

Summary Report
for
National Aeronautics Space Administration (NASA)
&
Centro Para Prevenção da Poluição (C3P)
2009 International Workshop on Environment and
Alternative Energy

November 2009



Executive Overview

The NASA & C3P International Workshop on Environment and Alternative Energy was held on November 10 to 12, 2009 at the research facility of the GE Global Research Center in Garching (near Munich), Germany. The three-day workshop provided an excellent forum to showcase innovative and emerging environmental and energy technologies, share lessons learned, and identify new joint opportunities. Individuals from five countries (United States, Portugal, Germany, France, and United Kingdom) attended, including students and professors from University of California, San Diego (UCSD), the Technical University of Munich (TUM), and the Munich University of Applied Technology (FHM). The workshop was completed with a November 13, 2009 tour of GE's gas engine manufacturing plant in Jenbach, Austria.

Forty U.S. and international subject matter experts presented on environmental-related topics, ranging from renewable and alternative energies to climate change response to electronics recycling, among others.

The workshop began with a general session led by distinguished speakers from C3P and NASA. Welcome remarks were made by the Director of GE Global Research – Europe, Dr. Carlos Haertel, and from the United States Consul General to Munich, Mr. Conrad Tribble.

General (ret.) Pelagio Castelo Branco, C3P Director, welcomed all participants and guest-speakers and thanked Dr. Haertel for the use of GE's facility for the workshop. Gen. Branco provided a brief overview of C3P and recalled some landmarks related to the intercontinental relationship. Also highlighted was the need for C3P in Portugal and what partnerships C3P has begun to form with manufacturers, industry associations, universities, and testing and engineering centers of excellence throughout the European Union (EU).

Ms. Olga Dominguez, NASA Assistant Administrator for Infrastructure, followed and discussed the importance of agencies such as NASA being more efficient and reducing waste as a way of reducing mission risk and cost of operations. She noted how workshops such as this help NASA incorporate European Union requirements and directives into its risk planning. She also noted the importance of C3P in helping foster the demonstration of new technologies.

The workshop provided an excellent forum for information exchange among the international science and technology community in a broad range of technical areas of interest to academia, defense and commercial industries. Throughout the workshop, the concept of collaboration and its inherent benefits was stressed.

Several desirable interactions occurred between presenters and attendees. Some examples include:

- Various presentations from European speakers, notably a Portuguese Ministry of Environment presentation on global climate policy and a Hewlett Packard (HP) presentation on manufacturing of electronics, provided insight to U.S. attendees on new environmental drivers for change emanating from the European Union.
- Several attendees asked to be added as team members of one or more NASA Technology Evaluation for Environmental Risk Mitigation (TEERM) Principal Center projects.
- The inclusion of graduate student presentations enriched the substance and culture of the workshop, and represents a direction that C3P and NASA wishes to continue for future workshops. As just one example of student benefit, TEERM intends to explore how research by one University of California at San Diego student might be of value to a new TEERM project that is demonstrating and modelling concentrated solar power for air conditioning of buildings.
- NASA accepted an offer from the Dean of Engineering at the University of California, San Diego to hold next year's workshop at UCSD.

Summary Report for C3P & NASA Technical Workshop 2009

Garching, Germany
November 10-13, 2009

Introduction

Since 2003, C3P has held an annual technical workshop for interchange and to help identify new project opportunities. In November 2009, C3P and NASA hosted a technical workshop in Garching (near Munich), Germany.

This report summarizes the activities and key outcomes of the three-day workshop and adjunct meetings.

Background

As an international organization, C3P facilitates partnerships between Portuguese, European and United States governments, industries and other governmental agencies for identifying and integrating Pollution Prevention (P2) solutions, practices and procedures that qualify less or non-hazardous materials used in acquisition, manufacturing and sustaining maintenance processes. C3P is comprised of two elements: ITB, which provides engineering and technical support; and ISQ, which supports the identification of pervasive needs and technologies across Portugal and Europe, as well as providing alternative material, technology identification and demonstration/validation testing.

C3P was established to facilitate partnerships not only between NASA and Portuguese government agencies, but also between various Portuguese, American, and European Small and Medium Enterprises (SME). C3P fosters multi-participant cooperation to avoid duplication of effort, costs, and technical risk in reducing or eliminating hazardous materials at multi-program contractor sites and the various national host installations.

The Portuguese Ministry of Environment and NASA recognize C3P per the *Joint Statement Between NASA and the Portuguese Ministry of the Environment Regarding Cooperation in the Field of Environmental Pollution Prevention Matters*, first signed on September 18, 2002.

On a day-to-day basis, C3P supports program managers, defense contractors and industries from Portugal and Europe, and in particular, the SMEs, in addressing multi-participant problems in the uses of hazardous materials, waste generation and disposal. The concept operations of C3P define a systematic, phased methodology for identification and execution of C3P projects.

NASA's TEERM Principal Center is the primary day-to-day U.S. government interface to C3P. TEERM supports NASA in demonstrating and qualifying new materials and processes to reduce risk to NASA's mission. TEERM accomplishes these efforts through an ever-growing list of domestic and international partners.

Overview of 2009 Workshop

The NASA & C3P International Workshop on Environment and Alternative Energy was held on November 10 to 12, 2009 at the research facility of the GE Global Research Center in Garching (near Munich), Germany. The three-day workshop provided an excellent forum to showcase innovative and emerging environmental and energy technologies, share lessons learned, and identify new joint opportunities. Individuals from five countries (United States,

Portugal, Germany, France, and United Kingdom) attended, including students and professors from UCSD, the Technical University of Munich (TUM), and the Munich University of Applied Technology (FHM). The workshop was completed with a tour of GE's gas engine manufacturing plant in Jenbach, Austria on Friday, November 13, 2009.

Ms. Amanda Kent served as the primary ITB, Inc. workshop coordinator and point of contact supporting any ITB, Inc., NASA, C3P, chairperson, speaker, and attendee requests. Mrs. Kerry Wagner acted as backup coordinator, point of contact and served as primary registration desk support. Mr. Kurt Kessel and Mr. Matt Rothgeb provided support to each technical session chairperson and Mr. Brian Greene served as the general session Master of Ceremonies.

Over the course of the three day workshop, forty U.S. and international subject matter experts presented on environmental-related topics, ranging from renewable and alternative energies to climate change response to electronics recycling, among others.

The workshop began with a general session led by distinguished speakers from C3P and NASA. General (ret.) Pelagio Castelo Branco, C3P Director, welcomed all participants and guest-speakers and thanked Dr. Haertel for the use of GE's facility for the workshop. Gen. Branco provided a brief overview of C3P and recalled some landmarks related to the intercontinental relationship. Also highlighted was the need for C3P in Portugal and what partnerships C3P has begun to form with manufacturers, industry associations, universities, and testing and engineering centers of excellence throughout the European Union (EU).

Ms. Olga Dominguez, NASA Assistant Administrator for Infrastructure, followed and discussed the importance of agencies such as NASA being more efficient and reducing waste as a way of reducing mission risk and cost of operations. She noted how workshops such as this help NASA incorporate European Union requirements and directives into its risk planning. She also noted the importance of C3P in helping foster the demonstration of new technologies.

Following Ms. Dominguez, welcoming remarks were made by the Director of GE Global Research – Europe, Dr. Carlos Haertel, and the United States Consul General to Munich, Mr. Conrad Tribble. Mr. Pedro Barata of Portugal's Ministry of Environment discussed the status and latest progress on Europe's climate change policy.

The welcoming remarks were followed by three distinguished speakers representing different sectors of the globe. Mr. Bill Barry of NASA, Ms. Nathalie Meusy of the European Space Agency, and Mr. Klaus Hieronymi of HP discussed subject matter relating to NASA, sustainable development, and natural resources and manufacturing for electronics.

The afternoon general session was comprised of four presentations. Mr. James Leatherwood of NASA and Mr. Eduardo Dias Lopes of ISQ - Portugal spoke on the topic of sustainability followed by US and European university presentations by Mr. Frieder Seible, Dean of Engineering at the University California San Diego and Prof. Dr.-Ing. Gerd Becker, Professor at Munich University of Applied Sciences.

The first day concluded with presentations by several graduate students of the University of California at San Diego. Topics ranged from advances in solar energy technologies to analysis of solar irradiance data to wind turbine design.

The workshop provided an excellent forum for information exchange among the international science and technology community in a broad range of technical areas of interest to academia, defense and commercial industries. Some examples include the following technical session summaries:

- Session A.1. Materials Management and Substitution

The morning presentations in Track A on the second day of the workshop provided an overview of work being done by U.S. Air Force Space Command in the development and

testing of coatings and coating systems that meet or exceed required specifications and standards while reducing negative impacts to the environment. The presentations covered a broad range of topics including the development and testing of new coating systems as well as new coating technologies. The mid-morning presentations on the second day of the workshop shifted to more topic specific presentations including: Chrome Free Coatings, Lead-Free Electronics, and Citric Acid Passivation. The presentations outlined specific projects that are working to reduce or eliminate hazardous waste streams that pose a current or future risk to mission.

During this session a new point of contact (Lt. Casey Matthews; Project Manager, Coatings Technology Integration Office Materials and Manufacturing Directorate {AFRL/RXSSO – Wright-Patterson AFB, OH}) was established for future lead-free electronic projects involving the field testing of electronic assemblies. There is potential that C-5 aircraft may be able to carry a test skid supporting lead-free testing.

- Session A.3. Remediation and Clean-Up

The morning presentations in Track A on the third day of the workshop provided a mix of presentations that discussed both in-situ remediation technologies, as well as the challenges facing major clean-up efforts in the U.S. and Portugal. Many successes have come from the development of in-situ treatment technologies designed for the clean-up of dense non-aqueous phase liquids (DNAPLs), such as chlorinated-solvent contaminated sites. As these technologies continue to evolve, there is hope that large scale sites contaminated with DNAPLs may be completely remediated in the near future using environmentally sound techniques. Aside from treatment technologies, the presentations on the third morning of the workshop provided case studies on sites that require major remediation in the U.S. and Portugal. The remediation sites in Portugal pose a specific challenge in that laws and guidelines for clean-up have not been specifically developed for Portugal. Remediation activities in Portugal are being conducted based on Ontario, Canada guidelines, which make identifying responsible parties and establishing contamination thresholds difficult. For the U.S. sites presented, the challenges come from the sheer size and location of the contamination sites. This session provided fresh insights for consideration in meeting NASA clean-up responsibilities.

- Session A.4 Recycling and Pollution Control

The afternoon session in Track A of the third day of the workshop covered a mixture of technical topics and general presentations. General presentations included recycling and affirmative procurement and green purchasing while technical presentations discussed hazardous materials management for hypergolic processes at KSC and a presentation on the variety of applications of a hollow-fiber membrane technology that has been tested at several NASA facilities. Presentations were mostly of a technical nature and well received within the session.

- Session B.3 Creating Sustainable Facilities and Operations: Challenges from Encroachment and Climate Change

The morning presentations in Track B for the third day of the workshop covered the topics of climate change and encroachment on federal lands by nearby populations. Topics included a detailed overview of a draft encroachment action plan on what to do to mitigate the risks of encroachment. Climate change discussions and presentations revolved around historical data from ice-cores and the modern collection of data to show the high potential for global warming that exists as well as the discussion of what this means to the planet as a whole. One interesting detail discussed related to the anthropogenic decrease of fresh water in rivers and streams globally which is already damaging brackish water ecosystems as salt waters intrude into river mouths and how this coupled with rising seas is of great concern for the health of many river systems. Presentations were high-level overviews of the topics mentioned, with discussions in the mid-afternoon breakout sessions covering more specific topic areas.

The second day of the workshop concluded with a poster session by students from UCSD and two German universities: TUM and FHM. Student stood next to their posters and entertained questions from the workshop attendees about their university research.

Concluding remarks were made by NASA officials who emphasized the importance of such research and student collaboration, and the interest in seeing progress on their research at next year's C3P-NASA workshop scheduled for San Diego, California.

Workshop Outcomes

Throughout the workshop, the concept of collaboration and its inherent benefits was stressed. Several desirable interactions occurred between presenters and attendees. Some examples include:

- Various presentations from European speakers, notably a Portugal Ministry of Environment presentation on global climate policy and a Hewlett Packard presentation on manufacturing of electronics, provided insight to U.S. attendees on new environmental drivers for change emanating from the European Union.
- Several attendees asked to be added as team members of one or more NASA Technology Evaluation for Environmental Risk Mitigation (TEERM) Principal Center projects.
- The inclusion of graduate student presentations enriched the substance and culture of the workshop, and represents a direction that C3P and NASA wish to continue for future workshops. As just one example of student benefit, TEERM intends to explore how research by one University of California, San Diego student might be of value to a new TEERM project that is demonstrating and modelling concentrated solar power for air conditioning of buildings.
- NASA accepted an offer from the Dean of Engineering at the University of California San Diego to hold next year's workshop at UCSD.

The following attachments are included as supporting material to the workshop summary report. Attachment one: *Lessons Learned C3P & NASA Technical Workshop, JOG, and Special Events* and attachment two: *C3P & NASA Technical Workshop Agenda*.

NASA/C3P- 2009 INTERNATIONAL WORKSHOP ON ENVIRONMENT AND ALTERNATIVE ENERGY
“Global Collaboration in Environmental and Alternative Energy Strategies”

GE Global Research- Garching/Munich, Germany

FINAL AGENDA – Revised (11.10.09)

Time	Day 1 - Auditorium	
	Tuesday, November 10	
7:45 am – 5:00 pm	Registration/ Information Desk	
9:00 am – 10:30 am	Welcome and Opening Remarks Session Lead: General P.C. Branco C3P – Portugal	<ul style="list-style-type: none"> – Centro Para Prevenção da Poluição Welcome – General P.C. Branco, General Director, C3P – Portugal – NASA Headquarters Welcome – Olga Dominguez, Assistant Administrator for the Office of Infrastructure, NASA – HQ – Public Private Partnerships – Conrad Tribble, Consul General, Consulate General of the United States - Munich, Germany – GE Global Research – Europe – Welcome – Dr. Carlos Haertel, Director of GE Global Research – Europe, GE – Post 2012 Global Climate Policy: A European Perspective – Nuno Lacasta/ Pedro Barata, Portugal’s Climate Change Commission Executive Director/Policy Advisor, Ministry of Environment
10:30 am – 10:45 am	Break / Beverages	
10:45 am – 1:00 pm	Keynote Speakers Session Lead: General P.C. Branco C3P – Portugal	<ol style="list-style-type: none"> 1. NASA Cooperation with Europe – Bill Barry, NASA European Representative, NASA – US Embassy Paris 2. European Space Agency View of Sustainable Development – Nathalie Meusy, Head of Coordination Office on Sustainable Development Directorate of Resources Management , ESA – HQ 3. Material Issues in Manufacturing Electronics – Klaus Hieronymi, Chairman of the Environmental Board Hewlett-Packard Europe, Middle East and Africa, HP
1:00 pm – 2:00 pm	Lunch (may be purchased at the GE canteen/cafeteria)	
2:00 pm – 3:05 pm	General Technical Sessions Session Lead: James Leatherwood NASA – HQ	<ol style="list-style-type: none"> 4. NASA's Vision of Sustainability – James Leatherwood, Director, Environmental Management Division, NASA – HQ 5. Role of Innovation in Sustainable Development – Eduardo Dias Lopes, Director of Research and Development Division, ISQ – HQ Portugal
3:05 pm – 3:20 pm	Break / Beverages	
3:20 pm – 4:00 pm	General Technical Sessions Session Lead: James Leatherwood NASA – HQ	<ol style="list-style-type: none"> 6. UCSD Campus: A Test Bed for Sustainability – Frieder Seible, Dean of Engineering, University California San Diego 7. Shaping Students for a Sustainable Future – Prof. Dr.-Ing. Gerd Becker, Munich University of Applied Sciences
4:00 pm – 5:30 pm	University of California, San Diego Student Presentations	<ul style="list-style-type: none"> – Effects of Solar Photovoltaic Panels on Building Heat – Micro-Optic Solar Concentrators – Solar Intermittency at Four Distributed Sites in Colorado – Enhanced Waste Heat - Energy Conversion Through Nanostructured Thermoelectrics – Accuracy of Solar Irradiances Derived from GOES Satellite Data in the Coastal: Regions of Southern California – Computational Fluid-Structure Interaction with Application to Wind Turbines

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Time		Day 2		
		Wednesday, November 11		
7:45 am – 6:00 pm		Registration/ Information Desk		
		Track A - Maxwell Room	Track B - Auditorium	
		Technical Sessions	Technical Sessions	
9:00 am – 10:10 am	A.1. Materials Management and Substitution Session Lead: Lt. W. Casey Matthews USAFSPC	1. Opening Remarks & Speaker Intro – Lt. Casey Matthews , Coatings Technology Integration Office- Project Engineer, USAFSPC 2. Key Players of corrosion Control in the USAF – Lt. Casey Matthews , Coatings Technology Integration Office- Project Engineer, USAFSPC 3. Tech Overview: Metallization – Lt. Casey Matthews , Coatings Technology Integration Office- Project Engineer, USAFSPC	B.1. Renewable and Alternative Energy Systems Session Lead: Professor Oliver Mayer GE Global Research- Europe, GE	1. Opening Remarks & Speaker Intro – Professor Oliver Mayer , Senior Scientist , GE Global Research Europe 2. Energy Portfolio Evolution...from Generation to Distribution at GE – Michael Idelchik , Vice President - Advanced Technology Programs, GE Global Research Europe 3. Battery and Fuel Cell Driven Electric Vehicles – Prof. Dr.-Ing. Ulrich Wagner , Technical University of Munich 4. Transforming Biogas from Methane to Methanol for use in Fuel Cell – Prof. Dr. Loroeh , Beuth Institute Berlin and Dipl. Ing. Ortloff , TU Cottbus
10:10 am – 10:25 am	Break			
10:25 am – 11:25 am	A.1. Materials Management and Substitution Session Lead: Lt. W. Casey Matthews USAFSPC	4. Chrome Free Coatings for Aerospace – Matt Rothgeb , Senior Engineer, ITB 5. Lead-Free Electronics Issues & Concerns – Kurt Kessel , Senior Engineer, ITB 6. Alternative to Nitric Acid Passivation – David Yasensky , Materials Engineer, USA	B.1. Renewable and Alternative Energy Systems Session Lead: Professor Oliver Mayer GE Global Research- Europe, GE	5. Status and Technical Challenges of Compressed Air Energy Storage Technology – Matthias Finkenrath , Dr. GE Global Research Europe 6. European Award Building-Integrated Solar Technology 2008 – Prof. Dr.-Ing. Gerd Becker , Munich University of Applied Sciences 7. Towards a Cost Effective Green Energy Production – Eduardo Dias Lopes , Director of Research and Development Division, ISQ - HQ Portugal 8. Organic Rankine Cycles / Waste Heat Recovery – Dr. Thomas Frey , Research Scientist, GE Global Research Europe
11:25 am – 12:45 pm	Breakout Session		Breakout Session	
1:00 pm – 2:00 pm	Lunch (may be purchased at the GE canteen/cafeteria)			
2:00 pm – 3:10 pm			B.2. WEEE and E-Waste Recovery Session Lead: Margarida Pinto ISQ – HQ Portugal	1. Opening Remarks & Speaker Intro – Margarida Pinto , Director Assistant/Project Manager, ISQ – HQ Portugal 2. ELECTROVALUE Project: Towards E-Waste Recovery – Margarida Pinto , Director Assistant/Project Manager, ISQ – HQ Portugal 3. Assessment of WEEE Reuse in Electrovalue: An LCA Approach – Eduardo Silva , ISQ - HQ Portugal 4. E-waste Management: Market Impact from a Manager Perspective – Mónica Luízio , Amb3e - Portugal 5. Domestic E-Waste in Africa: Recycling for a Profit? – Klaus Hieronymi , Chairman of the Environmental Board Hewlett-Packard Europe, Mid. East & Africa, HP
3:10 pm – 3:45 pm			Breakout Session	
3:45 pm – 4:00 pm	Wrap – Up			
4:00 pm – 7:00 pm	Meet & Greet + Student Poster Session Initiation and Discussion			
	- CDTM: Applied Research and Education at the Intersection of Technology and Management, TUM/CDTM - Pilot Project: Potential of ICT in the Energy Sector, TUM/CDTM - Examples of Prototyping Projects in Emerging Technologies, TUM/CDTM		- Institute for Energy Systems: Research and Resources, TUM - Alternative fuels for Biomass Gasification, TUM - ORC for Waste Heat Recovery: Stationary and Mobile Applications, TUM - Transversal Flux Machine and Polymere Motor, Ortloff Technologie GmbH	

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Time		Day 3		
		Thursday, November 12		
7:45 am – 3:30 pm		Registration/ Information Desk		
		Track A - Maxwell Room	Track B - Auditorium	
		Technical Sessions	Technical Sessions	
9:00 am – 10:10 am	<p>A.3. Remediation and Cleanup</p> <p>Session Lead: Jackie Quinn NASA</p>	<ol style="list-style-type: none"> Opening Remarks & Speaker Intro – Jackie Quinn, Environmental Engineer, NASA In-situ Nano Technology Remediation Methods – George Hoag, Ph.D., Senior Vice President, Director of Research and Development, VeruTEK Cooperation on Contaminated Site Characterization along the Tejo River near Lisbon – Cristina Ascenso, Head of Environmental Studies, ISQ – HQ Portugal EZVI - Jackie Quinn, Environmental Engineer, NASA 	<p>B.3. Creating Sustainable Facilities and Operations: Challenges from Encroachment and Climate Change</p> <p>Session Lead: Christina Hudson, SAIC / Sam Higuchi, NASA HQ</p>	<ol style="list-style-type: none"> Introductions, Session Overview, NASA Encroachment Process – Christina Hudson, Deputy Division Manager, SAIC and Sam Higuchi, Staff Engineer, NASA – HQ Encroachment Case Study – Mick Bilney, Consultant, TEC How to Start Addressing Climate Change Impacts & Adaptation: Pilot Workshop – Sam Higuchi, Staff Engineer, NASA HQ
10:10 am – 10:25 am	Break			
10:25 am – 11:25 am	<p>A.3. Remediation and Cleanup</p> <p>Session Lead: Jackie Quinn NASA</p>	<ol style="list-style-type: none"> NASA Remediation Challenges – David Amidei, Environmental Engineer, NASA - HQ Efficiently Controllable Permeable Reactive Barriers (EC-PRBs) For Effective Passive In Situ Ground Water Remediation: A European Perspective – Dr. Volker Birke, Dipl.-Chem, Ostfalia University - University of Applied Sciences Braunschweig-Wolfenbüttel - Campus Suderburg 	<p>B.3. Creating Sustainable Facilities and Operations: Challenges from Encroachment and Climate Change</p> <p>Session Lead: Christina Hudson, SAIC / Sam Higuchi, NASA HQ</p>	<ol style="list-style-type: none"> Overview of Climate Change – Alex Ruane, NASA GISS Climate Change Impacts and Strategic Mitigation Measures in Coastal Zones – Mário Baptista Coelho, Prof. Dr., Lisbon Sciences University Port Cities Exposure to Climate Change: Mitigation and Adaptation Costs - Susan Hanson, Research Fellow, University of Southampton - Tyndall Centre for Climate Change Research Adaptation Measures in New York City – Alex Ruane, NASA GISS Sustainability as Overarching Solution – Christina Hudson, Deputy Division Manager, SAIC
11:25 am – 12:45 pm	Breakout Session		Breakout Session	
1:00 pm – 2:00 pm	Lunch (may be purchased at the GE canteen/cafeteria)			
2:00 pm – 3:45 pm	<p>A.4. Recycling and Pollution Control</p> <p>Session Lead: Janet Bethay Innovative Health Applications, LLC</p>	<ol style="list-style-type: none"> Opening Remarks & Speaker Intro – Janet Bethay, NASA Lead Center for Recycling and Affirmative Procurement, Lead, Innovative Health Applications, LLC Hazardous Waste Associated With Space Launch Operations: Hypergolic Vapors and Liquids – Kurt Kessel, Senior Engineer, ITB Reduction of VOCs & Other GHG Emissions from Gas Streams Using Membrane Technology – Stephen P. Conover, President & C.E.O., Applied Membrane Technology, Inc. Sustaining Mission Success Through Recycling and Green Purchasing – Janet Bethay, NASA Lead Center for Recycling and Affirmative Procurement, Lead, Innovative Health Applications, LLC 	<p>B.4. Creating Sustainable Facilities and Operations: Challenges from Encroachment and Climate Change</p>	<ol style="list-style-type: none"> Follow-on Discussion and Brainstorming – Christina Hudson, Deputy Division Manager, SAIC and Sam Higuchi, Staff Engineer, NASA – HQ
3:10 pm – 3:45 pm	Breakout Session		Breakout Session	
3:45 pm – 4:00 pm	Wrap-up			

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FINAL AGENDA – Revised (11.10.09)

Time	Day 4- GE Energy- Jenbacher Headquarters Biogas Technical Tour - Jenbach/Austria	
	Friday, November 13	
7:15 am – 7:35 am	Meet in Munich Marriott Hotel Lobby	
7:45 am	Depart Munich Marriott Hotel	
9:30 am	Arrive at GE Energy- Jenbacher Headquarters	
9:30 am – 12:00 pm	Biogas Plant Tour: GE's Jenbacher Gas Engine Division is one of the world's leading manufactures of gas-fueled reciprocating engines, packaged generator sets and cogeneration units for power generation. It is one of the only companies in the world focusing exclusively on gas technology.	Hall 7: Tool Management Hall 6: Heat Treatment and Material Testing Hall 5: Engine Assembly Hall 4: Crankshafts Hall 3: Cylinder Liner and Small Parts Hall 2: Horizontal Machining Center Hall 1: Crankcase and Large Parts
12:00 pm – 1:00 pm	Lunch (GE Energy- Jenbacher canteen/cafeteria)	
1:00 pm – 2:00 pm	Wrap-up, Q & A, Final Discussion	
2:00 pm	Depart GE Energy- Jenbacher Headquarters	
3:45 pm	Arrive at Munich Marriott Hotel	