22nd International Conference on
Harmonisation within Atmospheric Dispersion Modelling for Regulatory Purposes
10-14 June 2024, Pärnu, Estonia

TOOLS TO SUPPORT CITY LEVEL CLIMATE PLANNING – CURRENT STATUS AND FUTURE NEEDS FOR IMPACT ASSESSMENT

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Abstract: Cities are crucial actors in combatting climate change, and climate change mitigation actions and plans are central components in city strategies on, i.a., transport, housing and zoning. Such local level actions, however, often affect cities and citizens in numerous ways beyond the reduction of greenhouse gases, e.g. by impacting air quality. Experts and policy makers who prepare city-level strategies call for information and tools to assess various side-effects of the climate measures across sectors and impact categories.

To identify the most urgent needs in tool development and relevant impact categories the tools should address, we carried out a series of surveys among chosen climate and air quality experts in the six biggest Finnish cities. The questions which the surveys and existing tools' analysis wished to give insight were: (1) which impact categories are most relevant to support the preparation of climate plans at city level; (2) what tools are already available in these categories in Finland and internationally; (3) how useful these tools are for city experts' work in practice; and (4) how the existing tools should be developed and what new tools are needed.

The city experts saw air pollution derived health impacts and economic impacts of climate mitigation measures as the most important impact categories. The analysis indicated that many of the existing and openly available tools were, however, not useful for city experts in practise. Many of the tools were not directly intended to be used for city-level assessments. The biggest obstacles with city-level tools were that they were too complicated or time-intensive to integrate into work routines, and the produced results were not compatible between tools due to different calculation methods.

For the future, city experts wished to have more comprehensive scenario assessments combining the effects of different sectors to determine the overall impacts of planned measures. As a reaction, Finnish Environment Institute Syke started a development of an integrated fine particle health damage and investment and labour impact tool for climate measure planning for Finnish cities (Karvosenoja et al. 2022). The tool was launched in 2023.

Key words: *Climate, Air Pollution, Health, Economic Impacts, Cities*

INTRODUCTION

Measures on climate change mitigation are often top priorities in cities, as far as environmental investments are concerned. Resources on air pollution related actions or assessments might be more limited, especially in cities with relatively clean air, such as typically present in the Nordic countries. However, experts working in cities' climate departments are aware and concerned of the air quality and other side-impacts of climate actions. Several cities in Finland have expressed a need for easy-to-use tools to assess such impacts.

To answer this call, Finnish Environment Institute Syke has carried out a series of projects to investigate most urgent needs of cities in impact assessment, what tools are already easily available for practical use to assess these impacts, and what new features or tools should be developed. A comprehensive review of cities' climate plans was carried out to find out the potential impact categories. Surveys and workshops with the participation of city experts were facilitated to invenstigate cities' preferences. Existing tools and

models were listed and published as a web service. To enhance the assessment capabilities of the two impact categories that cities considered the most important, air pollution health impacts and economical impacts, a new tool IhQ was developed in the later phase of the project. Finally, to make these tools and methods into practical use, an instructions manual for zoning experts was created and published. This abstract gives an overview of the projects and presents some main findings.

MOST RELEVANT IMPACT CATEGORIES IN CLIMATE PLANNING

The project to investigate the availability of climate measure impact assessment tools started in 2019, initiated by discussions with six major Finnish cities: Helsinki, Espoo, Vantaa, Tampere, Turku and Oulu. The Helsinki Region Environmental Services Authority (HSY) participated with their climate goals. In addition, the cities of Kuopio, Lahti and Lappeenranta participated in the planning and as test users of the IhQ tool in the later phase of the project.

As a first step, cities'climate plans and actions in different economical sectors within the plans were analysed to identify relevant impact categories (Table 1). To get more detailed insight of cities' preferences in impact assessment, three workshops were facilitated during 2019 with active participation of experts from the cities and HSY. As a result, health, nature, and social impacts as well as the direct and indirect economic effects were identified as the top impact category priorities where cities wished to gain information in the form of tools.

AVAILABLE TOOLS FOR IMPACT ASSESSMENT

To answer the needs expressed by city experts, a literature review and researcher interviews were carried out to discover available impact assessment tools and assess their usefulness in practise. The focus was to produce an overall view of existing models and tools, and an analysis of their applicability to the versatile evaluation of impacts. The usability of more than 200 different models and application targets were examined. Some examples of impact assessment chains and potential tools are presented in Table 2. To familiarise the cities' planners of climate measures with the impact categories, as well as the models and tools that are already available, an online tool library was constructed (https://kiltova2app.netlify.app/, in Finnish).

In their present form, a large portion of the models require profound expertise, which often means extensive cooperation among cities and expert organisations. In many cases, this might be challenging in practise due to limited resources in cities.

TOOL DEVELOPMENT AND SUPPORT FOR CITY ZONING

To answer the call from cities' needs for tools and priorities in impact assesment, Finnish Environment Institute Syke developed a fine particle health damage and investment and labour impact tool, IhQ, for Finnish cities and municipalities that was integrated within an existing climate measure planning tool (Karvosenoja et al. 2022). A demo version of the tool is available in English (https://ihq-demo-harmo.netlify.app/) and the final version in Finnish was launched in 2023 (https://laskurit.hiilineutraalisuomi.fi/vaikutusarviointi/). A screenshot of the user interface of the IhQ tool demo version is presented in Figure 1.

An important target of application of tools is the support for city zoning practises. For this, as a most recent step in the process, a practical guidance document about the use of assessment tools for municipality zoning planners was created, using the experiences and collaboration networks gained in the earlier projects (Regional Council of Kymenlaakso 2023).

FUTURE NEED FOR TOOLS

Urban biodiversity and nature values have gathered inreased attention in recent years among cities' policy makers. Need for tools to assess biodiversity in integrated frameworks together with climate plans was raised also in our expert workshops and interviews. Such tools are scarce. According to the city experts, one challenge in taking biodiversity issues into consideration in climate planning frameworks is the lack of common metrics to quantitatively estimate the changes in the state of nature. Economic valuation of biodiversity is one potential option for the basis of such integrated tools.

Table 1. Number of actions in Cities' Climate Programs identified for different sectors. Cities: E= Espoo, H=Helsinki, Ta = Tampere, Tu = Turku, V = Vantaa, O = Oulu

Classification 1	Classification 2	Classification 3	E	H	Ta	Tu	V	O
Transport	Transport system	Walking & Cycling	6	8	4	2	3	4
Transport	Transport system	Public Transport	5	5	6	6	3	3
Transport	Transport system	Transport pricing	-	4	-	-	1	-
Transport	Transport system	Urban structure	4	3	3	-	5	5
Transport	Transport system	New mobility services	-	5	3	-	1	-
Transport	Transport system	Logistics	1	4	1	1	1	-
Transport	Vehicle technology	Electricity	3	6	3	4	3	4
Transport	Vehicle technology	Bio	2	2	2	2	1	5
Buildings	Energy efficiency	Old building stock	5	27	3	3	9	4
Buildings	Energy efficiency	New construction	4	20	16	2	7	2
Buildings	Energy production	Emission-free energy sources	4	4	4	4	5	6
Buildings	Heating method	Replacing oil	1	2	3	2	1	1
Buildings	Heating method	Heat pumps	1	4	2	1	-	-
Buildings	Heating method	Centralized heat production	-	2	1	2	1	1
Buildings	Building materials	Wood construction/Recyc.materials	1	4	1	-	3	-
Energy production	Energy Efficiency	Waste Heat Flows	1	1	-	1	2	-
Energy production	Energy Efficiency	Energy Storage	-	1	1	1	-	-
Energy production	Energy Efficiency	Smart Systems	-	2	1	-	-	-
Energy production	Power Plant/networks	Efficiency Ratio	-	2	4	1	-	-
Industry	Energy Efficiency	Buildings/Processes	-	1	1	-	-	3
Industry	Vehicle Technology	Work Machines	1	6	1	-	-	1
Industry	Energy Production	Emission-Free Energy Sources	1	-	-	-	-	-
Agriculture	Livestock	Manure	-	1	1	-	-	-
Agriculture	Vehicle Technology	Work Machines	1	2	1	-	-	1
Forestry	Forest management	Rotation Period	-	1	2	-	-	-
Forestry	Forest management	Management Practices	-	2	2	-	-	-
Forestry	Forest management	Afforestation of New Areas	-	2	2	-	-	-
Consumption/waste	Food	Vegetarian/Local Food	1	4	1	-	3	-
Consumption/waste	Food	Food Waste	1	3	1	-	1	-
Consumption/waste	Food	Dietary Habits	-	1	-	-	1	-
Consumption/waste	Other Consumption	Consumption Tourism	-	1	-	-	-	-
Consumption/waste	Other Consumption	Other Goods Consumption	5	6	3	3	2	1
Consumption/waste	Other Consumption	Other Services Consumption	5	5	2	-	3	1
Consumption/waste	Material Efficiency	Waste Prevention	-	2	1	-	-	1
Consumption/waste	Material Efficiency	Recycling	-	10	9	1	9	1
Consumption/waste	Waste Management	Wastewater Treatment	-	-	2	-	1	1
Consumption/waste	Waste Management	Landfill Emissions	1	-	-	-	-	6
Others	Education	Educational Institutions	-	3	-	-	2	3
Others	Education	Other Organizations	-	5	1	2	3	1
Others	Communication	Internal	-	10	-	-	2	1
Others	Communication	External	-	7	-	-	4	1
Others	Economy	Smart & Clean	-	9	1	-	4	2
Others	Economy	Finance	-	3	-	1	-	-
Others	Other	Adaptation	-	4	-	-	2	-

Table 2. Examples of identified impact chains. Suitable tools for assessing measures and actions of climate programs are given as numbers (some sources only in Finnish).

Aggregated Climate action sectors in CPs	**Transport system and vehicle technologies:**	**Building materials, energy efficiency and heating**	**Consumption, food, material efficiency and waste**
Green House Gases	-Decreasing fossil fuel usage and vehicle mileage [1, 6, 18, 22, 25] -Increase in electric vehicles reduces emissions [1, 6, 18, 22, 25] -Increasing modal share of public transportation and walking/ cycling [1, 6, 18, 22] -Accounting for lifecycle emissions of vehicles and infrastructure [3, 4, 10, 30, 39]	-Improving energy efficiency ratio of buildings and processes [3,7,21,33,35] -Reducing energy consumption by changing heating methods. [1, 3, 7, 21, 22, 32] -Addressing consumption peaks with energy storing and smart management.[32] -Reducing lifecycle emissions (reusing, recycling, and material choices). [4, 10, 19, 30]	-Lowering lifecycle emissions by directing consumer choices and city acquisitions to low-emission alternatives.[4, 10, 20, 30] -Promoting circular and sharing economy [4, 21, 10] -Reducing waste and emissions from waste. [4, 10, 30] -Improving recycling efficiency.[4, 10, 21, 30]
Economical	-Large investments in public transporation. [9, 18, 31] -Public and private transportation pricing.[6, 18] -Reduced healthcare costs due to modal share and technological changes.[13, 15, 22]	- Actions increasing energy efficiency are usually cost-effective emission reducing methods.[2, 9, 11, 32] -Decreasing household energy consumption and costs.[7, 9, 31, 32] - Changing heating methods in buildings has a significant employment effect.[10, 22]	-Low-emission options impact employment and regional economy. [9] -Increase in value from more sustainable supply chain.[4,10,30] -Choosing cost-effective actions. [9, 24]
Environmental	- Negative impacts of widespread adoption of biofuels on ecosystems. [10, 21, 27, 38] -Effects of new energy infrastructure to land use. [4, 10, 14, 21, 30, 38] -Urban consolidation effects on land use and biodiversity. [4, 10, 14, 21, 23, 27, 28, 30, 36, 37, 38, 39]	-Primary energy volume effects on fuel production, land use and biodiversity. [10, 23, 27,28, 38] -Increasing wood construction affects the amount of logging, carbon sinks and biodiversity.[10, 14, 19, 27, 28 ,39] -Replacing cement with e.g. wood decreases production emissions. [4, 10, 19, 30]	- Material flow effects on biodiversity, eutrophication, ecotoxicity and water bodies [10, 23, 36] - Reducing environmental impacts with lca, environmental criteria and certificates. [4, 19, 30,38]
Health	-Health benefits from increasing physical activity.[13] -Health benefits from reduced Transport noise and accidents [5, 8, 13, 18, 35] -Health benefits from reduced road dust and air pollution [10,13,20,27,29]	-Replacing and improving energy production with low-emission alternatives reduces air pollution. [5,8,15, 20] -Energy efficiency affects wood burning in stoves and boilers (black carbon) and impacts air quality. [5,8,15, 20] - Additional wood heating volume relates to heating methods[12, 15, 22]	-Public health effects of sustainable dietary habits. -Reducing the concentrations of harmful substances in food by developing agricultural production.[10]
Social	-Public transportation affects equal opportunities and inclusion of different areas. [6] -Just transition to low-emission vehicles. [33] -Information-based guidance. [16, 26]	- Ability for public participation on energy system emissions and climate goals [16] -Energy costs affect low-income households. [33] - Inequal opportunities to change heating methods. [33]	-Reducing citizen consumption.[16,17] -Increasing equal opportunities with circular and sharing economy. [33]

1 AlasSken (Syke), 2 ASKO (VTT), 3 Building footprint tool (Ministry of Environment), 4, CCaLC2 (University of Manchester) 5 CNOSSOS-EU (JRC), 6 Commercial transport modelling softwares, 7 EKOREM (Syke), 8 ENFUSER, (FMI), 9 ENVIREGIO (Syke), 10 ENVIMAT (Syke), 11 E-PASS (VTT), 12 FRES (Syke), 13 HEAT (WHO), 14 Carbon Calculator (Pirkanmaa ELY centre), 15 IHQ (Syke), 16 Climate diet (Syke), 17 The Baltic Sea Calculator (Syke), 18 IVAR3 (FTIA), 19 Nordic Swan Ecolabel, 20 Juhilas (Syke), 21 KEKO (Syke), 22 KILTOVA (Syke), 23 KUSTAA (Syke), 24 KUTOVA (Syke), 25 LIPASTO (VTT), 26 Materialfootprint calculator (LAB), 27 MELA (Luke), 28 MOTTI (Luke), 29 NORTRIP (NILU), 30 OpenLCA (GreenDelta), 31 POLIREM (Syke), 32 REMA (VTT), 33 SISU (Statfin), 34 Solar power profitability (Syke), 35 TARVA (FTIA), 36 VEMALA (Syke), 37 Blue-green factor (City of Turku), 38 Zonation (University of Helsinki), 39 YASSO (FMI)

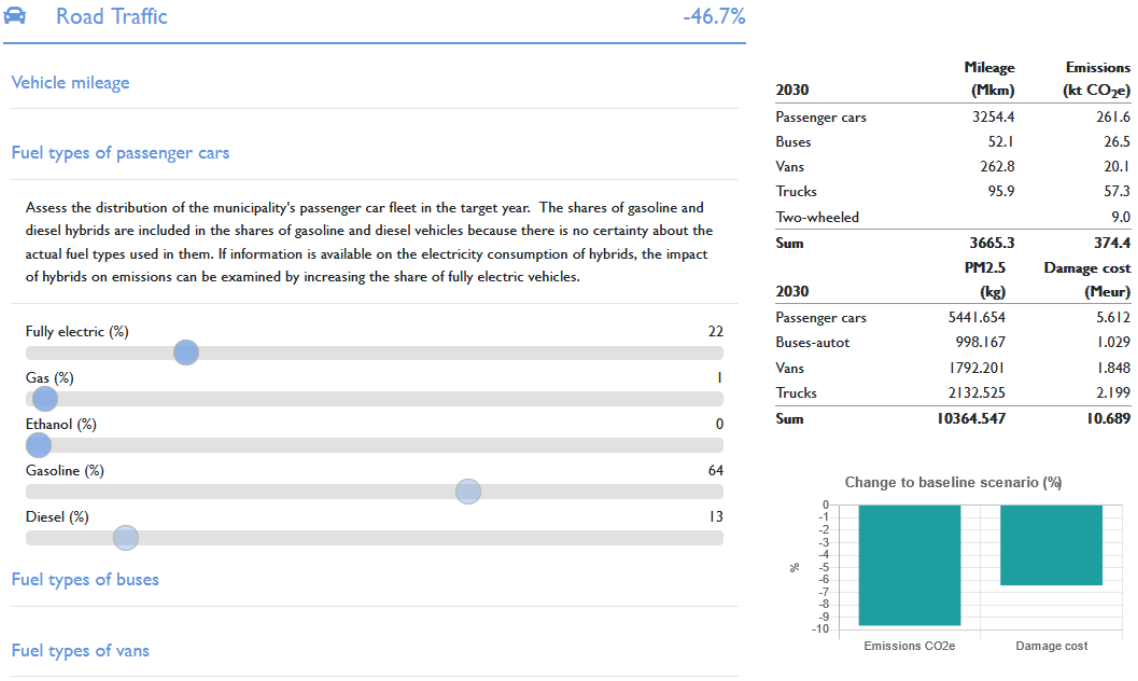

Figure 1. Screenshot of the user interface of the IhQ tool demo version (https://ihq-demo-harmo.netlify.app/).

CONCLUSIONS

The study intended to bring academic modelling-based work into practical policy making in cities and find new directions for future model and tool development. The initiative for the survey came from the cities' experts and their need for an overview of the tools that are available. Working together with city experts helped to build an efficient channel to policy making processes and enhanced the capabilities of city experts to build more versatile climate plans with air quality and other impact category considerations. In addition, the working process brought city experts from climate and air quality fields closer together.

ACKNOWLEDGEMENTS

This work was supported by the Ministry of environment in the projects KILTOVA 1 and 2, and by the Strategic Research Council (SRC) within the Research Council of Finland in the scope of the CLIMATE-NUDGE project ('Nudging for climate: Using behavioral sciences for steering communities to reduce greenhouse gas emissions and fortify carbon sinks'), grant number 358456.

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