

ODM Technical Roadmap Report Out:

ODM Missions and Technologies



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Outline



➤ ODM Mission Path Forward

- Mission Workgroups/University-Centric
 - Urban VTOL Air-Taxi, Thin-Haul Commuter, Scale-up/Scale-down Strategy
- Focused Regulatory Mission Enablement Opportunities

➤ ODM Technologies Path Forward

- TAC ODM Roadmaps: Investment Portfolio
- NIA Strategy White Paper: Partnerships
- Early Investment Seedlings: ODM Highest Priority and SBIR Topics
- Integrated Flight Demonstration Opportunities: RFI
- Professional Society Outreach: Electric Flight Conference
- Leverage External Technology Research: Connect ODM Industry

ODM Mission Path Forward



Reference VTOL Mission: Urban VTOL Air-Taxi's

Scale-down Mission: Small UAS Public Service

Scale-up Mission: Thin-haul VTOL commuter

- Partnerships: Strong industry breadth and push
- Technologies: Strong leveraging of technologies
- Regulations: Strong regulation change required
- NASA – Scaling Adoption Alignment: Moderate



Reference CTOL Mission: Thin-Haul CTOL Commuters

Scale-down Mission: Advanced General Aviation CTOL Aircraft

Scale-up Mission: Regional Commercial Airliner

- Partnerships: Moderate industry breadth and push
- Technologies: Moderate leveraging of technologies
- Regulations: Weak regulation change required
- NASA – Scaling Adoption Alignment: Strong



ODM Mission Path Forward



ODM Mission Strategy: Transition ODM work groups to mission/market pre-competitive enablement efforts

- Establish university partners to lead specific thrusts
- Focus on feasibility studies that support industry needs
- Bi-monthly invited progress reports
- Urban VTOL Air-Taxi Workgroup
 - MIT: Urban environment operational feasibility
 - Duke: Operations Center for remote “pilot in command”, fleet operations
 - Northwestern: Aircraft automation for remote command
 - NASA: Mission economic feasibility
- Thin-Haul Commuter Workgroup
 - Georgia Tech: Electric operation network and economic feasibility
 - Purdue: Electric vehicle integration feasibility
 - NASA: Emissions reduction feasibility

ODM Mission Path Forward



Focused Regulatory Mission Enablement Opportunities

- High priority regulatory barriers that require collaborative support across industry-govt-academia
- Follow example of Electric Propulsion F39.05 ASTM standard
- Urban VTOL Air-Taxi Mission Specific
 - IFR Reserves for Short Range Electric Aircraft (30 min + Alternate)
 - Electric Multi-engine Single Engine Equivalency
 - Helipad/Vertiport Requirements (Collaboration with HAI)
 - Critical, Highly Augmented Flight/Propulsion and Trajectory Control
 - Automated Perception and Planning for Trajectory, Mission & Airspace Management
 - Fixed Wing Powered-Lift ASTM Sub-committee (Is this possible...)
- Thin-Haul Commuter Specific
 - IFR Reserves for Short Range Electric Aircraft (45 min + Alternate)

ODM Technology Path Forward



ODM Technology Investment Strategy: Present ODM technology roadmaps to NASA Transformational Aeronautic Concepts (TAC) program management for decision making

- **Roadmap products show portfolio across near, mid, long term focus**
- **Technology roadmaps across primary opportunity areas with prioritization based on goal enablement**
- **Simplified Vehicle Operations**
- **Electric Propulsion**
- **Acoustics**
- **Safety Systems**
- **Airspace**
- **Advanced Manufacturing**

ODM Technology Path Forward



ODM Technology Partnerships: NIA commissioned white paper being developed by Bruce Holmes

- **Understand how prior public-private partnership have succeeded and failed, showing a range of partnering approaches**
- **ODM Vision opportunity clarification**
- **Independent assessment of ODM technology needs**
- **Identification of public good from ODM investment**
- **Identify potential ODM participants, contributors, stakeholders**
- **Perform stakeholder interviews**
- **Identity international efforts, collaborative and competitive**
- **Provide final report to NASA Aeronautics**
- **Early review opportunity to provide feedback before final report**

ODM Technology Path Forward



ODM Early Investment Seedlings: Select highest priority technologies across investment areas for early start, and leverage SBIR subtopics.

- **NASA TAC ODM investment is at earliest an FY18 start, but some FY17 seedling starts may be possible. Are there clear high priority investments across the ODM technology areas?**
- **SBIR Subtopics are creating improved alignment opportunities for small companies to engage in ODM technologies**
 - STTR T15.01 Distributed Electric Propulsion Aircraft Research: Electric and hybrid-electric integration, technologies and concepts.
 - SBIR A3.01 Advanced Air Traffic Management Systems Concepts: Includes UAS and ODM integration
 - SBIR A3.06 Hybrid Electric Vertical Takeoff and Landing: VTOL specific electric and hybrid-electric technologies and concepts.

ODM Technology Path Forward



ODM Integrated Flight Demonstration Activities: Develop opportunities for industry collaboration in hybrid-electric and autonomy flight demonstrators.

- **NASA Electrified Aircraft Propulsion Flight Demonstrator RFI: Released Sept 16, 2016**
- **“Information is sought for Flight Test Demonstrator Vehicle concepts to substantially buy down the risk of a future Objective Vehicle with one of the following five goals.”**
 - A) Reduced carbon emissions through transformative aircraft and airspace operations. The objective vehicle should be 4-9 passenger CTOL aircraft.
 - B) Reduced carbon emissions through transformative aircraft and airspace operations. The objective vehicle should be 1 or more passenger VTOL aircraft.
 - “The Flight Test Demonstrator Vehicle may support a direct commercial spin-off product, while also providing more broadly applicable lessons.”

ODM Technology Path Forward



ODM Professional Society Outreach: Continue to work with professional societies to achieve maximum outreach and engagement across industry and academia.

- **NASA ODM workshops are completed, with a transition towards greater support of professional society conferences that continue to offer opportunities for ODM networking.**
- **AIAA Aviation 2017 Electric Flight Workshop: Jun 5-9, Denver, CO**
 - Currently planning a 3 day event including presentation sessions, panels and expo
 - Michael Patterson (NASA Langley) Transformational Flight PC Chair planning lead
 - Opportunity to join planning committee to determine session content and focus.
- **AHS 2018 Forum Electric Flight Workshop**

ODM Technology Path Forward



ODM Leverage External Technology Research: Connect ODM community to external research that has high relevance.

- **Advanced Battery and Chargers: Battery 500 Consortium**
- **Autonomous Cars: Leverage emerging DOT guidelines**
- **Guidance from ODM Community to help prioritize engagement strategies.**

Federal Government Aims to Develop a 500 Wh/kg Battery, 350 kW Charging System

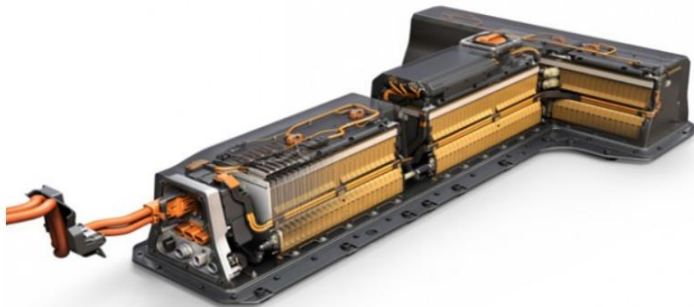
by [Larry E. Hall](#) | July 29, 2016

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Li-ion Battery Fast Charge - Cycle Life Test Results

