Project results and user guide

Approach and methodology for modelling changes to CO₂ emissions resulting from the deployment of Intelligent Transport Systems

www.amitran.eu
What is Amitran?

The Amitran project - “CO₂ Assessment Methodology for ICT in Transport” - has defined a methodology to estimate the CO₂ emission effects of different Information and Communication Technology applications for transport (otherwise known as ITS - Intelligent Transport Systems). This methodology is based on an approach to modelling the effects of different types of ITS application at different scales. The project’s scope was on surface transport (road, rail, inland waterways and short-sea shipping) in Europe.

This brochure highlights the key outputs available from Amitran, summarises the Amitran methodology in a step-by-step guide (the Amitran Checklist) and also provides a directory to the information found in the Amitran Knowledge Base.

Why Amitran?

Public authorities and agencies, as well as infrastructure operators, which invest in new ITS measures, need to know the likely results of each kind of measure, in order to direct investment where it has the most benefit. One result is greener transport in terms of lower CO₂ emissions.

Example: An urban road authority might be considering deploying Adaptive Signal Control for road junctions in its city. One question would be: “What will be the effect on CO₂ emissions?”

Amitran can help by providing guidance for the assessment and modelling process, including the linking of different proprietary models and cost-benefit / cost-effectiveness evaluation guidance.

Industry and transport operators may also use Amitran to assist evaluations and benchmarking of potential new investments and products.

How can Amitran help?

The project’s outputs are aimed at two main groups of users: technical and non-technical:

<table>
<thead>
<tr>
<th>User profile</th>
<th>Technical users</th>
<th>Non-technical users</th>
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<tbody>
<tr>
<td>Technical users</td>
<td>People with knowledge of (and access to) modelling software, who conduct impact assessments of transport strategies, proposals or schemes. Includes researchers, consultants, public authorities, transport infrastructure owners, transport service operators, etc.</td>
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</tr>
<tr>
<td>Why use Amitran?</td>
<td>The Amitran methodology ensures that researchers, consultants and modellers follow a robust approach, considering all relevant steps and processes.</td>
<td>Although such people will not directly apply the Amitran methodology, they need to have a basic general understanding of the process in order to set terms of reference for assessment studies, monitor them and better understand their results and implications. Specifying the use of the Amitran methodology for CO₂ evaluation projects for ITS enables greater transparency in comparing results.</td>
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<tr>
<td>What does Amitran provide?</td>
<td>All the outputs shown on the next page.</td>
<td>Amitran Checklist (summarised in this brochure; also a more complete version downloadable from <a href="http://www.amitran.eu">www.amitran.eu</a>)</td>
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What does Amitran provide?

- **Checklist**
  - Step-by-step guide through the framework for users (online and downloadable)

- **Amitran evaluation framework**
  - Technical description of the architecture

- **ITS effects**
  - Information on more than 50 ITS applications
  - Traffic related parameters affected by ITS

- **Guidance on models**
  - Describing a selection of available simulation models

- **Model interfaces**
  - Software providing generic connections between models

- **Scaling up statistics**
  - Link to EU and national data for scaling up results

- **CBA/CEA guidance**
  - Advice on conducting Cost-benefit and Cost-effectiveness analyses

- **Knowledge Base site**
  - Wiki site containing all the information for technical users

- **Project website**
  - Containing all the public deliverables

The Knowledge Base site containing all the information is available at:

www.amitran.eu/knowledge-base

Information is also available in the public project deliverables, available by work-package (WP) at:

www.amitran.eu/results-2

Amitran is not a tool that can replace modelling or analysis, but a methodology to aid the analysis process determining the CO₂ impacts of ITS application, providing guidance, examples and recommended practice.

It also provides model interfaces and links to datasets relevant for scaling up and model calibration/validation.

The user will need:

- A research question: What ITS application do you want to measure? On what scale?
- The appropriate demand, traffic and emission modelling software at micro or macro level.
- Relevant data, as described in Checklist Step 5
How does Amitran work?

The diagram below shows the main elements in the process of assessing the effects on carbon dioxide emissions of deploying an Intelligent Transport System.

An ITS application can have an influence on transport processes such as traffic demand (mode or route choice), driver behaviour or vehicle conditions (including fleet management). This influence will be reflected in the transport system both regarding passengers and freight on the networks and transport modes affected.

Changes to the transport system in turn have an effect on parameters that directly influence CO₂ emissions, such as speed, acceleration, kilometres travelled, etc. From these parameters, CO₂ emissions on a local level can be calculated and scaled up to a larger geographic region.

Besides output on CO₂ emissions, fuel consumption can also be acquired as an output of energy efficiency, since there is a one-to-one relationship between fuel consumption and CO₂ emissions (and potentially other emissions, although these are not covered by Amitran).

The Amitran Checklist: ten steps to conducting a CO₂ assessment for an ITS application

This Checklist can be used by people studying the effects of ITS from the basis of a specific research question.

It can also be used by people that commission assessment studies, to help define terms of reference and to verify that the party carrying out the assessment has taken the right steps and considered all the relevant factors.

The following steps are described more fully, with links for further information, in the Checklist section of the Amitran Knowledge Base.
Step 1: Define the ITS application for which you wish to study the CO₂ effects

It is assumed the user has a specific ITS application in mind. Amitran covers more than 50 individual ITS applications, based on the classification used in the related ECOSTAND project (www.ecostand-project.eu). They are fully described in the ITS applications section of the Amitran Knowledge Base, with a use case example for one application from each of the six main categories below.

The top level categories and sub-groups of applications are:

<table>
<thead>
<tr>
<th>Category</th>
<th>Navigation Information</th>
<th>Traffic Management and Control</th>
<th>Demand and Access Management</th>
<th>Driver Behaviour and Eco-driving</th>
<th>Logistics and Fleet Management</th>
<th>Safety and Emergency Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups of applications</td>
<td></td>
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<tr>
<td>Navigation systems</td>
<td>Navigation systems</td>
<td>Signal control</td>
<td>Electronic Fee Collection</td>
<td>Driver assistance and cruise control (road traffic)</td>
<td>Public transport systems</td>
<td>Augmented awareness</td>
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<tr>
<td>Traveller information systems</td>
<td>Highway systems</td>
<td>ITS supported measures</td>
<td>Railway systems</td>
<td>Freight transport systems</td>
<td>eCall</td>
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<tr>
<td>Planning support systems</td>
<td>Railway systems</td>
<td></td>
<td>Driving behaviour (road traffic)</td>
<td>Inland waterway systems</td>
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<td>Inland waterway information systems</td>
<td>Enforcement systems</td>
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<td>Inland waterway systems</td>
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<tr>
<td>Inland Waterway systems</td>
<td>Parking guidance</td>
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</table>

The application needs to be described in as much detail as possible in order to be able to carry out a good assessment, including:

- what does the application do?
- how does the application work?
- what is the goal of the application?
- under which conditions does the application work?

Amitran can help by providing information on potential effects and references to relevant literature on specific systems.

Step 2: Define your research question

The research question will be related to the effect of a certain system on CO₂ emissions for a specific investigation area for a certain penetration or acceptance rate.

**Example:** what are the effects of Adaptive Cruise Control on CO₂ emissions at the EU level when 50% of vehicles are equipped with the system?

More specific information can possibly be added to the research question, such as a future year, a specific situation (for example motorways), or different penetration rates per country. The research question needs to be defined very accurately to enable an appropriate modelling approach.
Step 3: Identify the factors and parameters influenced by your ITS application

ITS applications impact CO₂ emissions indirectly in different ways, as outlined above (see How does Amitran work?). In order to choose the most appropriate modelling approach it is important to identify the parameters influenced by the relevant ITS application.

Amitran provides a complete list of parameters and factors relevant for describing traffic and, hence, CO₂ emissions.

Step 4: Identify the model types required for the assessment

With help of the factors and parameters that are influenced by your ITS application, types of models (demand, traffic simulation, emission; macro/micro) needed and the interfaces between them can be determined. This can be done with help of the Amitran framework.

Step 5: Define data needs for the assessment

Importantly, any assessment requires that various data sets are available. The required data sets depend mainly on your specific ITS application, your research question and the models that you will use. Data types, for which you will need data, are:

- Situational or context data: data on transport supply (i.e. road network data, possibly including data on the traffic management and control) and structural data (i.e. population, economy, etc.)
- Data needed for the estimation and calibration of models
- Data on the reaction of users to an ITS application
- Data on the frequency and probability of incidents (only for certain scenarios)

Possible data sources are literature, driver simulator studies, experiments and direct measurements, data from earlier projects like Field Operational Test (FOT) data, publicly available sources, stated preference surveys, etc. When no data sources are available, input might be based on expert judgment.
Steps 6 to 8: Selection and use of models

These steps cover selecting and using:

- **A demand model** (Step 6) · if necessary

  This is used to create the demand in terms of trips from origins to destinations; it provides trip numbers between zones or cells of a network per time slice and mode. The application of a demand model requires the network to be defined and as input, socio-economic data are needed.

- **A traffic simulation model** (Step 7)

  This links the demand to the traffic network; it uses the data provided by the demand model to create the traffic flow. It calculates link based traffic data (macroscopic model) or trajectory information for individual vehicles (microscopic model). The Amitran framework provides indications which type (macroscopic or microscopic) is required.

- **An emission model** (Step 8)

  This uses the data provided by the traffic model to calculate emissions. Additional input may be the division of the whole vehicle fleet into emission classes if this is not yet covered by the traffic models’ output.

Amitran does not provide models, nor does it recommend specific software. It provides advice on the types of models to use and provides information on some models as a starting point. Amitran interfaces facilitate the exchange of data between models. Interfaces are described in a generic fashion and are provided in the Knowledge Base for several common software combinations. The interfaces are available from [www.amitran.eu/results-2](http://www.amitran.eu/results-2) (see under WP5) and also from the Knowledge Base at [www.amitran.eu/knowledge-base](http://www.amitran.eu/knowledge-base) (see Guidance and links to the model interfaces).

Step 9: Scale up results (optional)

Projects, simulations, experiments and other type of tests often deliver results at a local scale (e.g. for a link, small network or city). However, policy and business decisions are usually taken based on expected effects at a more global level. Therefore results might need to be scaled up to a higher level.

Scaling up refers to the extrapolation of effects from a smaller scale to a larger (geographical) scale. The level to which the scaling up is carried out depends on the user of the methodology and the research question he or she wants to address. This can for example be country level or EU level. Scaling up is not something that can be done by simply following some steps: it is a very project-specific procedure and requires in-depth knowledge on the project results and on the level to which you want to scale up.

In Amitran, two methods for scaling up are distinguished and explained in the Knowledge Base: using statistics and using a macroscopic traffic model. To assist in scaling up, Amitran provides links to statistics currently covering 15 of the EU Member States.

This is available at [www.amitran.eu/knowledge-base](http://www.amitran.eu/knowledge-base), by following the link to EU and national statistical data (Statistical Knowledge Base).

Step 10: Carry out a cost-benefit analysis (optional)

To evaluate the effects, a Cost-benefit analysis (CBA) and a Cost-effectiveness analysis (CEA) can be carried out.

- **A CBA forms a comprehensive and unified approach to estimate the costs and benefits of different ITS applications.**

- **A CEA provides a simple methodology to rank ITS applications on their main effect: the reduction in CO\textsubscript{2} emissions.**

Amitran provides specific guidelines for CBA and CEA for ITS assessment of CO\textsubscript{2} effects, linked to Amitran methodology. It presents a systematic approach in different steps, providing examples and references to relevant literature.
Be part of it!

• If you are commissioning or organising studies into the effects of ITS on emissions, whether at a local, national or European scale, recommend that your consultant or researcher follows the Amitran approach.

• If you are a technical expert or modeller carrying out studies, go to the Amitran Knowledge Base for guidance, examples (use cases), model interfaces and links to statistical data.

• Any feedback, comments, or do you wish to contribute additional information or data to the Knowledge Base? Use the contact details below, or see our website to contact a specific project partner.

To learn more about the project, visit www.amitran.eu

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