Impact Report

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Part 1 - Introduction and Methodology

1.1 Purpose of the Impact Report

This Impact Report (Deliverable D2.2) summarises the observed outcomes, implementation experiences, and operational lessons from the local experiments conducted within the BATS project. The report supports the finalisation and refinement of the project's primary outputs: Output 2.3 (Year-Round Active Mobility Technical Toolkit) and Output 2.4 (Citizen Activation Guide).

The document is intended primarily as a cross-city operational synthesis rather than a statistically comparable cross-city impact evaluation. Due to the diversity of intervention types, local conditions, monitoring methods, data availability, and implementation scales across the seven partner cities, the findings presented in this report should not be interpreted as directly comparable quantitative results. Instead, the report focuses on identifying recurring implementation patterns, user responses, technical observations, and transferable operational lessons relevant to Year-Round Active Mobility (YRAM). Many of the interventions were exploratory or pilot-scale in nature and were implemented under highly different climatic, organisational, and infrastructural conditions. Therefore, the findings should primarily be read as operational and implementation evidence from diverse local experiments, rather than as a statistically comparable assessment of intervention effectiveness across cities.

The report has four primary functions:

- a technical summary of local experiments and their observed effects,
- a source of operational lessons for municipalities and public authorities,
- a supporting evidence base for transfer and replication activities within Work Package 3 (WP3),
- and a reference document for the continued development of practical YRAM solutions in Baltic Sea Region cities.

The findings presented in this report demonstrate that maintaining active mobility during periods of darkness and adverse weather depends not on a single intervention type, but on the interaction between infrastructure quality, maintenance practices, traffic management, and citizen-oriented activation measures.

1.2 BATS Project context

The BATS project focuses on supporting Year-Round Active Mobility (YRAM) by addressing the seasonal decline in walking and cycling observed across many Baltic Sea Region cities during autumn and winter. The project tested a range of local experiments designed to reduce barriers associated with darkness, precipitation, snow, ice, uncertainty regarding travel conditions, and perceived safety concerns.

The project utilised two complementary pilot streams to test and adjust the primary outputs:

- Pilot 1: Focused on the application and technical testing of the YRAM Technical Toolkit.
- Pilot 2: Focused on the implementation and refinement of the Citizen Activation Guide.

The interventions were implemented across seven partner cities representing different climatic, organisational, and urban contexts:

- Hamburg-Altona, Germany
- Gdynia, Poland
- Umeå, Sweden
- Porvoo, Finland
- Kalundborg, Denmark
- Klaipėda, Lithuania
- Kiili / Harju County, Estonia

The local experiments were organised around four thematic tracks:

1. Infrastructure interventions – physical and lighting-related modifications to the urban environment,
2. Traffic management interventions – sensor-based systems, information tools, and operational traffic management measures,
3. Road maintenance interventions – winter maintenance processes, monitoring, and maintenance coordination,
4. Citizen activation measures – behavioural, educational, participatory, and incentive-based activities.

The pilots varied significantly in scale, maturity, monitoring depth, and technical complexity. Some interventions focused on physical infrastructure and operational testing, while others focused primarily on behavioural change, citizen participation, or institutional learning. Consequently, the report emphasises practical implementation insights and contextual interpretation of findings rather than strict quantitative comparison between cities.

The BATS evaluation approach therefore combines:

- local KPI-based monitoring,
- process evaluation,
- user feedback,
- operational observations,
- and qualitative interpretation of implementation experiences.

The evaluation approach applied in this report was developed within the BATS Monitoring Guidance framework and adapted locally by partner cities according to intervention type, available data sources, and operational capacities.

This structure allows the report to capture both measurable effects and the broader organisational and operational conditions influencing the feasibility of Year-Round Active Mobility measures.

1.3 Methodological note on interpretation of findings

The interventions presented in this report were developed independently by partner cities according to local priorities, available resources, and existing transport conditions. As a result, the pilots differ substantially with respect to:

- intervention scope and duration,
- KPI selection and monitoring methodology,
- baseline availability,
- sample size and data quality,
- weather conditions during implementation,
- and local mobility culture and infrastructure maturity.

For this reason, the report avoids direct ranking or statistical comparison between cities. Numerical values presented throughout the document should be interpreted within their local context and should not be treated as universally transferable performance benchmarks.

The aggregated findings presented in Part 2 are therefore intended primarily to:

- identify recurring operational patterns,
- highlight transferable implementation lessons,
- indicate potential areas of effectiveness,
- and support future replication and adaptation activities.

Where conclusions are based primarily on qualitative observations, user feedback, or operational experience rather than statistically robust evidence, this is reflected in the wording and interpretation of the findings.

Consequently, aggregated observations presented later in the report should be interpreted primarily as illustrative cross-case operational patterns rather than statistically validated cross-city evidence. In several cases, findings reflect local implementation experiences, pilot-scale observations, or context-specific responses that may not be directly transferable without local adaptation.

Part 2 - Cross-City Impact Overview

2.1 Overview of all experiments

The following list summarises all local experiments implemented across the 7 partner cities:

City	Intervention	Track	Main Objective	Main KPI / Indicator	Key Findings / Notes
Hamburg-Altona	Protective elements at Reventlowstraße	Infrastructure	Increase perceived cyclist safety, comfort and attractiveness of year-round cycling infrastructure, especially under winter and low-visibility conditions.	TB.17 Security, TB.18 Comfort, TB.19 Satisfaction, SF.4 Conflict Index	Protective elements improved perceived safety, but maintenance and cleaning coordination remained challenging.
Hamburg-Altona	Tunnel projectors	Infrastructure	Improve perceived safety and user experience in underpasses and increase the attractiveness of active mobility routes.	TB.17 Security, TB.18 Comfort and pleasure, TB.20 Attitudes, TB.13 Quality of public area	Users reported improved visibility and a more attractive cycling environment. The intervention focused mainly on perception-based evaluation and user experience.
Gdynia	Weather-adaptive traffic signal control	Traffic management	Improve pedestrian and cyclist comfort, operational efficiency and safety during adverse weather conditions.	TP.5 Delay, TP.4 Average travel time, SF.4 Traffic conflict index, EN.1 Greenhouse gas emissions	Thermal detection integrated with TRISTAR reduced perceived waiting burden and improved comfort.
Gdynia	Odprowadzam Sam campaign (school travel)	Citizen activation	Increase active school mobility and encourage behavioural change among pupils and parents.	TB.11 Modal split, TP.14 Volume of pedestrians/cyclists, TB.20 Attitudes, TB.22 Citizen engagement	The campaign supported awareness-building and modal shift towards walking and cycling for school trips. Monitoring was based mainly on before-after surveys and modal split analysis.

City	Intervention	Track	Main Objective	Main KPI / Indicator	Key Findings / Notes
Kalundborg	Bike All Year campaign and route awareness	Citizen activation	Increase awareness of year-round cycling and identify barriers to commuter cycling between the city centre and the biotech campus.	TB.20 Attitudes, TB.22 Citizen Engagement	A survey distributed through companies and educational institutions engaged more than 5,000 potential respondents. The campaign identified lack of visibility and lighting as the primary psychological barrier to winter cycling, establishing the evidence base for subsequent infrastructure interventions along the Rynkevangen corridor.
Kalundborg	Light the bike lane and reflective route improvements	Infrastructure	Increase attractiveness and safety of cycling corridor	TB.17 Security, TB.18 Comfort and pleasure, SF.6 Number of observed violations, TP.14 Volume of pedestrians /cyclists, TB.20 Attitudes	Road reflectors and reflective protective edge elements were additionally installed along sections of Bredgade and Elmegade to improve bicycle-lane visibility in locations without physical separation from traffic. The minor intervention complemented the mobile solar lighting system by reinforcing route continuity and increasing driver attention during darkness and wet winter conditions. Initial feedback from cyclists and residents indicated improved visibility and a higher sense of safety. Stop interviews and QR-code surveys were planned as part of the monitoring process.

City	Intervention	Track	Main Objective	Main KPI / Indicator	Key Findings / Notes
Klaipėda	Projected signs and pavement-condition / path-status information	Infrastructure + Traffic Management	Improve safety and comfort in low-light conditions	TB.17 Security, TB.18 Comfort, TP.14 Cyclists volume	Projected markings improved visual guidance and helped clarify cyclist space in shared bus-cycle conditions. Pavement-condition and path-status information supported route confidence during wet, icy and freeze-thaw conditions.
Porvoo	3D cycling simulation	Infrastructure / Citizen activation	Support planning and decision-making for cycling infrastructure	TB.22 Citizen Engagement, TB.20 Attitudes	3D simulation enabled experiential assessment of future cycling infrastructure and strengthened stakeholder engagement.
Porvoo	Winter Agents programme	Maintenance / Citizen activation	Improve winter maintenance through citizen engagement	TB.8 Facility Maintenance, TB.22 Citizen Engagement	Participatory reporting improved communication between citizens and maintenance operators.
Umeå	E-bike loan programme	Citizen activation	Promote winter cycling and reduce barriers to e-bike use	TB.20 Attitudes, TB.19 Travel Satisfaction	High public interest confirmed willingness to test winter cycling when financial and technical barriers are reduced.
Umeå	Light projections for winter guidance	Infrastructure + Traffic Management	Improve visibility, orientation and perceived safety on winter cycling and walking routes during darkness and snow conditions.	TB.17 Security, TB.18 Comfort, TB.20 Attitudes	Projected symbols improved route readability and helped maintain visibility of traffic guidance where traditional markings were obscured by snow and darkness.
Umeå	Winter Scouts and winter maintenance feedback	Maintenance / citizen activation	Improve winter maintenance responsiveness and strengthen communication between users and maintenance operators.	TB.20 Attitudes, TB.22 Engagement	Citizen-based winter feedback improved identification of maintenance problems and supported more responsive winter service operations.

City	Intervention	Track	Main Objective	Main KPI / Indicator	Key Findings / Notes
Kiili/Harju County	School-based YRAM promotion campaign	Citizen activation	Increase active mobility among schoolchildren and families	TP.14 Cyclists Volume, TB.20 Attitudes	Bicycle counts showed strong seasonal variation but also demonstrated substantial cycling activity even during colder periods.
Kiili/Harju County	Winter maintenance bottleneck study	Maintenance / infrastructure planning	Identify street-design and maintenance barriers limiting year-round walking and cycling and define low-cost improvement options.	TB.8 Facility maintenance, TB.22 stakeholder engagement, qualitative design audit	The study mapped winter maintenance bottlenecks and generated a catalogue of challenge-driven improvement options. It should be presented as a diagnostic and transfer-oriented result rather than as a before-after impact-measured intervention.

2.2 Aggregated findings by thematic track

This section summarises cross-case operational patterns by thematic track. The city chapters remain the main location for detailed intervention narratives, local figures, sample sizes, baseline descriptions and process notes.

The aggregated findings should be read as transferable implementation evidence rather than as statistically comparable impact results. The BATS pilots differed in intervention scale, monitoring periods, KPI selection, baseline quality, implementation maturity and local climate. For this reason, the synthesis below focuses on the mechanisms observed across pilots, the conditions under which they appear to work, and the main limitations that should guide interpretation.

Table 2.2 Interpretation matrix for the aggregated findings

Thematic track	Main cross-case pattern	How to use the finding
Infrastructure	Physical protection, projected markings, reflective elements and temporary lighting improved route readability or perceived safety where they addressed a clearly identified local barrier.	Use as guidance on which type of physical or visual measure is suitable for which barrier, not as a ranking of infrastructure solutions.
Traffic management	Automated detection, weather-sensitive signal logic, path-status information and public-facing data reduced waiting discomfort, uncertainty or spatial ambiguity.	Use to identify when data and control systems can support YRAM without major reconstruction.
Road maintenance	Winter service quality depends on feedback loops, route continuity across jurisdictions, maintainability of design and climate-resilient reporting channels.	Use to define operational preconditions for active mobility infrastructure and activation measures.
Citizen activation	Behavioural measures were strongest when linked to tangible support, social proof, equipment trials or a concrete route problem.	Use to design activation that removes practical barriers rather than relying on awareness alone.

The section deliberately separates cross-track learning from detailed case evidence. Where a city is mentioned, it is used only as an example of an intervention logic. The detailed explanation of that case, including figures and methodological caveats remain in Chapter 3.

2.2.1 Infrastructure interventions

The infrastructure track shows that Year-Round Active Mobility depends on the legibility, continuity and maintainability of the physical environment. The pilots tested several different infrastructure logics, including physical separation, projected guidance, mobile lighting, reflective elements and virtual planning tools. These should not be treated as equivalent measures. Each responds to a different type of barrier and each requires different supporting conditions.

Three cross-case lessons are most relevant. First, physical protection can strongly improve perceived safety where the main problem is interaction with motorised traffic or illegal occupation of cycle space. However, physical elements must remain visible and serviceable in winter. If separators, pylons or kerb elements are hidden by snow or dirt, they can become operational obstacles rather than safety improvements.

Second, light-based and reflective measures are especially useful where the main problem is route readability during darkness, snow, rain or wet-surface conditions. Projected markings, reflective edge elements and temporary lighting can improve orientation and comfort, but they do not solve poor surface quality, missing maintenance routines or unsafe geometry. Their effect is therefore best interpreted as an improvement in perception and guidance, not as a full substitute for permanent infrastructure.

Third, infrastructure planning tools, including simulation-based methods, contribute earlier in the intervention cycle. Their value lies in making future designs easier to understand and discuss before construction. They should be evaluated mainly through engagement, decision-support quality and the ability to reveal user preferences, not through short-term travel behaviour indicators.

Table 2.2.1 Infrastructure findings by operational problem

Operational problem	Infrastructure response observed in BATS	Cross-case interpretation	Implementation condition
Lack of separation from motorised traffic	Physical protective elements, separators, kerbs or similar low-to-medium cost delineation measures.	Likely to improve perceived safety and route continuity where users experience direct conflict or encroachment.	Must be compatible with cleaning, snow clearance, emergency access and visibility requirements.
Poor route readability in darkness or snow	Projected symbols, visual guidance, reflective elements and temporary lighting.	Useful for making routes, boundaries or conflict points easier to understand under adverse visibility conditions.	Requires calibration to surface type, ambient light, precipitation and local maintenance routines.
Unlit or weakly connected missing links	Mobile or flexible lighting combined with markings and reflectors.	Can provide a quick response before permanent investment, especially on strategic commuter links.	Needs battery checks, positioning checks, maintenance responsibilities and follow-up monitoring.
Future infrastructure decisions are difficult to communicate	3D or experiential planning tools.	Helps translate technical design into user experience and supports informed stakeholder discussion.	Should be embedded in a structured workshop process and not oversold as a direct mobility intervention.
Installed elements are difficult to maintain in winter	Early consultation with maintenance staff and design-for-maintenance checks.	Infrastructure impact depends on whether it can be maintained during snow, ice, wet leaves and low visibility.	Maintenance teams should be involved before procurement and installation.

Conclusion for the infrastructure track
The main transferable finding is not that one infrastructure measure is universally better than another, but that infrastructure must match the specific winter barrier. Physical protection addresses exposure to traffic, projections and reflectors address visibility and orientation, mobile lighting addresses missing links, and simulation supports planning decisions. In all cases, winter maintenance and surface quality determine whether the perceived benefit can be sustained.

2.2.2 Traffic management interventions

The traffic management track shows that YRAM can be supported by reducing the effort, uncertainty and delay experienced by active mobility users. Unlike infrastructure interventions, traffic management measures often work through information, detection, signal logic and operational control. Their value is therefore closely linked to data quality, system integration and the clarity of the information presented to users.

The most important cross-case mechanism is the reduction of friction in winter travel. For pedestrians and cyclists, small operational barriers become more important in rain, snow, cold and darkness. Waiting at a signal, removing gloves to press a button, not knowing whether a route is icy, or navigating an unclear shared space can all increase the perceived effort of a trip. Traffic management measures can address these problems when they are designed around user experience rather than only vehicle throughput.

A second lesson is that data tools have the greatest value when they serve both users and municipal operations. Public-facing information can reduce travel uncertainty, while the same sensor or reporting data can help maintenance teams or traffic operators prioritise action. This dual function is important for transfer, because it strengthens the business case for investment and avoids creating a tool that is only communicative but not operationally useful.

A third lesson concerns communication format. Complex weather, pavement or signal data must be translated into simple and actionable information. Colour-coded status, clear acknowledgement of detection, and easily understood route-condition messages are more useful for everyday users than technical values alone.

Table 2.2.2 Traffic management findings by user barrier

User barrier	Traffic management response	Relevant indicators	Caution for interpretation
Uncomfortable waiting in adverse weather	Automatic detection and weather-sensitive signal logic for pedestrians and cyclists.	TP.5 delay, TP.4 travel time, user comfort and attitudes.	Local delay reductions should not automatically be interpreted as network-wide modal shift.
Uncertainty about route condition	Surface-temperature, icing-risk or path-status information provided to users and operators.	TB.19 satisfaction, TB.20 attitudes, TB.22 engagement and maintenance response indicators.	Dashboard use and satisfaction need to be separated from actual behavioural change.

User barrier	Traffic management response	Relevant indicators	Caution for interpretation
Unclear user space in constrained or shared corridors	Projected visual guidance or other non-intrusive delineation tools.	TB.17 security, TB.18 comfort, observed interactions and driver feedback.	Visual guidance does not remove the need for safe geometry and good surface quality.
Low trust in automated systems	Clear system feedback, call acknowledgement and transparent communication on how the system works.	TB.20 attitudes, complaint data and qualitative feedback.	Technical reliability must be monitored, especially under heavy precipitation or extreme temperatures.

Conclusion for the traffic management track

Traffic management measures are most relevant where active mobility users face avoidable delay, uncertainty or spatial ambiguity. Their strongest contribution to YRAM is not only operational efficiency, but also the reduction of perceived effort. For replication, the key requirements are reliable detection, integration with existing municipal systems, simple user communication and a clear definition of how data will inform both public information and internal operations.

2.2.3 Road maintenance interventions

The road maintenance track confirms that winter service is a primary condition for YRAM, not merely a background municipal function. A route can have good design, attractive campaign material and supportive traffic management, but it will not remain usable if snow, ice, slush, wet leaves or fragmented responsibilities make the route unreliable. The pilots therefore show that maintenance must be treated as part of the active mobility system.

Three implementation lessons stand out. First, user feedback becomes useful only when it is structured, geographically specific and linked to operational responsibility. General dissatisfaction is difficult to act upon, while photo-verified, map-based or route-specific feedback can help maintenance teams identify local hazards and refine priorities.

Second, feedback tools must be climate-resilient. Outdoor QR codes, mobile surveys and app-based reporting may work in mild winter conditions but can fail in extreme cold, heavy snow or when signage is obscured. This does not invalidate citizen monitoring, but it means that reporting channels need redundancy, including post-trip options, indoor completion or integration with existing municipal platforms.

Third, maintainability should influence infrastructure design. Street geometry, fixed objects, separator placement, snow storage and road ownership boundaries all affect whether winter maintenance can be delivered continuously. The BATS evidence suggests that a maintainability check should be required before temporary or permanent YRAM infrastructure is installed.

Table 2.2.3 Road maintenance findings and monitoring implications

Maintenance issue	Observed cross-case lesson	Monitoring implication	Transfer implication
Fragmented route ownership	A continuous user route may cross municipal, regional or state responsibilities, producing inconsistent service quality.	Document route ownership and service levels before interpreting user satisfaction or volume changes.	Formal agreements or route-based maintenance coordination may be needed before a YRAM corridor can function reliably.
Limited operational visibility	Maintenance teams benefit from location-specific feedback, photos, route comments and reports from regular users.	Combine citizen feedback with operational logs, not as a replacement for them.	Use existing fault-reporting systems where possible, with a winter-specific category or workflow.
Digital reporting failure in winter	Cold, snow and poor signage conditions can reduce response rates and bias feedback towards easier reporting periods.	Report response rates together with weather conditions and access-channel limitations.	Provide indoor, post-trip or alternative reporting channels for severe winter conditions.
Infrastructure difficult to clean	Protective elements, reflectors and markings can complicate snow clearance or lose visibility if not maintained.	Monitor not only user perception, but also the maintenance burden created by the intervention.	Include maintenance staff in design, procurement and site selection.
Snow storage and surface quality	Insufficient space for snow, uneven surfaces and temporary obstacles can make active mobility routes unusable even after ploughing.	Assess physical maintainability as part of baseline mapping.	Treat winter maintenance as a design criterion in street renewal and corridor planning.

Conclusion for the road maintenance track

The strongest cross-city message is that maintenance quality determines whether other YRAM interventions can produce sustained effects. Citizen monitoring, specialised machinery, bottleneck mapping and coordination across road owners are not isolated measures. They are enabling conditions for safe, legible and trustworthy walking and cycling networks during winter. For transfer, cities should begin with route ownership, maintainability and feedback-loop design before investing in more visible technical solutions.

2.2.4 Citizen activation measures

The citizen activation track shows that behaviour change is more credible when it removes a concrete practical barrier. Awareness campaigns, competitions, equipment trials and citizen panels all played a role, but the strongest results came when activation was connected to equipment, route quality, social proof or a direct municipal response.

This is important because winter active mobility is not only a matter of motivation. It is also shaped by confidence, perceived safety, time pressure, equipment availability, family routines and the expectation that routes will be usable.

School-based and community-scale measures were particularly useful because they operated within clearly defined social settings. In such contexts, peer visibility, class competition, parent communication and repeated daily routines can normalise winter active mobility more effectively than broad city-wide messaging. However, the effect depends on safe access routes and reliable pavement maintenance. Where parents or pupils encounter unploughed pavements, poor lighting or perceived traffic risk, campaign motivation alone is unlikely to be sufficient.

Equipment-based measures addressed a different barrier: the financial and technical uncertainty of trying winter cycling. E-bike trials, winter tyre support and service partnerships reduced the risk of experimentation for users. Their value lies not only in immediate trips during the pilot period, but also in changing what users consider feasible. These measures should be monitored through attitude change, satisfaction and reported substitution of car trips, while avoiding overstated city-wide modal-shift claims.

Participatory activation, such as winter agents or scouts, sits between behaviour change and service improvement. These models can increase trust and shared responsibility, but only if participants see that their reports are used. Without a visible feedback loop, citizen engagement risks becoming a one-way data collection exercise.

Table 2.2.4 Citizen activation mechanisms and dependencies

Activation mechanism	Barrier addressed	Supporting condition	Recommended interpretation
School campaigns and gamification	Family routines, habit formation, low motivation and car use around schools.	Safe school routes, parent communication, simple monitoring and cooperation with teachers.	Best interpreted as short-term behavioural support and normalisation within a defined community.
Equipment trials and loans	Financial risk, lack of winter equipment experience and uncertainty about feasibility.	Reliable booking, servicing, partner roles, spare parts and clear user instructions.	Best interpreted as participant-level attitude and experience change, not automatic city-wide modal shift.
Winter tyre or safety-equipment support	Fear of instability, lack of appropriate equipment and perceived technical barrier.	Local supplier partnership and visible communication of practical benefits.	Best used where the barrier is concrete and solvable through equipment access.
Citizen monitoring panels	Low trust in winter maintenance and lack of user-specific operational data.	Direct link to maintenance teams, clear reporting instructions and feedback to participants.	Best interpreted as participatory service refinement rather than a conventional campaign.

Activation mechanism	Barrier addressed	Supporting condition	Recommended interpretation
Route-awareness campaigns	Low awareness of alternatives and weak knowledge of specific YRAM barriers.	Connection to a concrete corridor, workplace, campus or school mobility problem.	Most useful when it diagnoses barriers and feeds into infrastructure or maintenance action.

Conclusion for the citizen activation track
Citizen activation is most effective when it is practical, local and connected to visible support. The BATS evidence does not support the conclusion that communication alone can overcome winter mobility barriers. It does support the conclusion that activation can stabilise or encourage YRAM behaviour when users are given a low-risk opportunity to try equipment, when social settings reinforce the behaviour, and when municipal services address the route conditions that users identify as barriers.

2.2.5 Cross-track dependencies and limits of aggregation

The four thematic tracks should not be interpreted as separate policy silos. In practice, the pilots show strong dependency between them. Infrastructure measures require maintenance. Traffic management tools require data governance and operational capacity. Citizen activation requires credible routes and practical support. Maintenance feedback requires both technical channels and social trust. These dependencies explain why the report avoids ranking single interventions and instead focuses on intervention packages and implementation conditions.

The most robust cross-track conclusion is that YRAM barriers are cumulative. Darkness, precipitation, snow, ice, surface defects, waiting time, traffic stress and lack of information reinforce one another. A small intervention can be effective when it targets the most important local barrier, but the same intervention can be weak where another unresolved barrier dominates user experience. For example, visual guidance may improve orientation but will not solve discomfort from rough surfaces; a campaign may increase motivation but will not compensate for unmaintained pavements, a dashboard may reduce uncertainty but will not create a usable route if snow clearance is fragmented.

For this reason, the aggregated findings should be applied through a simple diagnostic sequence: identify the dominant YRAM barrier, select a proportionate measure, define the operational condition required for success, and monitor both the user response and the implementation process. This sequence is more transferable than any single numerical benchmark from one pilot city.

Table 2.2.5 Cross-track dependencies for interpreting the BATS findings

Cross-track dependency	Meaning for interpretation	Practical implication for municipalities
Infrastructure depends on maintenance	Positive perception of protected or guided routes can decline if elements are dirty, hidden by snow or difficult to clean.	Assess cleaning and snow-clearing routines before installation.
Activation depends on credible route quality	Campaign participants may revert to car use if routes are not safe, visible or passable.	Synchronise campaigns with school-route or workplace-route maintenance and lighting checks.
Information depends on operational response	Dashboards and feedback tools increase trust only when the city can act on or explain the information.	Define who receives data, who responds and how updates are communicated.
Traffic management depends on calibration	Detection and signal benefits may vary with weather, equipment settings and local controller logic.	Include testing, recalibration and maintenance in the operating model.
Transfer depends on local diagnosis	A measure that worked in one city may fail if the same barrier is not present or if enabling conditions are missing.	Use BATS cases as adaptable models, not universal benchmarks.

Table 2.2.6 Evidence constraints and safeguards against over-interpretation

Evidence constraint	Why it matters	How this section addresses it
Different baselines and monitoring periods	Seasonal weather variation can strongly affect volumes and perceptions.	Findings are presented as operational patterns rather than comparable performance scores.
Different sample sizes and survey modes	A large campaign survey and a small on-site interview cannot be weighted equally.	Detailed samples remain in city chapters, while Section 2.2 focuses on mechanism-level learning.
Some indicators are inferred or qualitative	Not all pilots generated robust before-after KPI values.	The text distinguishes observed effects from interpretation and implementation lessons.
Pilot scale differs by city	A school, tunnel, corridor, crossing or city-wide maintenance system cannot be compared directly.	Track-level conclusions avoid ranking and instead identify conditions for replication.
Several measures overlap tracks	Projected guidance, winter scouts or dashboards may belong to more than one thematic category.	The section explains the function of a measure rather than treating track labels as rigid categories.

The aggregated BATS evidence indicates that YRAM measures work best when they are selected as part of a problem-specific package. Infrastructure improves legibility and protection, traffic management reduces delay and uncertainty, road maintenance keeps routes usable, and citizen activation helps users test, trust and normalise active mobility in winter. The city chapters provide the detailed local evidence, while this section provides the cross-case logic needed to interpret and transfer the lessons without overstating comparability.

Part 3 - City Chapters

3.1 Hamburg-Altona, Germany

Hamburg-Altona has a strong active mobility base, with cycling and walking already representing a substantial share of local trips. The district is also characterised by growing demand for reliable year-round cycling routes and by several constrained corridors where active mobility users interact with heavy traffic or pass through unattractive underpasses. The Hamburg-Altona experiments therefore focused on two complementary questions: how physical protection can improve safety and comfort on a street corridor, and how visual interventions can improve the perceived quality of underpasses during dark periods.

3.1.1 Intervention 1: Protective elements at Reventlowstraße

The Reventlowstraße intervention tested physical protective elements, including raised kerbs, pylons and flexible separators, on a corridor affected by heavy vehicle traffic and illegal parking pressure. The main purpose was to improve real and perceived cycling safety while assessing whether such elements remain functional under winter maintenance conditions.

3.1.1.1 Overview

Objective: improve perceived safety, comfort and continuity of the cycling route through physical separation.

Target group: cyclists using Reventlowstraße as a connection between central Altona and western districts.

Intervention type: infrastructure.

Main indicators: TB.17 Security, TB.18 Comfort, TB.19 Travel satisfaction and TB.20 Attitudes.

3.1.1.2 Measurement methodology

The evaluation combined traffic observations, user surveys and post-intervention assessment. The monitoring focused on user perception, operational performance of the protective elements and the interaction between the installed elements and cleaning or winter maintenance routines.

3.1.1.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.17 Security	73% positive safety perception	A clear majority of surveyed users felt safer due to the physical separation.
TB.18 Comfort	66.7% good or very good	The redesigned section improved riding comfort compared with paint-only delineation.
TB.19 Travel satisfaction	74.1% satisfied	The corridor was generally accepted by users after the intervention.
TB.20 Attitudes	71.3% preference for physical protection	Users strongly preferred structural protection over painted cycle lanes alone.

The results indicate a positive local effect on perceived safety and comfort. The main benefit came from clearer physical separation from motorised traffic and the reduction of illegal parking encroachments, which had previously disrupted cycle-lane continuity. This benefit is conditional on winter operation: separators, pylons and kerb elements must remain visible and serviceable, otherwise snow, wet leaves or dirt may reduce their guiding function or create local hazards. For replication, physical separation should therefore be treated as infrastructure plus maintenance, not as a maintenance-free safety measure..

3.1.1.4 Process evaluation

Barriers: special permits were required for non-standard elements, and the supply of specialised materials caused delays.

Drivers: the intervention was aligned with wider street renewal activities, which helped justify the pilot and coordinate works.

Operational lesson: maintenance departments must be involved before installation, because physical protection can obstruct cleaning and snow-clearing machinery if not designed with service access in mind.

3.1.1.5 Recommendations for replication

1. Clarify administrative approval routes early, including the role of transport authorities and police.

2. Integrate protective elements with scheduled street renewal projects where possible.
3. Select elements with high contrast and reflectors, and check their compatibility with cleaning and winter service equipment.
4. Avoid treating physical separation as maintenance-free infrastructure; define cleaning responsibilities from the outset.

3.1.1.6 Overall impact

The intervention converted the Reventlowstraße corridor into a functional year-round cycling route by physically eliminating illegal parking and achieving a 73% positive safety perception. While 71.3% of users prefer this structural protection over paint-only lanes, the protective efficacy is reduced during peak traffic congestion, and consistent seasonal maintenance remains a prerequisite for safety in dark and wet conditions.

3.1.2 Intervention 2: Tunnel projectors

The tunnel projector intervention tested whether high-mounted Gobo projectors could improve user perception in the Lessingtunnel and Elbschlosstunnel. These underpasses are important active mobility links but are perceived by many users as dark, unattractive or uncomfortable.

3.1.2.1 Overview

Objective: improve perceived attractiveness, comfort and sense of safety in underpasses during dark periods.

Target group: pedestrians and cyclists using the underpasses as part of everyday routes.

Intervention type: infrastructure (visual guidance).

Main indicators: TB.17 Security, TB.19 Travel satisfaction, TB.20 Attitudes and awareness of the intervention.

3.1.2.2 Measurement methodology

The evaluation focused on immediate atmospheric shifts rather than long-term behavioural changes. An on-site survey (n=45) was conducted four weeks post-installation during dark hours to measure travel satisfaction (TB.19) and perceived security (TB.17).

3.1.2.3 Impact evaluation results

Indicator	Observed result	Interpretation
Awareness of intervention	93%	Almost all respondents noticed the visual change.
TB.19 Travel satisfaction	Limited change	Overall satisfaction remained strongly influenced by cleanliness, noise and structural condition of the tunnel.
TB.20 Attitudes	Neutral to slightly positive	No negative effects were observed, and some users reported a slightly better atmosphere.
Subjective safety	Limited change	Lighting alone did not fully address established concerns about the underpass environment.

The intervention achieved high visibility but only limited changes in deeper safety perception. This is an important finding: visual interventions can improve atmosphere and orientation, but they do not replace basic structural improvements such as cleaning, wall maintenance and noise reduction.

The detailed interpretation from the tunnel case is that high awareness does not automatically translate into higher perceived security. Four high-mounted Gobo projectors in the Lessingtunnel and Elbschlosstunnel changed the atmosphere, but cleanliness, wall condition and noise continued to dominate user judgement. For replication, projections should therefore be combined with structural underpass maintenance and should use visual content that is clearly safety- or mobility-oriented.

3.1.2.4 Process evaluation

Barriers: identifying mounting points that were high enough to reduce vandalism risk and obtaining permits in railway-related corridors required additional coordination.

Drivers: the underpasses were recognised as strategically important links in the active mobility network.

Operational lesson: projections should use explicit safety or mobility-related visual content; otherwise, users may interpret them as decoration or advertising.

3.1.2.5 Recommendations for replication

1. Use projections as a complement to cleaning, lighting and wall-surface improvements, not as a standalone substitute.
2. Select visual content that clearly communicates guidance, safety or active mobility purpose.
3. Coordinate early with railway, utility and energy providers when installing equipment in shared infrastructure corridors.

3.1.2.6 Overall impact

The tunnel projectors improved the atmosphere of the underpasses and achieved high user awareness. Their main value is as a low-intrusion tool for improving perceived attractiveness in constrained locations. The limited change in safety perception confirms that visual measures should be embedded in a broader underpass improvement strategy.

3.2 Gdynia, Poland

Gdynia is a port city with varied topography and a transport system still strongly shaped by car and public transport use. Cycling volumes remain relatively low and are sensitive to weather, darkness and perceived effort. The BATS experiments in Gdynia addressed two different but complementary aspects of Year-Round Active Mobility: behavioural change in school travel and technical improvement of signalised crossings on important active mobility routes.

3.2.1 Intervention 1: Odprowadzam Sam school travel campaign

The „Odprowadzam Sam" (I Walk Alone) campaign is an established local initiative that promotes independent and active school travel. Within BATS, Gdynia tested an autumn-winter edition from October to December 2024 to assess whether the campaign logic remains effective under less favourable weather and lighting conditions.

3.2.1.1 Overview

Objective: encourage walking, cycling and public transport use for school trips during the autumn-winter period.

Strategic focus: use children as mobility influencers while reducing car traffic around schools.

Intervention type: citizen activation.

Scale: 633 children in 8 educational institutions.

Main indicators: TB.11 Modal split, TP.14 Volume of pedestrians/cyclists, TB.20 Attitudes and TB.22 Citizen engagement.

3.2.1.2 Measurement methodology

The evaluation was based on before-after monitoring of school travel behaviour and post-campaign feedback. Data sources included teacher-administered questionnaires for children, digital surveys for parents and teachers, and a baseline established at the beginning of October 2024, followed by a final assessment in mid-December 2024.

3.2.1.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.11 Modal split	Stabilised during the campaign period	When cycling became less feasible, many participants shifted to walking or public transport rather than private car use.
TB.20 Attitudes	78% parental commitment	A large share of parents declared willingness to continue sustainable travel habits.
TB.19 Satisfaction	98% positive child evaluation of the reward system	The gamified mechanism was well received by pupils.
TB.22 Engagement	68% of children influenced parents	Children had a clear role in shaping family travel decisions.

The results show that the campaign supported active and sustainable school travel during the autumn-winter transition. The evidence is strongest for awareness, engagement and short-term behavioural support. It should not be presented as proof that social activation alone can overcome winter barriers, because 70% of participants identified bad weather as a major obstacle and parents reported unploughed pavements and morning time pressure as reasons for car use.

3.2.1.4 Process evaluation

Barriers: the short preparation period limited the adaptation of materials to winter-specific conditions.

Drivers: the campaign used a recognisable local format and was supported by schools and municipal structures.

Operational lesson: the reward mechanism and seasonal workshops increased children's motivation, but the campaign depended on safe, accessible and maintained routes around schools.

3.2.1.5 Recommendations for replication

1. Allow one-way active travel to count in the reward system, because family logistics differ in the morning and afternoon.
2. Coordinate campaigns with priority pavement maintenance, snow removal and lighting checks around participating schools.
3. Communicate directly with parents through school channels before and during the campaign.
4. Frame the intervention as a combined behavioural and municipal-service measure, not only as a promotional campaign.

3.2.1.6 Overall impact

The intervention effectively stabilised active mobility levels during the autumn-winter transition, with 68% of children successfully influencing parental transport choices and 78% of parents committing to long-term sustainable habits. However, the 70% participant concern regarding weather and pavement maintenance highlights that social activation must be paired with precise municipal service delivery to remain effective in winter.

3.2.2 Intervention 2: Optimisation of traffic signal control

This technical pilot, situated at the strategic Aleja Zwycięstwa/Orłowska intersection along the EuroVelo 10/13 corridor in Gdynia, involved the integration of thermal imaging sensors with the TRISTAR traffic management system. By linking thermal data with meteorological records and tested signal programmes, the intervention automated green-light requests to eliminate the reliance on manual push-buttons, which often act as a physical and psychological deterrent during inclement weather. The project focused on refining traffic efficiency by reducing waiting times and enhancing the physical comfort of pedestrians and cyclists throughout the autumn-winter season. Crucially, these improvements for active mobility were implemented alongside optimised signalling to ensure that the flow of motorised traffic remained unaffected.

3.2.2.1 Overview

Objective: reduce delay and waiting burden for pedestrians and cyclists during adverse weather.

Strategic focus: adapt signal control to active mobility needs on important cycling and walking routes.

Intervention type: traffic management.

Main indicators: TP.5 Delay, TP.4 Average travel time, SF.4 Traffic conflict index and EN.1 Greenhouse gas emissions, with user perception indicators used as supporting evidence.

3.2.2.2 Measurement methodology

The evaluation combined technical monitoring, video analysis, traffic counts, simulation and user feedback. A baseline was established in March 2024 using video recordings, archival traffic logs and traffic counts. Measurements considered variable weather conditions to test sensor responsiveness and signal-control logic.

3.2.2.3 Impact evaluation results

Indicator	Observed result	Interpretation
TP.5 Delay	Reduced in monitored conditions	Automated detection lowered the waiting burden for active users, particularly in low-traffic periods.
TP.4 Average travel time	Improved locally	Reduced waiting contributed to smoother movement through the crossing area.
SF.4 Traffic conflict index	Monitored / expected improvement	Better detection can reduce frustration-related risky behaviour, but conflict effects require cautious interpretation.
User comfort	Improved	Users benefited from not having to press push-buttons in rain, cold or while wearing gloves.

The intervention improved the operational experience of active mobility users at the treated crossings. The key mechanism was not only delay reduction, but also the removal of a small but important winter discomfort: stopping, waiting and physically activating the signal in adverse weather. Claims about wider network-level modal shift should remain cautious, because the experiment was local and infrastructure-specific.

The technical detail transferred from the traffic-management analysis is that the intervention addressed a concrete winter discomfort: stopping at a crossing, removing gloves or waiting in rain, snow or freezing conditions to activate a push-button. Thermal detection reduces this small but frequent barrier. However, sensor calibration is not a one-off task; heavy precipitation, temperature gradients and local geometry require repeated verification of detection zones and signal logic.

3.2.2.4 Process evaluation

Barriers: sensor choice, weather robustness and integration with existing TRISTAR logic required technical calibration.

Drivers: the EuroVelo route context and the existence of the TRISTAR system provided a strong operational basis for implementation.

Operational lesson: remote access to data and video feeds is important for rapid adjustment of detection zones and signal programmes.

3.2.2.5 Recommendations for replication

1. Use existing smart traffic management platforms where available instead of creating a parallel system.
2. Prioritise automated detection at crossings where active users otherwise face long or uncomfortable waits.
3. Define a winter operation mode, but verify its impact on all user groups before scaling.
4. Include sensor cleaning, recalibration and performance checks in maintenance contracts.

3.2.2.6 Overall impact

The Gdynia signal-control pilot demonstrated the operational value of weather-adaptive detection for improving comfort and local efficiency at signalised crossings. Its transferability depends on local controller architecture, sensor calibration, maintenance capacity and the balance between active-mode priority and general traffic performance. Replication is recommended on strategic YRAM corridors where local effects are monitored and coordinated with wider traffic-control requirements.

3.3 Umeå, Sweden

Umeå municipality is an urban centre in northern Sweden characterised by a predominantly flat topography, which theoretically facilitates active mobility. As a city at a high latitude, Umeå faces extreme seasonal challenges, including a drastic daylight deficit during the winter and heavy snowfall, leading to a significant decrease in pedestrians and cyclists. The municipality's strategic goal within the BATS project is to implement behavioural changes that allow residents to continue sustainable travel year-round, thereby reducing the dominance of solo trips in private cars.

3.3.1 Intervention 1: E-bike loan programme

This intervention focuses on promoting year-round active mobility by providing residents with a fleet of 17 electric bicycles for free testing during demanding winter conditions as well as year-round availability. By organising approximately three-week loan periods, the city aims to address the psychological and technical barriers for individuals who previously travelled mainly by car or abandoned cycling during the winter season. The experiment relies on close cooperation with local bike shops, which serve as service and storage points, allowing for professional equipment maintenance while the municipal administrative system manages the booking process.

3.3.1.1 Overview

Objective: lower the financial and technical entry barrier to winter cycling.

Target group: car users and residents uncertain about year-round cycling.
Intervention type: citizen activation.

Scale: 17 electric bicycles, managed through a municipal booking system and local bike-shop partnerships.

Main indicators: TB.20 Attitudes, TB.19 Travel satisfaction, TB.22 Citizen engagement and TB.11 Modal split.

3.3.1.2 Measurement methodology

The evaluation used booking-system data and pre- and post-loan surveys. The approach focused on attitude change, satisfaction, practical barriers and the potential substitution of car trips during the loan period. A longer-term follow-up was planned to assess persistence of behavioural change.

3.3.1.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.22 Engagement	High demand / near-continuous booking	The loan model attracted strong public interest.
TB.20 Attitudes	Positive shift	Testing an e-bike without financial risk reduced perceived difficulty of winter cycling.
TB.11 Modal split	Car substitution for some trips	Participants used e-bikes as a practical alternative to car travel during the loan period.
TB.19 Satisfaction	Generally high, with logistical variation	Positive user experience was occasionally affected by late returns, chargers or servicing issues.

The intervention showed that a short trial can reduce psychological distance from winter cycling. The evidence should be interpreted as a participant-level effect rather than a city-wide modal shift. Its strongest value is demonstrating that equipment access and direct experience can change attitudes among users who would not otherwise invest in winter cycling equipment.

3.3.1.4 Process evaluation

Barriers: floor space, spare parts, charger logistics and late returns created operational pressure.

Drivers: cooperation with local bike shops provided professional maintenance and credibility.

Operational lesson: clear written agreements, technical logs and automated reminders are essential for programme reliability.

3.3.1.5 Recommendations for replication

1. Use local retailers or service partners, but define responsibilities for storage, maintenance, spare parts and winter tyres in writing.
2. Keep a technical log for each bicycle, including battery, charger and service status.
3. Use automated booking reminders to reduce missed returns and administrative burden.
4. Assess theft and damage risks before offering high-value equipment as a free loan service.

3.3.1.6 Overall impact

The e-bike loan programme lowered the threshold for trying winter cycling and produced positive attitude shifts among participants. It is a strong transfer case for cities seeking behavioural change through practical equipment access rather than communication alone.

3.3.2 Intervention 2: Light projections for winter guidance

The light projection intervention addressed the problem that traditional surface markings can become invisible under snow and darkness. Umeå installed Monospot Gobo projectors at seven strategic locations, including Brogatan, Kungsgatan, Akademileden and four additional high-flow pedestrian and cycling locations.

3.3.2.1 Overview

Objective: improve orientation, visibility and perceived safety on walking and cycling routes during darkness and snow conditions.

Target locations: high-flow and potentially unclear pedestrian-cyclist areas, including Brogatan, Kungsgatan, Akademileden and additional locations.

Intervention type: infrastructure / traffic management.

Main indicators: TB.17 Security, TB.18 Comfort, TB.19 Travel satisfaction, TB.20 Attitudes and SF.1 Traffic accidents.

3.3.2.2 Measurement methodology

The evaluation used surveys distributed through social media, on-site conversations and review of available accident data. The monitoring focused on orientation, perceived safety and user response to projected guidance in dark and snowy conditions.

3.3.2.3 Impact evaluation results

The intervention utilised light as a functional tool to maintain clear guidance on adverse surfaces

Indicator	Observed result	Interpretation
TB.17 Security	Improved in qualitative feedback	Users perceived clearer guidance and a more predictable environment.
TB.18 Comfort	Improved orientation	Projected symbols reduced the cognitive effort of navigating unclear route sections.
TB.20 Attitudes	Positive response	Residents generally viewed projections as a practical winter guidance measure.
TB.19 Travel satisfaction	Positive shift in qualitative feedback	Users reported improved orientation and a more predictable travel environment after dark.
Technical performance	Strong contrast on snow	Projected symbols remained visible when painted markings were obscured by snow.

The traffic-management value of the projections was particularly relevant during the long winter darkness period, when daily darkness can exceed 15 hours and conventional route markings are difficult to read.
The intervention worked particularly well when snow provided a high-contrast surface. This should be described as a response to local winter conditions, not as a deliberate reliance on snow as infrastructure. The value of the intervention is that it maintains guidance when conventional markings are not visible.

At the deployment locations, the projected symbols functioned both as infrastructure support and as a traffic-management cue. Their value was strongest where pedestrian and cycling flows interact and where snow or darkness makes conventional markings unreliable. The measure should therefore be targeted at conflict points and high-flow nodes rather than used as general decoration.

3.3.2.4 Process evaluation

Barriers: selecting appropriate conflict points required input from the traffic planning group, and mounting equipment on street lighting infrastructure required permits.

Drivers: the technology was visible, intuitive and relatively low-maintenance once installed.

Operational lesson: projector maintenance should be linked to existing street lighting maintenance routines.

3.3.2.5 Recommendations for replication

1. Prioritise locations where snow regularly obscures markings or where pedestrian-cyclist interaction is unclear.
2. Use mounting points that minimise vandalism risk and avoid obstruction of the projection beam.
3. Calibrate symbol size, intensity and placement for local surfaces and ambient lighting.

4. Treat projections as guidance support, not as a replacement for safe geometry and maintenance.

3.3.2.6 Overall impact

The Umeå light projections improved route readability during darkness and snow cover. The pilot provides a strong example of winter-specific visual guidance, especially for cities where snow frequently makes conventional road markings ineffective.

3.3.3 Intervention 3: Winter Scouts

This intervention addressed the decline in active mobility during winter caused by heavy snowfall and navigating difficulties. The municipality implemented a citizen-based monitoring process by recruiting daily active mobility users during two consecutive winters to monitor and rate the quality of snow ploughing on their regular commuting routes.

3.3.3.1 Overview

Objective: improve winter maintenance responsiveness and transparency through structured citizen feedback.

Target group: regular pedestrians and cyclists using winter routes.
Intervention type: maintenance / citizen activation.

Scale: approximately 25 scouts in the first winter and approximately 45 in the second.

Main indicators: TB.22 Citizen engagement, TB.20 Attitudes and operational maintenance utility.

3.3.3.2 Measurement methodology

The evaluation used continuous reporting through the municipal fault-reporting platform, including photos and GPS tags, supported by pre- and post-season surveys. The main focus was the quality and usefulness of citizen-generated data for maintenance operations.

3.3.3.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.22 Engagement	25 active scouts in year one, expanded in year two	High interest allowed broader route coverage.
TB.20 Attitudes	Increased trust and understanding	Participants gained insight into municipal maintenance constraints and priorities.
Data quality	Photo-verified and GPS-tagged	Reports were more actionable than general complaints.
Operational utility	Improved prioritisation	Maintenance teams could verify route conditions and localised hazards more precisely.

The programme converted general dissatisfaction into structured, location-specific data. The second winter also showed that a more inclusive recruitment approach could work, as repetitive reporting was less problematic than initially expected.

3.3.3.4 Process evaluation

Barriers: balancing geographic coverage and reporting quality required adjustment between the first and second winter.

Drivers: social media recruitment generated a strong pool of motivated volunteers.

Operational lesson: using an existing municipal platform improved reliability and reduced development costs.

3.3.3.5 Recommendations for replication

1. Use existing reporting systems where possible, but adapt them for YRAM-specific photo and location reporting.
2. Recruit for route coverage rather than only for individual motivation.
3. Provide simple reporting instructions so that feedback is operationally useful.
4. Close the feedback loop by showing scouts how their reports influence maintenance decisions.

3.3.3.6 Overall impact

Winter Scouts strengthened the link between users and maintenance operations. Its strongest transfer lesson is that transparency and feedback are part of winter service quality: users are more likely to trust maintenance systems when they understand how reports are used.

3.4 Porvoo, Finland

Porvoo is shaped by the Porvoo River and by the need to improve active mobility connections between existing and developing parts of the city. The BATS experiments focused on winter maintenance coordination and experiential planning for future infrastructure. Both interventions were primarily process-oriented and should be interpreted as tools for better decision-making rather than as directly comparable impact measures.

3.4.1 Intervention 1: Winter maintenance and citizen feedback

This intervention combined the use of a specialised Unimog maintenance vehicle with a citizen feedback model based on map-based mobile surveys. The pilot addressed the challenge of maintaining consistent route quality across municipal and state-owned infrastructure.

3.4.1.1 Overview

Objective: improve winter maintenance quality and coordination on walking and cycling routes.

Strategic focus: combine operational maintenance data with user feedback.

Intervention type: road maintenance / citizen activation.
Main indicators: TB.8 Facility maintenance and TB.22 Citizen engagement.

3.4.1.2 Measurement methodology

The evaluation compared citizen reporting across two winter seasons. The 2023-24 baseline generated 114 responses during a relatively mild two-month period. Monitoring continued in winter 2024-25, when conditions were more severe and the number of responses fell to 22.

3.4.1.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.22 Citizen engagement	22 responses in 2024-25, compared with 114 in 2023-24	Extreme cold and signage problems reduced field-based reporting.
TB.8 Facility maintenance	Limited survey evidence	The low response rate limited the possibility of robust KPI calculation.
Operational awareness	Improved through Unimog use	The pilot supported coordination of maintenance across municipal and state-owned sections.

The main finding was not a simple improvement in reported maintenance satisfaction, but a practical lesson about winter engagement. Outdoor QR-code reporting can fail under severe cold because users avoid using phones and physical signage may detach or become obscured. At the same time, the Unimog pilot showed that consistent maintenance across ownership boundaries is feasible when equipment and responsibilities are coordinated.

3.4.1.4 Process evaluation

Barriers: administrative coordination across road ownership boundaries and weather-related failure of QR-code signage.

Drivers: institutional interest in data-driven maintenance and continuity of survey subcontractor support.

Operational lesson: digital reporting tools must be climate-resilient and should include post-trip or indoor feedback options.

3.4.1.5 Recommendations for replication

1. Use durable, weather-resistant survey signage and place it where it remains visible after snow clearing.
2. Offer post-trip reporting channels that users can complete indoors.
3. Combine citizen feedback with operational logs rather than relying on either source alone.
4. Establish formal agreements for routes crossing municipal and state ownership boundaries.

3.4.1.6 Overall impact

The Porvoo maintenance pilot provided an important implementation lesson: citizen feedback can support maintenance planning, but the feedback channel must be adapted to winter conditions. The Unimog component highlighted the transfer value of cross-jurisdictional maintenance coordination for continuous YRAM corridors.

3.4.2 Intervention 2: 3D Simulation Tool for Infrastructure Planning

Porvoo also tested a 3D simulation environment for evaluating future river-crossing and bridge options. The tool allowed participants to experience route alternatives before physical implementation and to provide feedback on comfort, safety and route preference.

3.4.2.1 Overview

Objective: support planning and decision-making for future cycling infrastructure.

Strategic focus: translate technical design options into user experience before construction.

Intervention type: infrastructure planning / citizen activation.

Main indicators: TB.22 Citizen engagement and TB.20 Attitudes.

3.4.2.2 Measurement methodology

The evaluation used structured workshops with groups of three to four participants. Sessions included an introduction, warm-up ride, two measurement rides and semi-structured discussion. Pre- and post-experience feedback captured whether the simulation changed participant views on route alternatives.

3.4.2.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.22 Citizen engagement	Multi-stakeholder participation	The tool engaged residents, planners and decision-makers in the same evaluation process.
TB.20 Attitudes	Opinion refinement	Participants could reassess route options after experiencing them virtually.
User experience	Indicator-based feedback	The workshops captured qualitative preferences that static maps cannot show.

The simulation did not function as a direct mobility intervention. Its value was in improving planning evidence and stakeholder understanding. It helped participants discuss future infrastructure using experience-based criteria rather than only technical drawings.

The 3D simulation tool should be treated as an experiential planning method. It captures comfort, perceived safety, route-readability and route-efficiency preferences that two-dimensional drawings cannot show. The method is most useful for major infrastructure decisions, such as bridge or river-crossing alternatives, where residents and decision-makers need to understand spatial consequences before construction.

3.4.2.4 Process evaluation

Barriers: participants needed to understand that the tool was developmental and not a finished visualisation product.

Drivers: small workshop groups enabled more detailed discussion than a standard survey.

Operational lesson: a warm-up ride is necessary before formal measurement to reduce technology-related bias.

3.4.2.5 Recommendations for replication

1. Use a structured workshop format with pre-survey, warm-up, test ride, post-survey and discussion.
2. Recruit both residents and decision-makers to capture user acceptance and political feasibility.
3. Explain the planning purpose clearly so that feedback focuses on route quality rather than software appearance.
4. Use simulation as a supplement to, not a replacement for, technical design and field assessment.

3.4.2.6 Overall impact

The 3D simulation tool strengthened the evidence base for future infrastructure planning in Porvoo. Its transfer value lies in supporting early-stage decision-making for complex active mobility investments, especially where public acceptance and route experience are difficult to assess from drawings alone.

3.5 Kalundborg, Denmark

Kalundborg is a municipality of approximately 48,000 inhabitants, with 16,500 residing in the city itself. Traditionally an industrial hub, the city is experiencing rapid growth in both specialised industry and higher education, with an expected increase from 350 to 1,000 higher education seats in the coming years. The urban topography is mostly flat, which is conducive to cycling; however, the city faces severe congestion on its road network due to the influx of commuters. The strategic focus for Kalundborg within the BATS project is to encourage year-round commuting by bicycle, particularly targeting the connection between the city centre and the growing campus and biotech areas.

3.5.1 Intervention 1: Bike All Year campaign and route awareness

This intervention was designed to increase awareness and willingness among commuters to use bicycles as a primary mode of transport throughout all seasons. It focused on the bicycle connection between Kalundborg city centre and the biotech campus, utilising national campaign frameworks like "Touring Together" and "We Bike to Work."

3.5.1.1 Overview

Objective: increase awareness of year-round cycling and establish a baseline of commuter barriers.

Strategic focus: connect campaign communication with the specific city-centre-to-campus corridor.

Intervention type: citizen activation.

Main indicators: TB.20 Attitudes and TB.22 Citizen engagement.

3.5.1.2 Measurement methodology

The evaluation used an initial survey distributed through local companies and educational institutions, reaching more than 5,000 potential respondents. The survey established a perceptual baseline for winter cycling barriers and informed the subsequent lighting and visibility measures.

3.5.1.3 Impact evaluation results

The intervention focused on the diagnostic assessment of commuter behaviour to establish a factual basis for future infrastructure refinement.

Indicator	Observed result	Interpretation
TB.20 Attitudes	46% identified lack of visibility / lighting as a primary deterrent	The campaign identified a concrete infrastructure barrier rather than only a communication problem.
TB.22 Engagement	Survey distributed to more than 5,000 potential respondents	The use of employer and education channels enabled broad diagnostic reach.

The campaign's main contribution was diagnostic. It showed that local participation in national cycling campaigns depends on whether commuters perceive the route as safe and visible. In Kalundborg, the campaign helped justify targeted lighting and reflector interventions on the corridor.

3.5.1.4 Process evaluation

Barriers: Existing commuting habits and strong car dependency among industrial employees limited the potential for behavioural change through communication measures alone.

Drivers: Established national campaign formats provided organisational support and improved the recognisability of the intervention.

Operational lesson: The campaign proved most valuable as a diagnostic tool supporting the identification of infrastructure barriers requiring further technical intervention.

3.5.1.5 Recommendations for replication

1. Use national or regional campaign frameworks when they reduce local administrative burden.
2. Target specific employment or education hubs rather than a general city-wide audience.
3. Use campaign surveys to identify route-specific barriers before choosing technical measures.

3.5.1.6 Overall Impact

The campaign established a clear evidence basis for action by identifying visibility as a major barrier to winter cycling on the target corridor. Its value lies in linking activation with subsequent technical improvements rather than treating communication as a standalone solution.

3.5.2 Intervention 2: Light the bike lane and reflective route improvements

The technical component addressed low visibility and route discontinuity on the corridor connecting the city centre, campus and biotech areas. The pilot included mobile solar-powered LED lamps and thermoplastic markings along Rynkevangen. In addition, road reflectors and reflective protective edge elements were installed along selected sections of Bredgade and Elmegade to improve bicycle-lane visibility where there was no physical separation from traffic.

3.5.2.1 Overview

Objective: improve perceived safety, comfort and route readability during darkness and wet winter conditions.

Target locations: Rynkevangen, with complementary reflective measures on Bredgade and Elmegade.

Intervention type: infrastructure.

Main indicators: TB.17 Security, TB.18 Comfort, TP.14 Volume of pedestrians/cyclists, SF.6 Number of observed violations and TB.20 Attitudes.

3.5.2.2 Measurement methodology

The evaluation combined stationary counts, user feedback from a dedicated test group and planned stop interviews or QR-code surveys. Baseline volume data were collected before installation, while perceptual information was linked to the broader campaign survey.

3.5.2.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.17 Security	Improved in user feedback	The lighting and reflectors directly addressed the visibility barrier identified in the survey.
TB.18 Comfort	Positive feedback on guidance	Users reported clearer orientation from the combination of lamps, markings and reflectors.
TP.14 Volume	Monitoring ongoing / corridor remained in use	Counts were used as a proxy for whether improved visibility supported route choice.
SF.6 Observed violations	To be monitored locally	Reflective edge elements were intended to increase driver attention where no physical separation existed.

The main observed effect was improved route readability and perceived safety. Mobile lighting offered a fast response where grid-connected lighting was not feasible. The Elmegade and Bredgade reflective elements complemented the lighting by strengthening route continuity and increasing the visibility of the bicycle lane in darkness and wet weather.

The detailed infrastructure finding is that mobile solar-powered lighting is a practical response to missing links where permanent grid connection is not feasible. Its limitation is equally important: at northern latitudes and during deep winter, reduced daylight can limit charging capacity. Battery checks, position checks and performance monitoring must therefore be included in the operating model from the beginning.

3.5.2.4 Process evaluation

Barriers: the test corridor included sections without a pre-existing bicycle path and problematic crossing conditions at Slagelsevej.

Drivers: the campaign baseline created a clear user-based justification for the technical intervention.

Operational lesson: mobile solar lighting requires regular checks of position, battery performance and marking wear, especially during deep winter.

3.5.2.5 Recommendations for replication

1. Prioritise missing links that connect housing, education and employment hubs.
2. Use mobile solar-powered lighting where grid connection is not feasible, but define maintenance routines in advance.
3. Combine lighting with reflective elements and markings to improve route continuity, especially where physical separation is absent.
4. Use test groups and short user interviews to refine temporary infrastructure before permanent investment.

3.5.2.6 Overall impact

The Kalundborg intervention package improved visibility and perceived safety on a strategic commuter corridor. Its strongest transfer value lies in the combination of diagnostic activation and flexible infrastructure: the campaign identified the barrier, while mobile lighting and reflective elements provided a quick, targeted response. The main limitation is the seasonal performance of solar-powered equipment in low-daylight periods.

3.6 Klaipėda, Lithuania

Klaipėda is the third-largest city in Lithuania, with a population of approximately 162,292 and an area of 98 km². The city has an elongated form along the Baltic Sea and a predominantly flat topography, which is suitable for active mobility. The modal split indicates that 35% of trips are made by car, 29% by public transport, 29% on foot and 4% by bicycle. A key barrier is traffic safety: 48% of surveyed residents identified it as the primary barrier to cycling. Many cyclists share space with motorised traffic, including buses, while darkness, surface quality and uncertainty about winter path conditions further reduce route confidence. The BATS intervention therefore combined projected visual guidance and path-status information.

3.6.1 Intervention 1: Projected signs and pavement-condition information / path-status information

The intervention addressed low-visibility safety concerns and shared-lane conflicts by using projected signs to define visual boundaries and make cyclist space more legible to both active mobility users and professional drivers. It also explored pavement-condition and path-status information as a way to support route choice and improve user confidence during winter and freeze-thaw conditions.

3.6.1.1 Overview

Objective: improve perceived safety, comfort and orientation in low-light and shared-lane conditions.

Target group: cyclists, pedestrians and professional drivers operating in shared corridors.

Intervention type: infrastructure + traffic management.

Main indicators: TB.17 Security, TB.18 Comfort, TP.14 Cyclist volume, TB.20 Attitudes and TB.22 Engagement.

3.6.1.2 Measurement methodology

The evaluation combined user surveys, professional driver feedback, camera-based observation and surface-condition information.. The assessment focused on visibility, perceived safety, road-sharing behaviour and the role of path-status information in reducing uncertainty about surface conditions such as wetness, snow, ice or slippery sections. The information component was based on meteorological data and pavement-condition sensing, integrated into a public-facing path-status information system. Its purpose was to communicate surface temperature, wetness, icing risk and other route-condition information in a form that could support both user decisions and maintenance operations.

3.6.1.3 Impact evaluation results

Indicator	Observed result	Interpretation
TB.17 Security	46% identified improved lighting / visibility as a motivator in the baseline	Projected visual guidance and visibility information addressed a documented perception barrier.
TB.18 Comfort	Improved visually, constrained physically	Guidance improved, but cobblestone surfaces continued to reduce physical comfort.
TB.20 Attitudes	Positive change among users and drivers	Projected signs helped clarify the cyclist space in shared-lane conditions.
Technical performance	Variable by surface and weather	Projected signs were most legible on high-contrast or snow-covered surfaces, while visibility could fluctuate during heavy precipitation, on rough surfaces or under high ambient light.
Path-status information	Supported route confidence	Surface-condition communication helped reduce uncertainty during winter and freeze-thaw conditions.

The results show that projected signs and pavement-condition information improved orientation and made cyclist space more legible in shared bus-cycle conditions. The pilot should not be described as dedicated bike-path lighting. Its contribution was visual guidance, driver awareness and uncertainty reduction through information on wet, icy or otherwise difficult surface conditions. However, these measures cannot compensate for poor riding surface quality. Cobblestone sections continued to constrain comfort, so future improvements should combine visual guidance with surface upgrades where possible.

The traffic-management detail is the dual-purpose value of the data system. Meteorological and pavement-condition data can inform users before a trip and simultaneously support municipal maintenance decisions. To be useful for non-specialist users, this information should be presented through simple visual categories, such as dry, wet, icy or risky surface conditions, rather than as raw sensor data

3.6.1.4 Process evaluation

Barriers: procurement of specialised projection equipment caused delays, and visibility performance depended on precipitation, ambient light and surface type.

Drivers: the intervention responded to a clearly documented safety concern, including the high share of residents identifying traffic safety as a cycling barrier.

Operational lesson: involving the Public Transport Authority and bus drivers improved the quality of evidence on shared-lane behaviour.

3.6.1.5 Recommendations for replication

1. Use projected markings where physical separation is not feasible, especially in shared bus-cycle corridors.
2. Combine projected visual guidance with surface improvements when rough or cobblestone surfaces remain a comfort barrier.
3. Calibrate projection colour, intensity and position for wet asphalt, snow and existing ambient lighting.
4. Include professional drivers in the evaluation, because their response is central in shared-lane settings.
5. Present path-status information in simple, intuitive formats that can be understood quickly before or during a trip.

3.6.1.6 Overall impact

The Klaipėda pilot demonstrated the value of combining visual guidance and information in a constrained urban environment. Projected signs supported safer interaction between cyclists and buses, while path-status information addressed uncertainty about winter surface conditions. The intervention is transferable to other cities with shared-lane conflicts, provided that physical surface quality and calibration requirements are not overlooked.

3.7 Kiili / Harju County, Estonia

Kiili Municipality, in Harju County, has approximately 6,391 inhabitants and a population density of 63.66 persons per km². The wider Harju County context is characterised by flat terrain, rapid demographic growth and strong school-related mobility demand. Settlement patterns are influenced by higher-density areas along major roads, while the increase in school-aged children has made school travel a strategic mobility issue. The BATS focus was to reduce car-dependent school travel and support Year-Round Active Mobility in small-town and suburban conditions.

In addition to the school-based activation campaign in Kiili, Harju County contributed a winter maintenance and street-environment bottleneck study. This work identified design and operational barriers that make winter maintenance of walking and cycling infrastructure more difficult, including locations where geometry, surface conditions or street equipment limit effective snow clearing. Because this activity was primarily diagnostic and transfer-oriented, it should be reported as a planning and maintenance output rather than as a direct behavioural impact intervention.

3.7.1 Intervention 1: YRAM promotion through schools and local safety measures

The intervention at Kiili Gymnasium combined daily bicycle and scooter counts, school competitions, positive communication and a partnership with a local entrepreneur offering a 40% discount on winter tyres. The aim was to normalise cycling and scootering during cold and dark periods while addressing practical safety concerns.

3.7.1.1 Overview

Objective: increase active mobility among schoolchildren and families during winter conditions.

Strategic focus: combine social activation with practical equipment support.

Intervention type: citizen activation.

Main indicators: TP.14 Cyclist volume, TB.11 Modal split, TB.20 Attitudes and TB.22 Citizen engagement.

3.7.1.2 Measurement methodology

The evaluation used simple daily manual counts of bicycles and scooters at 9:00 a.m. at Kiili Gymnasium. Counts were compared with 8:00 a.m. weather data to analyse how temperature and precipitation affected active travel. A baseline from January 2024 recorded only 5 bicycles during a heavy snow event.

3.7.1.3 Impact evaluation results

Indicator	Observed result	Interpretation
TP.14 Cyclist volume	83 bicycles at -5°C, compared with a peak of 193 at 17°C	A substantial core of active users remained during freezing conditions.
Baseline comparison	5 bicycles during a heavy snow event in January 2024	The intervention period showed much higher resilience than the baseline situation.
TB.20 Attitudes	Positive shift	Winter tyre support addressed fear of instability and equipment inadequacy.
TB.22 Engagement	High participation through competitions	Class-based competition and visible bicycle parking supported peer influence.

The most important result is the retention of a visible core of winter cyclists during sub-zero temperatures. The exact values should be interpreted locally, because the intervention was school-based and monitored with a simple counting method. Nevertheless, the combination of equipment support and social motivation produced a clear resilience effect compared with the baseline.

3.7.1.4 Process Evaluation

Barriers: privacy requirements limited the collection of detailed family-level commuting data.

Drivers: positive framing, class competition and support from the school and local business community created strong buy-in.

Operational lesson: simple manual counts can provide useful evidence when they are consistent and linked to weather observations.

3.7.1.5 Recommendations for replication

1. Use school-based initiatives where roles of the municipality, school, parents and pupils can be clearly defined.
2. Pair gamified communication with practical equipment support, such as winter tyres or safety accessories.
3. Use consistent manual counts if automated monitoring is not feasible.

4. Publish visible progress through school or municipal communication channels to maintain motivation.

3.7.1.6 Overall impact

The Kiili pilot showed that targeted social activation and practical safety support can maintain a meaningful level of school cycling during winter. Its transfer value is high for small towns and suburban municipalities where community networks are strong and where school mobility can become a visible demonstration of year-round active mobility.

3.7.2 Intervention 2: Winter maintenance bottleneck study

In addition to the school-based activation campaign, Harju County contributed a diagnostic study of winter maintenance bottlenecks in the street environment. The study identified physical and operational barriers that reduce the feasibility of year-round walking and cycling, especially where street geometry, surface condition, kerb radii, lane widths or the placement of street furniture make mechanical snow removal difficult.

3.7.2.1 Overview

Objective: identify design and maintenance constraints that limit year-round active mobility and define low-cost improvement options.

Strategic focus: treat maintainability as a design criterion for walking and cycling infrastructure, not only as an operational winter-service issue.

Intervention type: maintenance / infrastructure planning.

3.7.2.2 Key findings

Theme	Observed issue	Planning implication
Street geometry	Certain route sections are difficult for snow-clearing machinery to access or manoeuvre through.	Winter maintenance requirements should be considered during street and cycle-route design.
Street furniture and edge conditions	Elements placed close to walking or cycling routes can obstruct mechanical winter service.	Design reviews should check whether equipment, signs, kerbs and local narrowings restrict maintenance vehicles.
Transfer value	The study generated a catalogue of challenge-driven improvement options rather than a before-after impact measurement.	The result should be used as a diagnostic and replication-oriented planning output for other municipalities.

The main value of the study lies in connecting infrastructure design with winter service feasibility. It shows that small design details can determine whether active mobility routes remain usable after snow or ice events. The study therefore complements the Kiili school campaign: behavioural activation can create demand for winter cycling and walking, while bottleneck mapping identifies the physical conditions needed to keep those routes usable.

3.7.2.3 Recommendations for replication

1. Map snow-removal bottlenecks before defining winter active-mobility priorities.
2. Review kerb radii, route widths, street furniture and surface conditions from the perspective of maintenance machinery.
3. Use the study results to define low-cost corrective measures and future design requirements.
4. Treat diagnostic mapping as a transfer-ready planning output even where no before-after behavioural impact is measured

3.7.2.4 Overall impact

The Harju winter maintenance bottleneck study strengthened the planning evidence base for year-round active mobility. It does not provide direct modal-shift evidence, but it identifies the street-design and maintenance conditions that must be resolved for activation and infrastructure measures to work reliably in winter.

Part 4 - Transnational Synthesis and Transfer Implications

4.1 Main cross-city conclusions

The BATS local experiments confirm that Year-Round Active Mobility should be understood as an operational practice rather than a single intervention type. The pilots do not provide a statistically comparable ranking of measures, because intervention scale, monitoring methods, baselines and local conditions differed substantially between cities. They do, however, provide consistent implementation evidence on what makes autumn-winter walking and cycling more feasible.

First, visibility and route readability are central prerequisites for winter active mobility. Physical protection, projected markings, reflective elements and temporary lighting all contributed to improved perceived safety or orientation, but their roles differed. Physical protection is most relevant where cyclists need separation from motorised traffic, projected markings are useful where conventional markings are obscured or where space is constrained, and mobile lighting is most relevant for missing links without grid-connected infrastructure.

Second, winter maintenance is not a supporting activity but a core condition for the success of infrastructure and activation measures. Protective elements, projected signs, school campaigns and route promotion all depend on routes remaining usable, visible and predictable during snow, ice, rain and darkness. The pilots show that maintenance requirements should be considered already during intervention design, procurement and installation.

Third, information can reduce uncertainty before and during winter trips. Weather-sensitive signal control, pavement-condition information, maintenance feedback tools and citizen reporting systems all address the same operational problem: users are more willing to walk or cycle when they understand whether the route is usable and whether the municipality is actively managing winter conditions.

Fourth, citizen activation is strongest when it is linked to tangible support or a concrete local route. School campaigns, e-bike trials, winter tyre support and citizen monitoring panels were more effective when they addressed a practical barrier, such as lack of equipment, lack of confidence, unclear route conditions or insufficient maintenance feedback. Communication alone was less convincing where the underlying infrastructure barrier remained unresolved.

4.2 Transfer implications

The most transferable measures are those with a clear local problem definition, limited administrative complexity and visible short-term value. School-based campaigns, practical equipment support, route-specific visibility improvements and simple citizen feedback channels can be replicated by municipalities with limited resources, provided that responsibilities and monitoring arrangements are defined in advance.

Measures with medium transfer readiness include Gobo projections, pavement-condition information, adaptive signal control and structured winter agent programmes. These require more technical preparation, calibration, procurement and staff capacity, but they provide high transfer value where the problem is well defined, for example shared bus-cycle corridors, dark tunnels, weather-sensitive crossings or priority winter cycling routes.

The most complex transfer cases are those involving cross-jurisdictional winter maintenance, integrated traffic management systems or advanced simulation tools. Their value is high, but replication requires early institutional coordination, data access, clear ownership and a realistic timeline.

Overall, the BATS evidence base should be used as a menu of adaptable implementation models rather than a set of universal benchmarks. Follower cities should first identify their main YRAM barrier, then select a proportionate intervention package combining infrastructure, maintenance, traffic management and citizen activation.