Modeling & Tools Update

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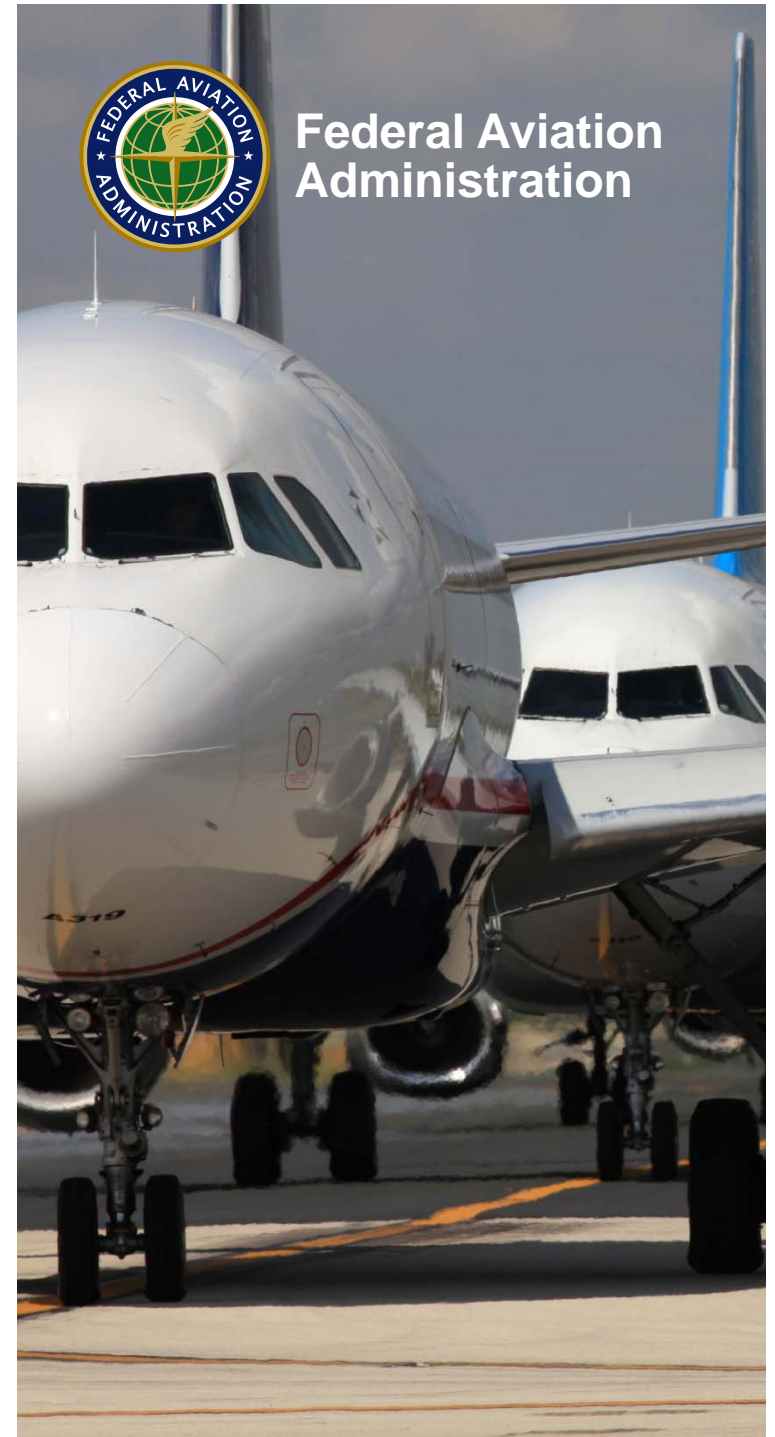
Presented to: E&E REDAC Subcommittee

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             Office of Environment and Energy
             Federal Aviation Administration

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Outline

- Overview of tools and analysis
- Interdependencies
- Updates on efforts to develop tool suite
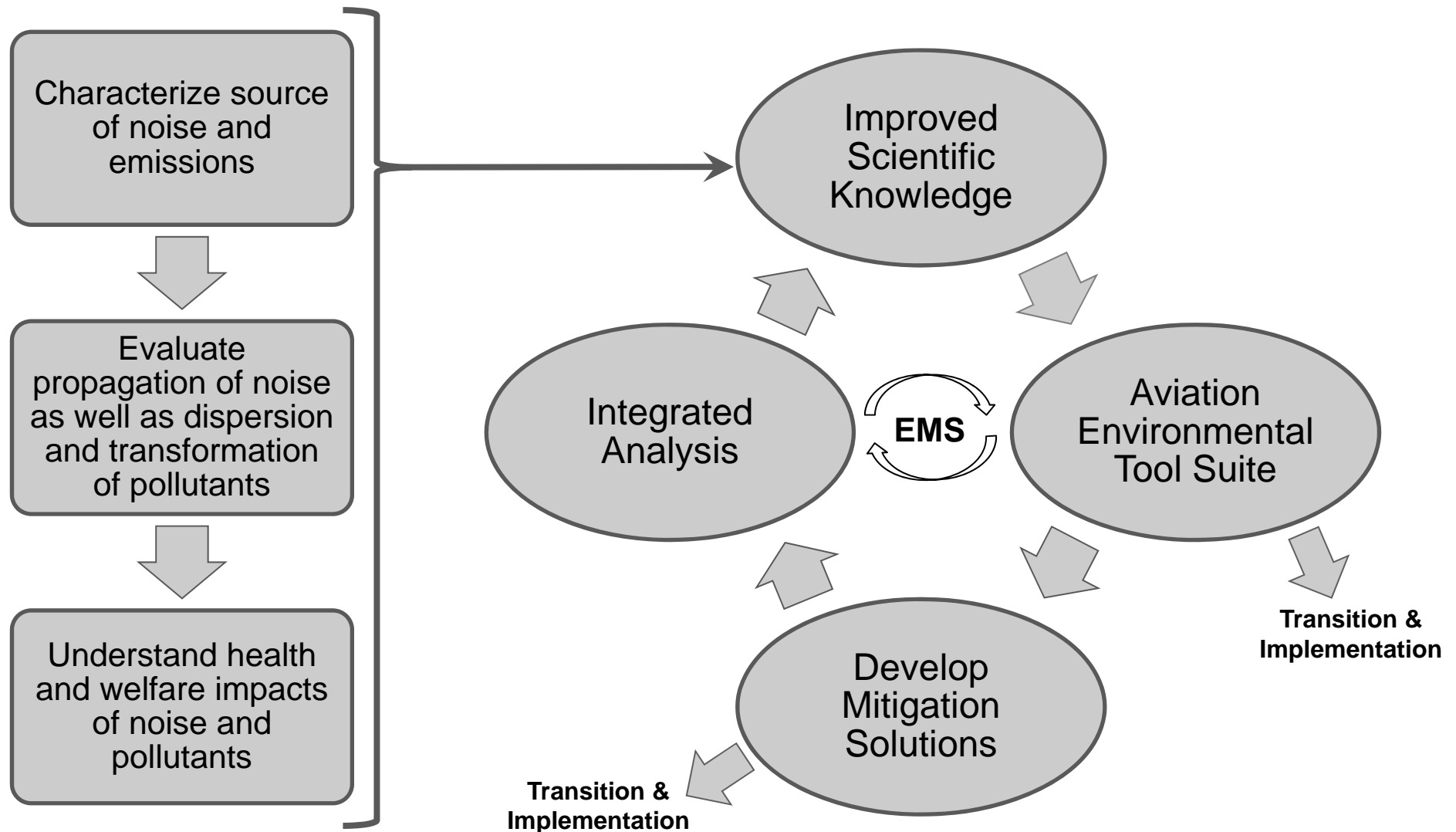- Future direction

Tools and Analysis

We develop tools for specific purposes:

- CAEP analyses
  - Noise
  - Emissions (NO_X, CO_2, and Black Carbon)
  - Global Market Based Measure

- NextGen analyses
  - Performance reporting (annual basis)
  - Future goals analysis (out to 2050)
  - Assessing benefits of NextGen

- Air space and airport design & planning

***Note this is <u>not</u> an all-inclusive list***

Knowledge, Tools, Mitigation, Analysis & Implementation

Characterize source of noise and emissions

Evaluate propagation of noise as well as dispersion and transformation of pollutants

Understand health and welfare impacts of noise and pollutants

Improved Scientific Knowledge

Integrated Analysis

EMS

Aviation Environmental Tool Suite

Develop Mitigation Solutions

Transition & Implementation

Transition & Implementation

Solution Development and Interdependencies

Modeling wide range of solutions and their consequences on fuel use, noise and emissions (e.g., basket of measures for CO_2 and a balanced approach for noise)
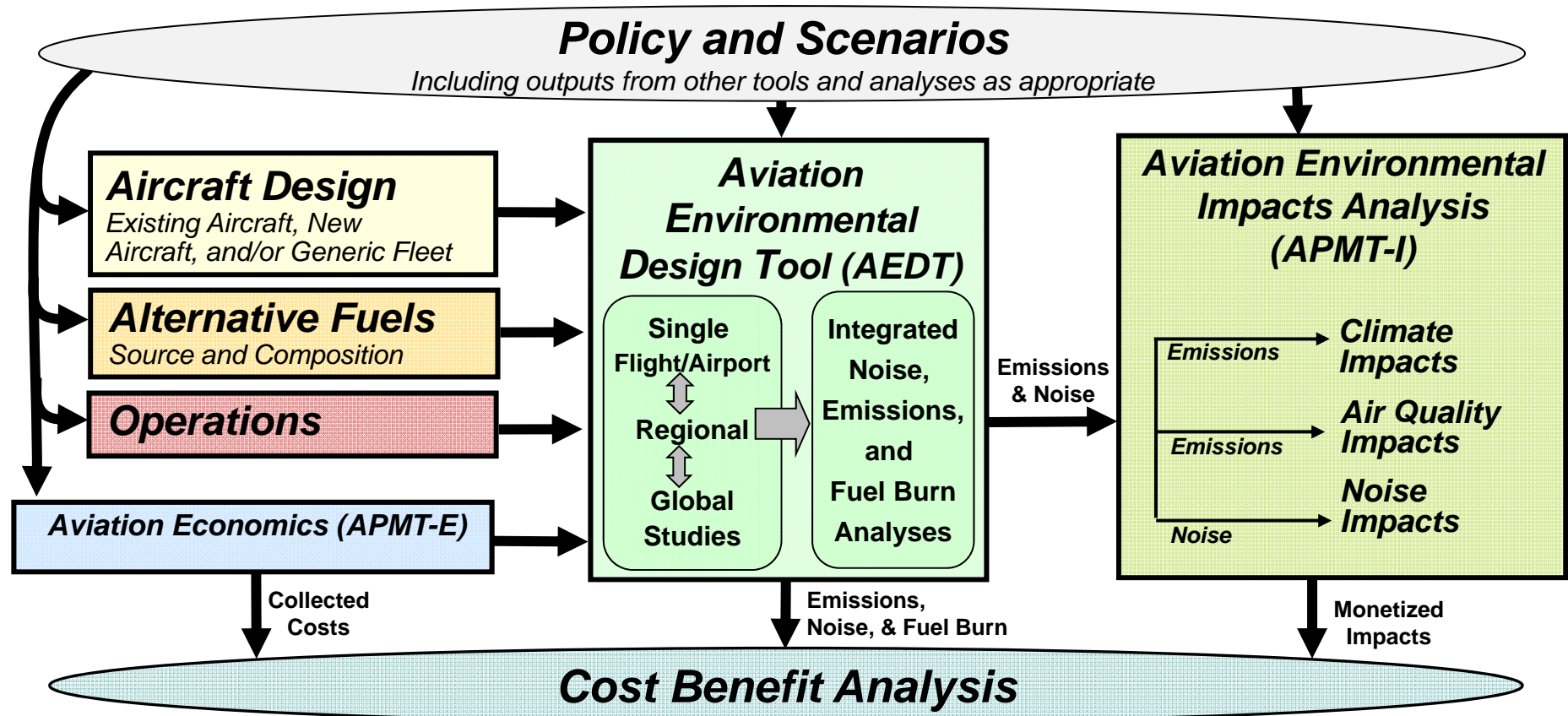
Roadmap Development & In-House Analysis

Tools and Analysis Roadmap

- **<u>Purpose</u>: creating tools and analysis roadmap**
- **<u>Motivation</u>: tools suite available to AEE is expanding**
  - There are AEE programs that focus on development of:
    - Tools for specific analysis
    - Interfaces and linkages between tools within the AEE Tool Suite
    - Methodologies / correlations to be incorporated within the AEE Tool Suite
  - Need to create an overall roadmap on tools based on AEE needs

AEE Modeling Lab

- **<u>Purpose</u>: bringing additional tools into AEE modeling lab**
- **<u>Motivation</u>: increased demand for in-house analysis to inform policy decision and budget investment**
  - AEE has required hardware capability in its modeling lab
  - Tools development will still reside with contractors
  - Near future focused on aircraft conceptual design tools and rapid fleet wide analysis tools

Efforts related to AEE analytical capabilities

- **AEDT**
  - AEDT Development and Next Steps
  - Methods to accurately capture operational procedures
- **APMT-Economics**
- **Aircraft performance analysis**
- **Additional ASCENT projects**
- **APMT-Impacts**
  - Covered by noise and emissions briefings
- **Alternative fuels analysis**
  - Covered in alt fuels briefing

AEDT

- Environmental Planning, Regulatory and Compliance Requirements

- Tracking, Reporting and Future Projection of System-Wide Environmental Performance

- Evaluation of Aviation Environmental Mitigation Options (aircraft and fuel technologies, and operational procedures)

- Analyses of International and Domestic Policy Options
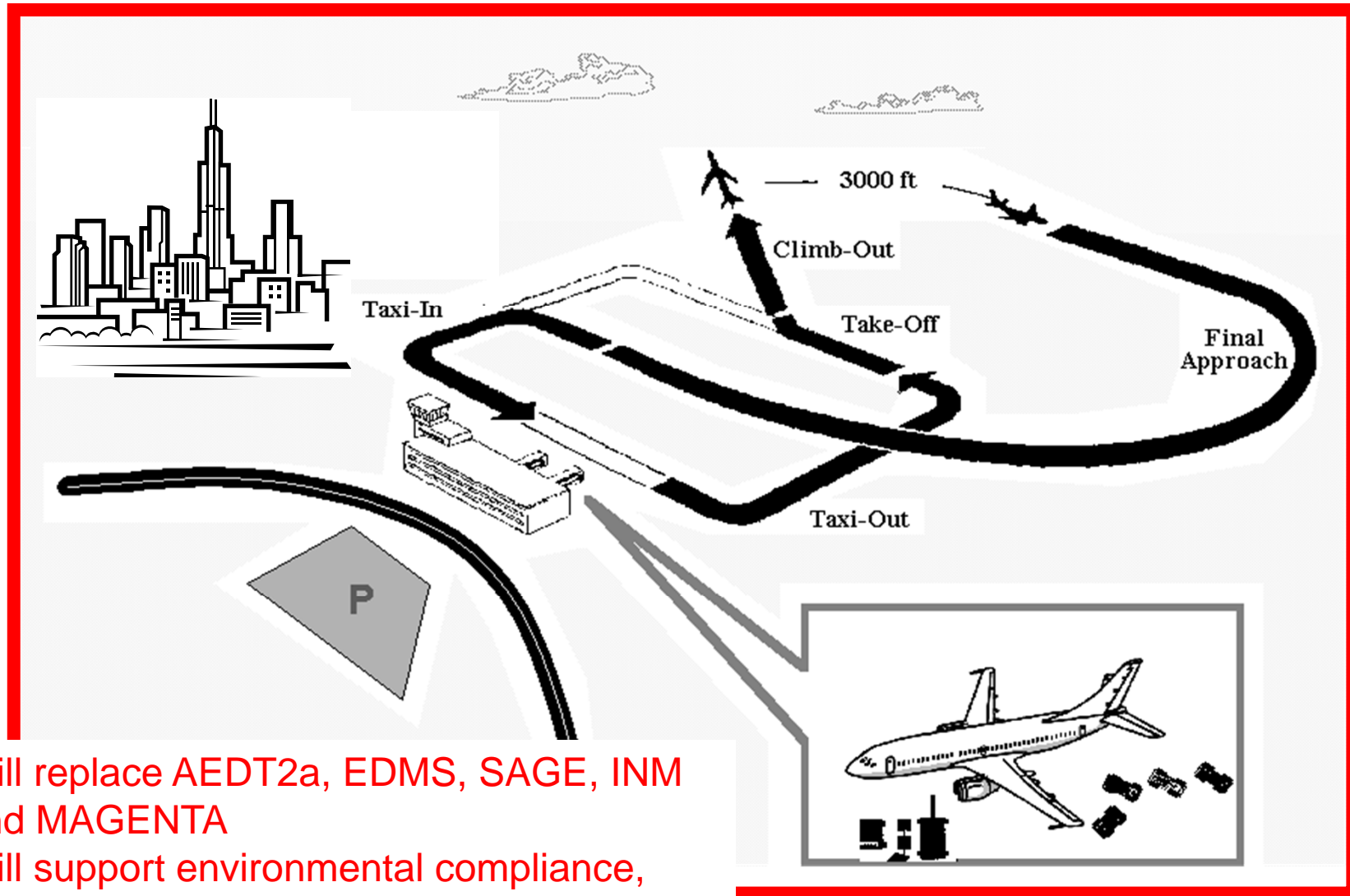
AEDT 2a Scope: Runway to Runway
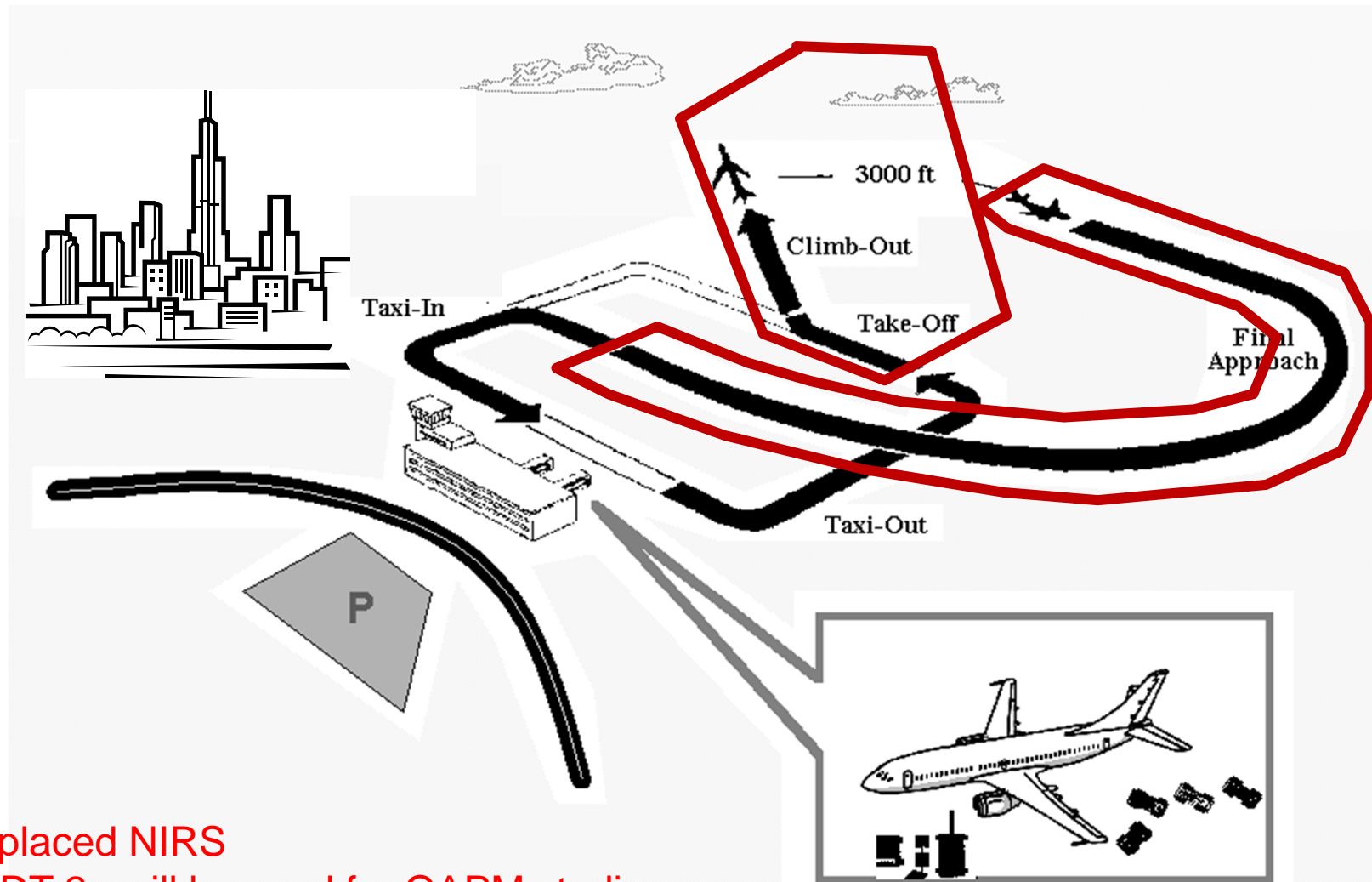
- Replaced NIRS
- AEDT 2a will be used for OAPM studies

AEDT 2b Scope: Gate to Gate

- Will replace AEDT2a, EDMS, SAGE, INM and MAGENTA
- Will support environmental compliance, research, assessment and decision-making

AEDT Development Update

- Released AEDT 2a in March 2012

- Released Service Pack 2 in Feb. 2014

- Last beta version of AEDT2b will be completed in late August 2014

- Next step will be to complete user interface and documentation

- AEDT2b being given to Design Review Group (DRG) for evaluation

- Release date depends on feedback from DRG evaluation and other QA/QC checks

AEDT: Next Steps

- AEDT2b Integration

  - TARGETS: Procedure design tool

  - TAAM: Airport and airspace traffic simulation

  - SWAC: NAS-wide air traffic simulation tool

- Improvements to fuel burn and emissions modeling, particularly in the descent and approach phases

- Ground operation modeling improvements including noise modeling

- Ability to assemble a flight from different kinds of data (e.g. sensor path, track nodes, great circle)

- Integrate research results on noise propagation

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APMT-Economics

- Starting work to improve model
- Current capability:
  - Model long-term aviation market response to introduction of environmental policy measures that directly affect aviation industry
  - Creates a fleet of aircraft and operations based on demand forecast and scenario inputs (economic and policy)
  - Outputs: aircraft operating costs, aviation demand, and fleet
- Potential areas for improvement
  - Improved usability
  - Ability to support Terminal Area Forecast (TAF) development
  - Increased functionality to model potential industry response
- BAH is leading effort to examine potential tool improvements (former PARTNER students at BAH are leading this effort)

Aircraft Performance Analysis (1 of 2)

- PARTNER CoE Projects on aircraft technology evaluation have concluded and we are currently evaluating results.
  - Environmental Design Space (EDS) - P14: Georgia Tech
  - CLEEN EDS - P36: Georgia Tech
  - Mission Specification Changes - P43: Stanford, Georgia Tech and BAH
  - System Level Uncertainty Quantification - P48: MIT

- New ASCENT Projects
  - Aircraft technology assessment (see next slide)
  - Helicopter performance (also discussed in noise briefing)

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Aircraft Performance Analysis (2 of 2)

- ASCENT project (NOI-10) for aircraft technology assessment
  - Provide modeling and assessment mechanism for CLEEN / CLEEN II
  - Evaluate broader future scenarios out to 2050
  - Supports NextGen Goals Analysis and CAEP trends assessment
- Project team:
  - Georgia Tech, Purdue and Stanford.
  - Other ASCENT researchers will be invited to participate (e.g., MIT) as well as gov't and industry.
- Primary Tasks:
  - Define scenarios and assumptions to examine with gov't, industry, academia stakeholders in a workshop fashion
  - Model aircraft technologies and configurations, heavily leverage existing work
  - Assess vehicle and fleet level performance

ASCENT Projects to Improve Modeling

Rapid Fleet-wide Environmental Assessment Capability

- Complement AEDT with lower fidelity screening tool capability to examine large number of policy scenarios that could be quickly analyzed and reduced to a manageable set of scenarios for more focused, high fidelity analysis in the environmental tools suite.

Aircraft Design and Performance Tool Connectivity with AEDT

- Extend compatibility of novel and existing aircraft design and performance assessment tools with AEDT to enable assessment of future scenarios using broad range of aircraft models

Analytical Approach for Quantifying Noise from Advanced Operational Procedures

- Developing analytical approach to address current noise modeling gaps such that it will be possible to capture changes in community noise due to the use of advanced operational procedures

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Current & Future Direction

Current and Future Direction:

- Develop tools to conduct analyses as needed for CAEP, NextGen, and planning

- Incorporate latest research results and knowledge about available environmental mitigation options

Potential Long-Term Efforts:

- Incorporate PDARS (Performance Data Analysis & Reporting System) data stream into AEDT to streamline computation of annual noise and emissions inventories

- Enable rapid calculation of noise and emissions consequences of aircraft operations to help inform those operating the National Air Space