to rising temperatures, increased use of air conditioners and energy, and longer growing seasons. BAQUET will address these issues as will be described in the next sections.

### 1.1.2 The BAQUET proposal

Smart cities and societies seek for sustainable solutions that lead to better EHWB in urban environments. When developing these solutions, cost aspects are often dominant, while the benefits are more difficult to quantify because many factors play a role. Costs related to health damage caused by exposure to air pollution and heat stress can be derived from health impact studies, but the exposure of individual citizens is difficult to quantify. This exposure shows strong temporal and spatial variations, driven by emissions and atmospheric mixing characteristics. There is a large body of evidence that quantifies the health effects of short term exposure to air pollution[15]. Nevertheless, most assessments focus on annual averages[14], guided by EU regulations ($PM_{2.5}$ < 25 $\mu g.m^{-3}$, $NO_2$ & $PM_{10}$ < 40 $\mu g.m^{-3}$). Many city governments acknowledge the need for further action to improve EHWB. An important initiative in that respect is the Covenant of Mayors (CoM) to endorse and support the efforts deployed by local authorities in the implementation of sustainable energy policies. However, while GHG emission reductions are relatively easy to quantify using bottom-up strategies, it is more difficult to link sustainable solutions to health impacts of air pollution and heat stress. BAQUET will make important contributions, by further integrating, evaluating, and applying advanced scientific models that aim to quantify these effects at high spatial and temporal resolutions.

BAQUET will couple these advanced scientific tools to a Decision Support System (DSS). This DSS evaluates the sustainability of urban planning interventions[16], and was developed in the EU project BRIDGE[17]. The Multi Criteria Analysis (MCA) methodology developed in BRIDGE is also suited to assess the impact of sustainable urban development on EHWB.

BAQUET differentiates between level-1 and level-2 cities. The level-1 cities Zagreb and Kraków (Figure 1) shall serve as test bed for the complete set of BAQUET's sustainable urban development tools. These two cities were chosen for important reasons: while many large Western European cities have successfully advanced in air pollution mitigation, Eastern European cities still suffer from poor air quality. For instance, the use of coal for domestic heating and industry makes Kraków (PL) one of the most polluted European cities, especially in winter[18]. The local government plans to ban coal for heating purposes by 2018. Zagreb (HR) represents a medium-sized Southern European city, with moderate air pollution problems, but with issues concerning summer heat stress[19] and allergic disorders caused by pollen[20,21]. In both cities urban sustainable development is on the political agenda, and plans to reduce the carbon footprint and to improve air quality are in various stages of development. Zagreb, for instance, signed the CoM in 2008, and now submits regular reports of implementation.

In cooperation with these cities and local stakeholders, existing and new policy strategies for air pollution and climate mitigation will be evaluated. Where appropriate, BAQUET scientists will bring forward innovative solutions. Based on altered air pollutant emission patterns and physical characteristics of the city, the health benefits will be simulated. Combined with the accompanying GHG emission reduction, this integrated approach thus estimates the impact of sustainable urban development policy on (i) exposure of citizens to air pollution and heat stress in urban environments (ii) health (iii) GHG emissions. BAQUET will also collect stakeholders' opinions on the urban sustainability priorities. Combining this information with the outputs of physical models, BAQUET will produce an overall indicator to compare different policy options.

To demonstrate the performance of the modelling components underlying the tools, BAQUET will employ a variety of validation operations. First, evaluation of individual BAQUET tools will use existing, but largely unexploited, long-term air quality records and meteorological monitoring in urban environments

throughout Europe. These are named level-2 cities in BAQUET (Figure 1). In many cities, long measurement records are present that reflect the effects of past air quality legislation, climate change, and GHG emission reduction strategies. BAQUET will address short timescales at high spatial resolution to investigate the strong diurnal and seasonal patterns visible in these data records. Understanding these patterns is vital for the design of proper abatement strategies and for an assessment of positive effects of such strategies on public health.

Disentangling the effects of local measures versus measures taken at national or EU level requires modelling strategies that allow source apportionment. Therefore, BAQUET's second method to demonstrate the performance of its tools will be to perform and analyse targeted multi-species and isotopic measurements in Kraków and Zagreb (the two BAQUET level-1 cities). BAQUET will acquire unique new and specialized measurements in these less well-sampled cities, and will assess the accuracy of the BAQUET tools to link sources of air pollutants and GHGs to atmospheric concentrations (source apportionment). In addition, personal monitoring equipment will be used to assess the ability of the BAQUET tools to downscale the model results to the level of personal exposure. Further details will be given in section 1.3.6. Finally, BAQUET will demonstrate the capability of its tools by predicting and measuring the impact of weekend-weekday transitions on air quality.

Future climate change is a major unknown in the assessment of air quality and heat stress, and will also affect the occurrence of allergic disorders (asthma, allergic rhinitis, and eczema). BAQUET will therefore additionally assess the potential impact of climate change on urban air quality and exposure to heat stress (section 1.3.8).

BAQUET will disseminate the results and create a firm basis for impact and its legacy by using advanced interactive presentation tools, notably a touch table (section 2), alongside the more common website solutions.

In summary, the BAQUET governance tools enable an integrated assessment of policy measures by combining (i) scientific data concerning the environmental and health impacts of exposure to air pollution and heat stress, for the past and present time, and under future climate change scenarios (ii) GHG emission reduction levels (iii) economic and societal estimates on the impacts of policy measures, and (iv) stakeholders' valuation of sustainable urban development. This ensures a proper interpretation of the scientific results by the stakeholders and allows for feedback and additional iterations regarding the effects of technological as well as non-technological measures.

## 1.2 Relation to the work programme

BAQUET addresses air pollution and heat stress in ten European cities throughout Europe. BAQUET will work closely with the municipalities of Kraków and Zagreb, designing integrated strategies to reduce their carbon footprint while improving the air quality. Targeted measurements that allow source apportionment will be performed in these cities, and a DSS tool will be used to provide a balanced evaluation of sustainable urban development strategies. Results developed in BAQUET will be disseminated using a touch table, promoting the market deployment of the tools and abatement strategies. Further relevance of the project objectives to the call text is illustrated in Table 1.

*Table 1: Relevance of the project objectives to the call text*

| Call Text | BAQUET |
|---|---|
| "The sources of pollution in cities are mainly linked to urban activities such as transport and heating" | Transport: Bicycle plans, ZEVs (electric, $H_2$ fuel cell), ban of dirty traffic; Heating: industrial heat, ban coal for domestic heating (Kraków) |
| "Other activities such as energy production, industrial activity, agriculture and trans-boundary pollution play an important role" | Multi-scale modelling (MACC/WRF/GRAL). Source apportionment, targeted measurements. Separation of long-range and local contributions |
| "consider both environmental and climate considerations when designing emission abatement strategies" | BAQUET modelling output includes exposure to air pollution and heat; GHG emissions; and also considers climate change scenarios. Green roof and infrastructure modifications are examples of measures that will be analysed |
| "Integrated approaches are needed" | Advanced tools to assess the entire chain from sustainable urban development to personal exposure. Integration of various effects, MCA |
| "involvement of the main pollution-generation sectors" | Stakeholder conference in Kraków and Zagreb, with representatives of energy producers, |

| | |
|---|---|
| | industries, public transport providers |
| "designing and implementing adequate abatement strategies and practices"; "complex systems dynamics of societal and technological changes required" | The MCA of sustainable urban development strategies in Kraków and Zagreb, provided by the DSS tool, will compare the multidimensional impacts of abatement strategies dealing with complex systems dynamics; use of presentation tools to disseminate results of scientific model calculations; Stakeholder involvement |
| "different regions and cities of Europe" | Analysis of air quality development in two level-1 and eight level-2 cities throughout Europe, with different climates, human activities, and mitigation strategies. Tools are tested and will be applicable throughout Europe |
| "advanced tools for the assessment, monitoring, modelling – including source apportionment –" | BAQUET modelling tools for exposure to air pollution and heat stress. Targeted measurements for source apportionment; MCA tool to integrate data for a comprehensive assessment |
| "awareness-raising actions and policy support activities" | Stakeholder involvement, personal monitoring, policy support by an interactive touch table to present scientific results, discuss and evaluate urban development strategies, public awareness |

## 1.3 Concept and approach

The BAQUET tools will assess the exposure of city populations in Europe to air quality and heat stress. They will allow evaluation of multiple effects of air pollution abatement strategies, in support of integrated air quality and climate change governance. BAQUET uses case studies to develop, evaluate, and apply these tools.

### The BAQUET case studies

BAQUET will focus on Zagreb and Kraków, level-1 cities for which different emission abatement strategies will be constructed using input from various stakeholders. The impact of proposed policy measures on emissions of air pollutants and GHGs will be estimated. These emissions will be fed into the BAQUET modelling systems that produce time-resolved and downscaled predictions on street level and the related exposure of citizens to air pollution and heat stress and associated health impacts.

A vital step in BAQUET is the use of the DSS tool, which evaluates the impact of measures to improve air quality and reduce GHG emission. Evaluation criteria are (1) exposure of citizens to air pollution and heat stress (2) GHG emissions (3) economic costs and benefits (4) stakeholders' evaluation, and (5) climate change impacts on air quality, allergic disorders, and heat stress. This integrated approach will allow a balanced assessment of long-term sustainable urban development solutions for the challenges that exist in many EU cities in terms of EHWB.

### Evaluation of the BAQUET tools throughout Europe

The ability of the advanced BAQUET tools to assess exposure of the urban population to air pollution and heat stress is a key factor. Therefore, the accuracy of BAQUET modeling tools will be assessed by (i) evaluation of calculated exposure to air pollution and heat stress in well-monitored EU city environments (ii) targeted measurements and measurement campaigns in Kraków and Zagreb that specifically address the contribution of various polluting sectors to local air quality (source apportionment) (iii) comparison of model predicted and monitored exposure to air pollution and heat at the citizen level (personal monitoring). With this, BAQUET will efficiently use existing measurements and employ technologically advanced measurement strategies in the relatively poorly sampled cities Kraków and Zagreb. In these towns, citizens are involved by asking them to participate in personal monitoring. Finally, the ability of the BAQUET modeling tools will be directly evaluated with a targeted campaign around weekend-weekday transitions. During this transition, industrial emissions and traffic density change drastically, which provides an opportunity to validate the BAQUET tools to acquire important information on the impact of (local) traffic and industry on local air pollution.

### *BAQUET's work program*

The overall concept of BAQUET is illustrated in Figure 2. BAQUET has nine work packages (WPs), including the coordination WP0.

Below we briefly describe the goal of each WP, the role of the WP in BAQUET and the links of each WP to on-going research and innovation activities at national and international level.

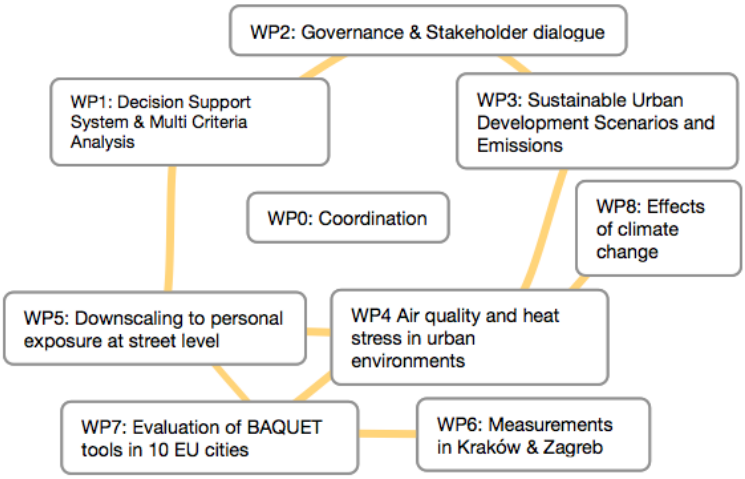


*Figure 2: Overview of the BAQUET work packages. WP0 deals with the overall coordination of the project, including dissemination activities.*

#### 1.3.1 WP1: BAQUET decision support system

The objective of WP1 is to develop a DSS. The selection of an abatement strategy of any urban development strategy is a political issue, which must be based on available scientific knowledge. The BAQUET DSS will organize, in a structured manner, all the necessary information to the decision making process, providing a synthetic indicator articulating all the inputs. This will also allow the *ex-ante* assessment of the multiple impacts on sustainability of air pollution and climate change mitigation strategies.

In a previous FP7 project (BRIDGE, grant agreement no. 211345), an MCA methodology was developed which integrated the outputs of complex physical models of environmental fluxes with socio-economic data characterizing urban planning alternatives and political priorities[16,17,22]. The BRIDGE challenge was to make a sustainability assessment of urban planning options by combining indicators from different scientific fields and sources: objective and quantitative as well as subjective and qualitative data. The final output integrates economic, social and environmental indicators, combining measurements of the more important project impacts with the preferences of policy makers[22].

The BAQUET challenge is similar and will build upon BRIDGE. However, in BAQUET advanced physical models are used to link sectorial emissions to various health impacts. Also impact of climate change on these metrics will be included (see table 2). The BAQUET modelling tools will characterize the physical impacts of strategies under assessment, while the stakeholders will provide the social and economic impacts. The analysis also requires a preliminary assessment of the costs of the available technologies (e.g. ZEV public transport). Health impact calculations will be based on scientific assessments, e.g. from the EU & WHO-funded HRAPIE project[23]. To analyse social acceptability of local and national air quality policy options, we link to the results of the FP7 project SEFIRA (grant agreement no. 603941).

*Table 2: Assessment criteria and indicators that will be included in the BAQUET DSS tool*

| Sustainable dimension | Criteria | Indicators |
|---|---|---|
| Economic | Economic costs<br>Economic opportunities | Investment costs<br>Maintenance and operation costs<br>Employment creation<br>Private investment attracted |
| Social & Environmental | Well-being<br>Social acceptability<br>Greenhouse gas emissions<br>Climate Change | Stakeholders' evaluation<br>Tonnes $CO_2$-equivalent emissions<br>Calculated health impact (see next row: Health) |
| Health | Long-term and short-term health impact<br>Non-accident mortality<br>Hospital visits<br>Sick leaves | Derived from calculated exposure to<br>• Air pollutants<br>• Pollen<br>• Heat Stress |

#### 1.3.2 WP2: Governance & Stakeholder dialogue

The objective of WP2 is to involve stakeholders in the project. BAQUET will concentrate on sustainable urban development in Kraków and Zagreb. Due to its geographical location and the use of coal for

domestic heating, air quality in Kraków is poor, especially in winter. One of the targets of sustainable urban development is therefore domestic heating, with a ban for using coal in 2018. Zagreb is representative of a medium-sized city with a continental climate, with an average maximum summer temperature of about 26°C. Apart from summer heat stress[19], increasing sensitization to ragweed pollen exposure has serious health impacts in Zagreb[21]. Apart from that, Zagreb has formulated targets to reduce emissions of air pollutants. Nitrogen oxide emissions must be reduced by 20% in the central part of the city, and $PM_{10}$ emissions by at least 30% in the heating season. Specific measures have been proposed to meet these targets in 5-7 years.

These two cities will be used as a test bed for the BAQUET tools. Using stakeholder dialogues, long-term sustainable urban development strategies will be formulated that address EHWB, including air pollution and climate mitigation. Innovative technological solutions will be discussed with scientific input from BAQUET experts. Potential stakeholders identified in Kraków are the ArcelorMittal steel factory and a company that constructs an Ecological Trash Incinerator. Important stakeholders already committed are the regional department of environmental protection (WIOS) and "Kraków Smog Alert". The latter is a grassroots movement that started at the end of 2012, and they negotiated the 2018 ban on solid fuel use for household heating purposes. Monitoring the effects of this target is an excellent test case for BAQUET. Options for sustainable urban development will flow into WP3, and the evaluation of stakeholders into WP1.

### 1.3.3 WP3: Sustainable urban development scenarios and emissions

The objective of WP3 is to translate the scenarios of WP2 into input data for the BAQUET tools. From the discussions with stakeholders and the city governments of Zagreb and Kraków, development scenarios will emerge that transform these cities into low carbon societies with better air quality. In WP3 these scenarios are translated into emission scenarios that are input to the modeling WP4 and downscaling WP5. Apart from that, BAQUET will assess air quality and thermal comfort in the eight level 2 cities (see Table 3). These cities span a wide range of urban environments, climatic conditions, and past urban development. Abatement of air pollution and GHG emissions has occurred on the scales of the EU, country and the city. To allow modelling of past mitigation strategies on city scale air pollution and thermal comfort, BAQUET will generate detailed emission maps reflecting the changes over the past decades. This will be accomplished by using sectorial speciation (e.g. traffic, industry, domestic heating) in the local emission inventories. These emission maps will be used in WP4 and WP5.

*Table 3: BAQUET cities and the specific issues that will be addressed per city*

| City | Issues considered in BAQUET |
|---|---|
| Athens | Effect of economic crisis on Air Quality, Thermal comfort |
| Barcelona | Air Quality & public transport (AIRUSE LIFE)[24] |
| Zurich | Analysis measurements on tram lines, retrospective filter analysis, pollen |
| Paris | Air Quality and diesel vehicles |
| London | Pollen, Thermal comfort |
| Rotterdam | Air Quality, Industry, Shipping, Thermal comfort, retrospective filter analysis |
| Vilnius | Retrospective filter analysis, Impact biomass burning on air quality[25-27] |
| Helsinki | Air Quality and road dust, Thermal comfort |
| Zagreb | Thermal comfort, Air Quality & Pollen |
| Kraków | Air Quality, domestic heating, phase out of coal usage |

For modelling the European scale, BAQUET will use emissions developed in earlier EU-projects, like Megapoli, CitiZen, MACC, AIRPARIF. Also use will be made of EU tools like E-PTRT. Natural emissions of non-methane volatile organics will be calculated with implemented tools like MEGAN. To investigate the uncertainties in the inventories of anthropogenic and natural emissions, sensitivity simulations will be performed with different anthropogenic emission inventories (e.g. EDGAR4.2, TNO MACC II, ACCMIP-MACCity) and different choices for natural emissions.

### 1.3.4 WP4: Air quality and heat stress in urban environments

The objective of WP4 is to calculate dynamical fields of air pollution levels and meteorology at high resolution around BAQUET cities. BAQUET will use advanced modelling tools to simulate weather and associated air quality in Europe. Boundary conditions for the EU domain will be provided by the MACC analysis. The EU domain will be simulated at a resolution of roughly 10x10 km, and around the city centres of the 10 BAQUET cities a resolution of 1x1 km will be employed. By nesting the urban modelling system to regional and global model estimates that reflect the air quality outside the city scale, the

influence of other polluting sectors (agriculture, biomass burning, industry, shipping where applicable) will be assessed. WRF-CMAQ[28] is the main simulation tool. To assess uncertainties, the model CHIMERE[29] will also be used, as well as different emission datasets and land-use classifications[30].

BAQUET will organize technical workshops for its partners to achieve a common set-up of the modelling framework for the BAQUET cities. A set of common chemical and meteorological boundary conditions will be applied, as well as common sets of natural and anthropogenic emissions (see WP3).

In the EU- FP7 project CityZEN similar modelling systems have been applied to the East Mediterranean[31,32]. Also, it has been shown that land use changes, such as urbanization, strongly influence urban climate and air quality[30,33]. For this reason, BAQUET will put special emphasis on the impact of urbanization on air quality and heat stress in urban environments.

The final output of this WP will be used as input to WP5 and in WP7.

#### 1.3.5 WP5: Downscaling to personal exposure at street level

The objective of WP5 is to estimate personal exposure of citizens to air pollution and heat stress. Since BAQUET aims to assess personal exposure, it is highly relevant and innovative to assess environmental parameters relevant for health (air quality and heat stress) at high temporal and spatial resolutions. This is especially important for primary air pollutants with short lifetimes and heat. BAQUET will downscale the simulation results from WP4 to the street level (1-5 m). Street level spatial resolution is necessary to assess the exposure of an urban population both in their homes (proximity to roads) and as they go about their normal day (travelling, at work, school etc.). Tools that will be used to achieve this resolution are GRAL[34] and AIRCITY[35] (order 5 m resolution). In mountainous areas we have the option to use more detailed wind fields calculated by GRAMM[36] as input to these tools.

These numerical tools are Lagrangian particle dispersion models that operate on a Cartesian grid, which are used to map concentrations from high-resolution emissions of primary pollutants, accounting for buildings, atmospheric stability, and background wind. As such, they can be considered as advanced downscaling techniques.

BAQUET will also address dispersion of pollen. Pollen are treated like primary air pollutants with high deposition velocities[37]. However, sources of invasive species like ragweed are very uncertain in location and timing of emission, and there is little data to validate models, although measurement records in Zagreb date back to 2002. We will build on expertise obtained in the FP7 project ATOPICA and a local Dutch project (Hay Fever Forecast).

To model outdoor thermal comfort we will use the SOLWEIG model[38,39] which is being incorporated into the SUEWS urban land surface model[40-43]. This allows for spatial differences (order 1 m, e.g. shaded and sunny part of the street) to be assessed. Using this model ensures that the modeling system is spatially consistent from city to person scale. Feedback can be handled using either simple boundary layer modeling to generate appropriately urbanized boundary conditions[43] or by including this urban land surface model within WRF.

Many level-2 cities in BAQUET already employ street-level air quality models, and results will be compared to assessments made with the BAQUET tools with the aim to identify model flaws in either approach. Personal exposure output of WP5 will be used in the DSS tool (WP1), and in WP7.

#### 1.3.6 WP6: Measurements in Kraków and Zagreb

The objective of WP6 is to perform dedicated observations that allow source apportionment and model evaluation in the level-1 cities Kraków and Zagreb. To this end, we will organize intensive field campaigns using mobile and stationary platforms during the summer and winter seasons. Additionally, these campaigns will make use of operational air quality and meteorological monitoring data. CO will be used as an important tracer for combustion processes, and ratios of other pollutants to CO will be used for source attribution. Additionally, measuring $CO_2$/CO, $NO_x$/CO, and primary aerosol/CO ratios, will provide a direct link between emission of pollutant and greenhouse gases by various sources.

Like the models, BAQUET will employ a "nested" measurement strategy, with three main pillars as indicated in Table 4. (1) Urban background measurements will be used to evaluate the meso-scale model results (2) Mobile platforms will provide measurements of aerosols, pollutant and greenhouse gases on high spatial resolution. Equipped vans (see table) and unmanned aerial vehicles (UAVs) will be used to map the city plume in horizontal and vertical dimensions. These measurements will be used to validate

the models at street level and on city scale (3) Personal sampling will be used to evaluate personal exposure calculations that will be used for health impact calculations in the MCA (WP1).

The UAV will be equipped with an AirCore, a long piece of coil flown with a balloon to passively collect atmospheric samples for vertical profile trace gas measurements[44]. For the UAV application, we propose to develop a lightweight AirCore system with an active pumping system for high-precision CO and $CO_2$ measurements, which shares the same basic principle as the normal AirCore applications.

The measurements, mapping air pollution and meteorology at various spatial and temporal scales, will be used in WP7.

*Table 4: Measurement strategy in BAQUET*

| Scale | Measurements |
|---|---|
| Urban background (longer time series) | Temperature, wind, humidity, radiation<br>$PM_1$, $PM_{2.5}$, $PM_{10}$<br>Aerosol high volume filters ($^{14}C$, $^{13}C$)<br>Reactive Organic Species (ROS)<br>Elemental analysis using Energy Dispersive X-Ray Spectrometry<br>Inorganic Ions<br>Poly Aromatic Hydrocarbon analysis<br>Organic/Elementary carbon<br>Aerosol size distribution, CO, $CO_2$, $NO_x$ |
| Mobile Van | Highly time-resolved characterization of aerosol chemical composition and physical properties, as well as trace gas composition<br>$NO_X$ and greenhouse gases (Picarro, $CH_4$, CO, $CO_2$ and $H_2O$)<br>AMS<br>Aethalometer (BC)<br>Pollen, Temperature, Relative humidity |
| UAV | Aerosol measurements (BC)<br>active AirCore system for high-precision CO and $CO_2$ measurements |
| Street canyon personal exposure monitoring | CO*, $NO_2$**, $CO_2$, $PM_{2.5}$, $PM_{10}$, BC<br>Pollen, using a Burkard pollen trap<br>Temperature |

*CO monitoring will additionally be carried out via mass deployment (>100 units) of personal sensors distributed to the urban population, linked via smartphone to a GPS and mobility app. These units are being developed by industrial partners in the UK.
**$NO_2$ detection based on luminol-$NO_2$ reaction has been successfully deployed in $NO_2$ sondes in the Netherlands[45]. Possible deployment as personal monitoring instrument and further industrial development will be investigated.

### 1.3.7 WP7: Evaluation of BAQUET tools in 10 EU cities

The objective of WP7 is to evaluate the BAQUET modelling tools with measurements, focussing on exposure to air pollution and heat stress at urban street level. Measurements from air quality networks in the 10 BAQUET cities will be analysed, as well as measurements from specific measurement campaigns conducted in the past. Focus will be on $NO_2$, $O_3$, $PM_{10}$, and $PM_{2.5}$, compounds that are regulated through EU legislation. However, to allow source apportionment and assessment of health impacts, also aerosol speciation, CO, $CO_2$, and NO will be evaluated. $CO_2$ measurements will be mainly used to assess emission factors of air pollutants, and BAQUET will link to various national and international projects that focus on GHG emission estimates from cities, including the ICOS European infrastructure.

Aerosol source apportionment for many years in the past will be possible by retrospective analysis of stored filter aerosol samples using a combination of off-line methods. These methods include offline Aerosol Mass Spectrometer (AMS) measurements and determination of the carbon isotopes $^{14}C$ and $^{13}C$. This allows separation of the major PM components coming from traffic, biomass burning, industry, or from secondary aerosol formation[46,47]. Stored filter records are available in Zürich, Vilnius, Rotterdam, and Athens, and can be linked to past known measures of improving air quality. This technique was already applied in Zürich[48,49] and this would be the first detailed long-term AMS dataset in the world, from different sites in Europe. Combined with other techniques, such as carbon dating, this technique should provide unprecedented insights into the long-term variability of the European urban aerosol chemical composition and sources.

In various cities networks of urban meteorological stations are available that allow to assess thermal comfort output from dedicated models. Specific model components, notably dispersion parameters and heat fluxes can be evaluated and improved using time series obtained from eddy covariance stations (e.g. London, Rotterdam, Helsinki) and their supporting meteorological stations. Using footprint analysis

and zooming in to dedicated events (e.g., holidays, weekends versus weekdays) the model-predicted effects of specific measures can be assessed.

Air quality observations (since 1984) from the Ministry of Environment in Athens have been compiled and new data have been acquired within EU- FP7 project (CityZEN 2008-2011)[50], while size and chemically resolved aerosol measurements with wintertime intensives in Athens continue in the frame of national projects. These data are well suited to evaluate the BAQUET tools. In Vilnius measurement programs collect data for $PM_{10}$, CO, $SO_2$, $NO_2$, and $O_3$. There are strong links with a Lithuanian-Swiss cooperation programme "Research and development" project "Aerosol in Lithuania: Investigation of primary-secondary and regional-local contributions to particulate matter in the south-eastern Baltic region" No. CH-3-ŠMM-01/08 (2012 – 2016), "Pollution Control in Biomass Combustion: from Pollutant Formation to Human Exposure" (BioMassPoll), project No. ATE05/2012 (2012-2015)[27,51]. BAQUET will add a modelling component to these programs. In Kraków, the MonitAir program will finish in 2016. The focus was fine scale resolution modelling of air quality and BAQUET will link to the MonitAir program.

For pollen, measurement records are available in the Netherlands, London, and Zagreb. MeteoSwiss is performing pollen measurements in Switzerland (with one station in Zürich), distinguishing 50 kinds of pollen, including ragweed. Zagreb has four stations at which pollen counts are collected at a time resolution of two hours.

The output of this WP is a thorough evaluation of the BAQUET tools, which will be used in WP1 (DSS) to weigh the assessed health effects of strategies against other criteria.

### 1.3.8 WP8: Effects of climate change

The objective of this WP is to investigate how climate change will impact the exposure and associated health effects to air pollution, heat stress, and pollen. To this end, BAQUET will downscale CMIP5 climate simulations. An ensemble of future climate realizations will provide boundary conditions for WRF and CHIMERE, which will simulate selected periods for the BAQUET cities. Temperature dependent natural (VOCs) and anthropogenic (e.g. $NH_3$) emissions will be re-evaluated to account for future climate. Urban sustainable development strategies for level-1 cities (WP3) will be evaluated with and without considering climate change.

Exposure to heat stress and pollen will be particularly sensitive to climate change. Uncertainties in the spread of invasive species and shifts in pollination season will be assessed within BAQUET. Concerning exposure to heat stress, mitigation options in e.g. Zagreb to reduce the heat island effect will be of special importance.

Climate change predictions from CMIP5 will be used. BAQUET will also link to the EU H2020 project URBANFLUXES, which will provide spatial estimates of the surface energy balance fluxes including the anthropogenic heat flux (traffic, air conditioning, industrial activities). Given the strong correlation between anthropogenic heat flux and air pollution (e.g. $CO_2$, PM) this will provide another assessment method. The output of WP8 will be used in WP1.

## 1.4 Ambition

Benefits from mitigation of climate change and air pollution are often not quantified on the city scale. As a result, cost considerations dominate and are not properly balanced against environmental benefits. BAQUET will develop and evaluate tools to propagate the impact of city level air quality and climate mitigation to benefits related to (i) reduced exposure to air pollutants and heat stress (ii) reduction of GHG emissions (iii) exposure to pollen. The BAQUET tools will be based on advanced scientific knowledge concerning (a) attribution of air pollution to emissions of traffic, industry, and other sectors (b) air pollution transport modelling & modelling of city climate, including unique downscaling features, to personal exposure levels (c) impact of short-term and long-term exposure to air pollution and heat on human health and illness (d) stakeholder evaluation. BAQUET physical modelling tools operate on high temporal and spatial resolutions, and thus go beyond the yearly-averaged metrics often modelled for air quality legislation purposes.

It is our ambition to make the BAQUET tool a transparent and well-validated instrument to be applied in dialogue with policy makers. This dialogue is central in the BAQUET approach and will involve stakeholders, city governments, NGOs, and SMEs, such as producers of ZEVs. Based on this dialogue, a number of realistic policy options will be designed in Zagreb and Kraków. This approach – the coupling of user-driven ideas of air quality and climate mitigation measures to advanced impact modelling – is

innovative and ensures user-involvement. Tools developed, including dissemination to stakeholders, will be suitable for market-development and can be applied in a wide variety of EU cities and on other continents.

Another unique feature of the BAQUET tools is that it will calculate the combined impact of the exposure to heat stress, air pollutants, and pollen. Traditionally, these impacts are considered separately. In addition, BAQUET will use the tools to assess the impact of climate change and will evaluate the co-benefits of GHG emission reductions and the stakeholder' evaluations. Climate change is expected to increase the exposure of urban populations to heat-stress, aggravate the air pollution[14], and increase the occurrence of allergic disorders in urban environments. A combined quantification of these health effects with and without considering climate change is challenging and innovative.

The BAQUET tools will be evaluated with existing and new, targeted, measurements. The re-analysis of existing data records makes excellent use of past and on-going efforts to sample the urban environment. By analysing filter material that was stored in different EU cities, BAQUET has the ambition to create the first detailed long-term AMS dataset in the world from different sites across Europe.

Citizen-empowerment will be accomplished by a personal monitoring program in Kraków and Zagreb with the aim to evaluate the down-scaling tool of BAQUET. Finally, the BAQUET interactive touch table will be used to disseminate the complex scientific results to the stakeholders and to secure the BAQUET legacy in an innovative way, along with more common platforms like websites. We expect that the use of the touch table to disseminate results will lead to a better understanding of the links between human activities, urban design, health impacts, and carbon footprint.

# 2 Impact

## 2.1 Expected impacts

A growing number of European cities consider environmental sustainability as the core of their urban development strategies. Both citizens and business benefit from a range of policies and initiatives supporting the development of attractive, high-quality urban areas that are sustainable, carbon neutral and climate resilient. A good example is the CoM that supports efforts deployed by local authorities in the implementation of sustainable energy policies. Therefore, we expect local and regional authorities to benefit from the tools developed by the BAQUET consortium. The tools facilitate the exchange of information and best practices at local, regional and even national level. They are developed to evaluate and quantify effects of specific technological air pollution abatement strategies that also reduce the carbon footprint, taking into account climate change issues as well. This is in line with the commitment made at Rio+20 to promote an integrated approach to planning, building and managing sustainable cities (http://sustainabledevelopment.un.org/rio20.html).

BAQUET's outputs will support EU-policies resulting from the EU Strategy for Sustainable Development and the 7the Environmental Action Plan (7th EAP), such as the Thematic Strategies on the urban environment and the sustainable use of resources. The 7th EAP sets out the priorities of environmental policymaking in the EU for 2014-2020, with a particular focus on EHWB.

It is expected that not only municipalities will benefit from the BAQUET tools. BAQUET's outputs are of immediate interest to a wide range of stakeholders, including urban designers and planners, project developers, health services, housing corporations, consultancy firms, building engineers, energy companies and other companies that develop options to improve air quality or thermal comfort in cities. Table 5 lists possible uses of BAQUET products and services.

*Table 5: Possible uses of BAQUET products and services*

| | |
|---|---|
| Indexing tools | Risk assessment, indexing of cities and neighbourhoods, quantification of impacts and assessment of the quality of the living environment (thermal comfort & air quality related health impacts) |
| Quick-scan tools | Screening of sensitivity and adaptive capacity of a city or neighbourhood, with regard to the combined exposure to heat stress and air pollution, in relation to scenarios for future climate and socio-economic development |
| Instrumentation tools | Extensive model instrumentation, including models or tools for thermal comfort & air quality related health impacts and socio-economic development, with which the effect of spatial planning and tailor-made measures can be mapped. This instrumentation can be used as a design and assessment instrument in the planning phase of urban development and instrument of |

| | |
|---|---|
| | policy development |
| Consultancy tools | Consulting and guidance to end-users, to support local governments and stakeholders in the implementation process |
| Awareness raising tools | Visualisation of problem areas and options of improvement in the context of other policy areas and development options supports awareness raising |

BAQUET will build a web site for the various stakeholders to disseminate the results of the project. However, in order to facilitate the knowledge dissemination in user consultation meetings, we will also build a user-friendly interface of the tools that can be displayed on the touch table. The envisioned BAQUET subcontractor "Climate Adaptation Services" (CAS) has a firm track record in the use of a touch table in support of assessing climate impacts and vulnerable areas on various spatial scales, awareness raising and assisting in developing climate adaptation options at the city and regional scale. Using pre-processed output of the various BAQUET component tools, the touch table will provide layered spatial visualisations to combine air quality measurement outcomes and effects of choices in different policy areas, from differing technological and non-technological measures, including spatial arrangement options. These maps/visualisations are employed in interactive workshop settings. That is, their visualisation potential in interactive settings allows transparent analysis of the various criteria.

The touch table allows close interaction between parties involved as they can stand around the table (Figure 3), which facilitates discussions and enhances communication between actors. In comparison with using maps on paper, the touch table is preferred due to the ability to easily overlay maps. Additional advantages are the storage of various types of data in one place and being able to zoom on different spatial scales.


*Figure 3: Use of the touch table in an interactive workshop session*

The table is considered ideal for fostering the integration of advanced tools for the assessment of air-quality and climate related problems - including source apportionment- as well as possible solutions to such problems potentially in relation to a suite of policy areas. Furthermore, it will allow a first test bed for long-term sustainable solutions being developed by companies and designers. Projecting the expected impact of proposed solutions in an early phase of development fits in the Research Through Design principle followed by many designers and companies and will optimize their development strategy. Application of the interactive touch table has clearly demonstrated its power in awareness raising, presenting climate impacts and vulnerabilities and the promotion and evaluation of climate adaptation options. A current Climate-KIC market study points to potential for up-scaling the tool to European dimensions. Alongside the more usual website application, the touch table will be an ideal instrument to promote the BAQUET tools and can serve as the foundation of a marketing strategy.

In particular using the touch table and website applications, BAQUET's outputs will support urban planning exercises from various stakeholders to improve citizens' quality of life, through:

- the improvement of environmental quality,
- the reduction of socio-economic costs caused by health impacts related to air quality and thermal comfort,
- and, in a broader perspective, the reduction of the carbon footprint.

By integrating air quality and thermal comfort related health impacts, carbon footprint and socio-economic aspects, a more efficient and coherent decision making will be possible. The touch table will

allow even further embedding in other policy areas and provide incentives for further development of the tools in the post-BAQUET area.

BAQUET will promote "science for impact" by bringing together different scientific disciplines from cross-European variations of physical environments and socio-economic conditions, which will result in a better understanding of the links between human activities, urban designs, health impacts, and carbon footprint. The number of urban dwellers will increase worldwide in the coming decades. This has generated a European and global market for tools and methods supporting the design process of sustainable and healthy cities. Since every city is unique, the tailoring of existing tools to specific situations or the development of additional tools may be needed to develop users-defined solutions. This is expected to lead to the development of new, innovative products and services, further exploiting the tools generated by BAQUET. The SME partners involved in BAQUET have the skill, experience, and motivation to help transforming the final form of the tools into a suitable product that can be maintained and further developed in the long run in support of application by various stakeholders. The consortium may therefore develop towards an innovative knowledge alliance that may become a powerful global player in the field of air quality, climate change mitigation and adaptation.

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