

Texas environmental improvement
Environmental
Research through research and science
Consortium

RESOLUTION 1.83

Whereas John Hall has served as the Executive Director of the Texas Environmental Research Consortium (TERC) since the organization's creation in 2002; and

Whereas Mr. Hall has worked with TERC's Board of Directors and the Houston Advanced Research Center (HARC) to assure effective implementation of the organization's air quality research activities and the New Technology Research and Development (NTRD) Program during his tenure; and

Whereas Mr. Hall has submitted a letter of resignation as TERC's Executive Director to Chairman LaBoon, effective immediately, in order to assume a consulting role with the Houston Advanced Research Center to support implementation of TERC's Air Quality Research and the NTRD Programs; and

Whereas Mr. George Beatty has been significantly involved in TERC's operations and activities since 2002 and played a pivotal and strategic role in TERC's creation; and

Whereas Mr. George Beatty is not a registered lobbyist at this time and commits to maintain this status.

Now, Therefore, Be It Resolved that the Board of Directors of the Texas Environmental Research Consortium hereby appoints Mr. George Beatty as TERC's Executive Director, effective immediately.

Adopted and Approved this 13th day of June 2006

Bruce LaBoon, Chairman

TERC Budget Report FY 04/05 Project Budget Summary*

	Number of Projects	Funds Committed	Total Funds	Available Funds
Completed Projects	23	\$3,866,792	\$5,950,019	\$0
Active Projects	6	\$1,892,397		

*Total FY04/05 Fund Source was reduced by \$141,403 and added to FY 06/07.

FY 06/FY07 Project Budget Summary**

	Number of Projects	Committed Funds	Total FY06/07 Funds***	Balance
Completed Projects	0	\$0	\$4,646,585	-\$38,835
Active Projects	11	\$1,828,431		
Approved Projects	14	\$2,167,072		
Proposed Projects	1	\$75,125		

**The Budgets For FY06/07 are still being developed.

***Total FY06/07 Funds include \$141,403 from FY05.

FY 04/05 Project Expenses		
	Full Costs	Sub-contract Costs
HGB Budget	\$1,123,926	\$880,464
DFW Budget	\$1,398,235	\$1,095,352
2005 Field Study	\$3,237,028	\$2,535,830
Contract Administration	\$190,830	\$190,830
Sub-Total	\$5,950,019	\$4,702,477
Total Available	\$5,950,019	\$4,702,477
Uncommitted	\$0	\$0

FY 06/07 Project Expenses		
	Full Costs	Sub-contracted Costs
HGB Budget	\$196,481	\$170,000
DFW Budget	\$115,577	\$100,000
East Texas Budget	\$271,606	\$235,000
2006 Field Study	\$1,244,766	\$1,077,000
Approved Projects	\$2,167,072	\$1,875,000
Proposed Projects	\$75,125	\$65,000
Project Sub-Total	\$4,070,628	\$3,522,000

Other FY 06/07 Expenses	
Science Advisory Council	\$123,066
Air Research Information	\$94,450
Sci. Syn./Dissemination	\$73,026
TERC Outreach	\$183,580
Contract Administration	\$140,670
Sub-Total	\$614,792

Total Available FY06/07 Funds	\$4,646,585	\$3,488,399
Balance	-\$38,835	-\$33,601

Active FY 04/05 Projects

Project Number	Project Title	Contractor	Start/End Date	Full Costs	Sub-contract Costs
H45.S	Modeling Strategy in Support of TexAQS-II and 8-Hour Ozone Assessment	UH \$515,085 TAMU \$329,995	11/5/2004 7/31/2006	\$1,106,706	\$866,974
H51A	Measurement of VOC Emissions from Railcar Loading Arm Fittings	URS	12/1/2005 7/31/2006	\$95,739	\$75,000
H60	Regional Transport	UH, UNC, Environ	11/18/2005 6/30/2006	\$527,688	\$413,381
H61	Diagnostic Modeling and Data Analyses of the Summer 2005 NETPS	UAH	12/1/2005 6/30/2006	\$102,121	\$80,000
H68	NOx Emissions from Compressors	ERG	12/1/2005 8/31/2006	\$31,913	\$25,000
H70	Annual Report	Dawson	11/21/2005 6/30/2006	\$28,230	\$22,115
Total:				\$1,892,397	\$1,482,470

Active FY 06/07 Projects

Project Number	Project Title	Contractor	Start/End Date	Full Costs	Sub-contract Costs
H45.D	Real Time Meteorology and Forecasting	TAMU	11/15/2005 8/31/2006	\$109,798	\$95,000
H51C	Evaluation of VOC Emissions from Flash and Condensate Tanks	URS	12/1/2005 7/31/2006	\$202,260	\$175,000
H53	Reconciliation of Point Source Inventories Using Remote Sensing and SODAR Techniques	UH	5/19/2006 1/1/2007	\$196,481	\$170,000
H55	Enhanced Land Surface Characterization	UT/CSR	10/1/2005 10/31/2006	\$115,577	\$100,000
H59	4DVar Data Assimilation	Virginia Tech	1/1/2006 8/1/2006	\$115,577	\$100,000
H72AB	An Update of TERP Program Analysis and LIRAP Program Analysis	Environ	4/17/2006 8/31/2006	\$184,923	\$160,000
H72C	School Bus Program	Environ	5/1/2006 10/1/2006	\$86,683	\$75,000
H75	Hydrocarbon Profiles at Sunrise Measured at Williams Tower	Battelle	4/1/2006 12/31/2006	\$231,154	\$200,000
H76	How Chemical Manufacturing Facilities in Harris County Are Using Point Source Monitoring to Identify and Reduce HRVOC Emissions	Environ	5/1/2006 8/31/2006	\$86,683	\$75,000
H78	TexAQS II Radical Measurement Project (TRAMP)	UH	4/12/2006 12/31/2006	\$462,309	\$400,000
H80	Coordination of TexAQS II	Jim Thomas	5/15/2006 3/31/2007	\$36,985	\$32,000
Total:				\$1,828,431	\$1,582,000

Approved FY 06/07 Projects

Project Number	Project Title	Contractor	Full Costs	Sub-contract Costs
H44.D	Continued Satellite Data Assimilation and Modeling Support	UAH	\$46,231	\$40,000
H45.C	East Texas Air Quality (ETAQ) Forecasting Project	UH	\$176,833	\$153,000
H50	Analysis of Potential Air Quality Improvements from Railroad Modifications	ERG	\$0	\$0
H52	Houston Exposure to Air Toxics Study (HEATS)/Developing SOW	NUARTC	\$57,789	\$50,000
H63	Aircraft Measurements in support of East Texas Transport Studies	Baylor	\$312,058	\$270,000
H65	Event Emission Tracking, THOE Forecasting, and Reactivity Based Modeling	UT	\$138,693	\$120,000
H66.LEV	Further Evaluation of the NOx Effects of Adopting the California LEV II Program	ERG	\$0	\$0
H66.SGU	Emissions Inventory Verification Study on Small Electric Power Generating Units in the Houston Region	ERG	\$40,452	\$35,000
H67	Emissions From Industrial Storage Tanks and Wastewater	TBD	\$231,154	\$200,000
H73	Modeling Analysis of TexAQs 2005, 2006 VOC Data in the Houston Region	TBA	\$346,732	\$300,000
H74	Measurements of Volatile Organic Compounds and Nitrogen Reservoir Species During TexAQs II-2006	TAMU	\$242,712	\$210,000
H77	Comparison of the Carbon Bond and SAPRC Photochemical Mechanisms Under Conditions Relevant to Southeast Texas	UT	\$75,125	\$65,000
TEES ESL-2006	TEES FY06	TAMU	\$249,647	\$216,000
TEES ESL-2007	TEES FY07	TAMU	\$249,647	\$216,000
Total:			\$2,167,072	\$1,875,000

Proposed Project

Project Number	Sub- Project Title	Contractor	Full Costs	contract Costs
H74 Add-on	Measure particle size distribution, N2O5 and HNO3 at Williams Tower	TAMU	\$75,125	\$65,000

Completed FY 04/05 Projects

Project Number	Project Title	Contractor	Full Costs	Sub-contract Costs
H12.8HRA	A Conceptual Model for 8-Hour Ozone Exceedances in East Texas	TAMU	\$58,169	\$45,569
H12.8HRB	Role of Modeling Assumptions in the Houston Mid-Course Review and Impacts on the Sensitivity of 1-Hour/8-hour Ozone to Emissions Reductions	UT/UH/UNC	\$716,875	\$561,587
H12.EE	Survey of Technological and Other Measures to Control HRVOC Event Emissions	UT-Austin	\$159,187	\$124,704
H17.A	Urban Heat Island Modeling	U. of Houston	\$31,604	\$24,758
H18.A	Locomotive Emissions	ERG	\$27,337	\$21,416
H22.A	Permit Data for Maximum Release Levels	URS	\$76,355	\$59,815
H31	Survey and Demonstration of Monitoring Technology for Houston Industrial Emissions	Environ	\$139,906	\$109,600
H35	Transport Contributions of Out-of-State Sources to East Texas Ozone	Environ	\$204,241	\$159,999
H36	Ozone Precursor Control Strategies in Texas vs. Out-of-State	Environ	\$70,205	\$54,997
H37	Evaluation of the NOx Emission Effects of Adopting California LEV II Program	ERG	\$11,249	\$8,812
H39	TexAQS II Tetroon Campaign	Battelle	\$331,878	\$259,987
H40	NOx from Oil and Gas Production	ERG	\$116,801	\$91,500
H41	Analysis of EPA Policy Development on the 8 Hour Ozone and PM 2.5 Standards	John Seitz	\$96,867	\$75,884
H42	Analysis of 2010 On-Road and Non-Road Emission Reductions	Environ	\$62,439	\$48,914
H43	Diesel Construction Equipment	ERG	\$227,561	\$178,267
H44	Met and Sci Planning and Support for TexAQS II	UAH \$309,103 SEAMS \$36,431	\$406,745	\$318,637
H44C	Aircraft and Instrumentation Support for TexAQS II	TVA	\$181,019	\$141,807
H46	New E. Texas Land Cover Data	UT/CSR	\$191,477	\$150,000
H48	Aircraft Measurements of HRVOCs Using Proton Transfer Reaction Mass Spectrometry	TAMU	\$333,779	\$261,476
H54	The Potential Impact of Solvent Emission Controls in East Texas	PCA Services	\$63,826	\$50,000
H56	Deployment of Two C-Band Radars to DFW and HGB for the 2005 Ozone Season	TAMU	\$123,123	\$96,452
H57	Inventory of Boilers, Process Heaters, and Stationary Engines and Gas Turbines (including duct burners) at Minor Sources of NOx	ERG	\$223,384	\$174,995
H58	Science Policy Synthesis	Environ. Harvey Jeffries	\$12,765	\$10,000
Total:			\$3,866,792	\$3,029,176

TERC Research Report

H60: Sensitivity analysis of 2009 8-hr ozone design values at DFW monitors to NOx emission reductions (and increase) from several sources

Episode	Reduce Gas Compressors (-233 tpd)	Retire mothballed EGUs* (-66.9 tpd)	Reduce DFW EGUs (-1.57 tpd)	Reduce East Texas EGUs (-329.5 tpd)	Add proposed EGUs (+48.5 tpd)
Aug 13-22, 1999 (SIP)	-0.50	-0.03	-0.16	-1.11	0.12
Aug 3-9, 2002	-0.25	-0.06	-0.26	-0.97	0.06
Aug 28-31, 2002	-0.15	-0.09	-0.10	-0.80	0.00
Sept 11 – 15, 2002	-0.45	-0.03	-0.21	-0.91	0.07

* EGU = electrical generating unit

■ [REDACTED]

Impact of EPA Engine Standards and TERP on 2012 DFW Ozone level

- Environ sensitivity test of NOx reductions from continuing TERP to 2012 and acquisition by 2012 of vehicles with new EPA engine emission standards
- Preliminary results of 2012 modeling:
 - Additional 66 tpd NOx reduction (~ 17%)
 - Additional 21 tpb VOC reduction (~ 6%)
 - Frisco monitor showed a reduction of 2.8 ppb (from 91.2 ppb down to 88.4 ppb)
 - Remaining North Central Texas monitors showed 2.3-2.8 ppb reductions

Recent Assessments of DFW Compliance

- 2009 O3 design values for DFW monitors is 91.2 ppb (attainment <85ppb)
- Reduction needed is 6.2 ppb
- TCEQ sensitivity tests of NOx reductions possible by 2009 from major and minor sources plus local controls reduce O3 design value by ~1ppb
- Mobile source NOx reductions are far more efficient at reducing O3 in DFW than reductions at distant point sources

Field Study: TexAQS II

- TERC Projects focused on Houston VOC issue based on intensive observations August to September 2006 with analysis completed by Spring 2007 for SIP inclusion
- Chemistry instruments on towers and around petrochemical facilities
- Aircraft measurements of chemicals and weather aloft
- Advanced modeling efforts forecasting up to date ozone conditions for targeted observations

H63: TexAQS II Aircraft Observations

- The NOAA Twin Otter
 - Quantify the effect of mixing levels on pollution levels
 - Validate air quality forecast models
 - Examine regional transport of pollutants to and from Houston
 - Investigate nighttime transport by the low-level jet
 - Improve prediction of pollutant events associated with daily processes, including local sea breeze
- Baylor University Institute for Air Science's Aztec aircraft
 - Assess impact of stationary fronts on local air quality
 - Examine transport into Houston and net production in area using box pattern flights
 - Investigate Planetary Boundary Layer (PBL) evolution
 - Examine export of pollution from Houston, including the effects of nocturnal transport and morning PBL entrainment.
 - Flights over Moody Tower and Williams Tower sites to investigate variations of ozone, CO, and aerosols and examine vertical diffusion.

H78: TRAMP Study at UH

- Houston climatology along with strong emissions of VOCs and NO_x favor strong photochemical processes yielding rapid ozone formation
- Chemical radicals play critical role in strong photochemical processes
- TRAMP study occurs at ground-based supersite on top of UH Moody Tower
 - Operates broad suite of instrumentation to elucidate fast radical chemistry in high pollution events typical for the HGA
 - Analysis of radical sources and sinks (and production and loss rates) as identified by a steady-state time dependent photochemical box model

H53: New VOC Monitoring Technology

- Estimate VOCs emitted using Solar Occultation Flux (SOF) technology
- SOF is new remote sensing method based on measuring infrared intensity of solar spectrum from a mobile platform (boat, automobile).
- Mass of ethylene, propylene, alkanes and several other pollutants measured along the path of the solar light
- Perform measurements at Sweeny Refinery, Texas City plants, Houston Ship Channel petrochemical plants, loading docks, and other high emission locations as determined by the most recent HAWK camera analysis

H75: Houston VOC Study from Williams Tower

- Isoprene and other hydrocarbons key in ozone formation
- Measurements in Georgia have shown layers of isoprene. Even relatively non-reactive gases, such as CO, have been found to have strong gradients within the Planetary Boundary Layer (PBL)
- Measurements of hydrocarbons with Proton Transfer Reaction- Mass Spectrometers (PTR-MS) at multiple levels of a skyscraper tall enough to exceed early morning PBL
- Observe the vertical profiles of reactive compounds within developing boundary layers over Houston
- Characterize hydrocarbon mixing ratios at multiple heights within PBL
- Supplement with canister air samples to measure hydrocarbons that cannot be measured by PTR-MS.
- Major research questions:
 - Will tower instruments detect residual stable layers of VOCs over night available to surface ozone chemistry the next morning?
 - What are the key processes responsible for specific vertical profiles?
 - What are optimal approaches for interpolation of profiles into existing SIP models?

H76: Using Point Source Monitoring to Identify and Reduce HRVOC Emissions

- **Document findings of HRVOC monitoring program at cooperating facilities**
 - sources and magnitude of emissions
 - success in finding and eliminating/reducing HRVOC emissions
 - difficulties encountered during program implementation.
- **Comparison of actual emissions determined by monitoring with emissions reported previously.**
- **Infrared camera findings and response to those findings**
- **Changes in awareness of HRVOC emission sources**
- **Practices that affect occurrence and size of emissions**
- **Response strategies for reducing emissions**
 - changes in maintenance programs
 - changes in operating practices
 - changes in how emission events are prevented and/or managed
 - education and training of personnel
 - equipment upgrades and replacements
 - investments in emission control systems.

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RESOLUTION 1.84

Whereas there is broad based interest in effective implementation of the Texas Emission Reduction Plan (TERP) and the Low Income Repair Assistance Program (LIRAP), including the emission reduction impacts of extending both programs to 2012 or 2013; and

Whereas effective implementation of these programs is crucial to the attainment of the one-hour and the eight-hour ozone standards in the Dallas-Ft. Worth and the Houston-Galveston regions; and

Whereas TERC conducted an assessment of the TERP program in 2004 and has been requested to conduct a similar assessment for this program, as well as the LIRAP program in 2006.

Now, Therefore, Be it Resolved that the Board of Directors of the Texas Environmental Research Consortium hereby authorizes the Houston Advanced Research Center to engage persons and/or entities to complete Research Project H72A **Texas Emission Reduction Plan (TERP) Program Analysis** relating to an assessment of the TERP program and H72B **Low Income Repair Assistance Program (LIRAP) Analysis** relating to an assessment of the LIRAP program at a cost not to exceed \$160,000 and research project 72C **Measurement of Selected Diesel-Associated Air Pollutants in School Bus Cabins Prior to and Following the Installation of Retrofit Technologies** relating to an analysis of school bus emission at a cost not to exceed \$75,000.

Be It Further Resolved that the Board of Directors of the Texas Environmental Research Consortium hereby increases the budget for research project H74 relating to the measurement of ozone precursors from Williams Tower during the Texas AQSH campaign from \$210,000 to \$275,000.

Adopted and Approved this 13th day of June 2006.

Bruce LaBoon, Chairman

Project Summary
H72A&B: TERP and LIRAP Program Analysis
June 2006

H72 Task A: Texas Emission Reduction Plan (TERP) Program Analysis

The TERP program was analyzed in previous TERC projects for the following: program progress toward SIP goals, TERP technologies, emissions impacts, costs and costs effectiveness, and program features. The study areas are the HGB and DFW regions. Project H72AB is updating this analysis and projecting emission reduction effects and cost effectiveness to 2009 and 2012. The study specifically addresses the projected emission and ozone effects of new engine standards and TERP's potential effect on future locomotives and commercial marine vessels projects (per request from TCEQ).

H72 Task B: Low Income Repair Assistance Program (LIRAP) Analysis

The LIRAP provides limited relief for low-income vehicle owners in the repair of vehicles failing the I&M test and/or purchase assistance for qualified replacement vehicles. LIRAP applies in counties that implement a vehicle inspection and maintenance (I/M) program and have elected to implement LIRAP provisions. This study is quantifying emission reduction accomplishments, cost-effectiveness, the methods for inclusion of LIRAP in modeling and SIP credits, and projections to 2009 and 2012 for the HGB and DFW regions. The study will identify ways in which the program can be improved to increase its impact and cost effectiveness. Options for related measures that could affect high emitters and/or older vehicles will be reviewed and incorporated in project findings.

Contractor: ENVIRON International
Budget not to exceed: \$160,000

Project Summary
H72C: Measurement of Selected Diesel-Associated Air Pollutants in School Bus Cabins Prior to and Following the Installation of Retrofit Technologies
June 2006

Previous studies have suggested that exposure to diesel exhaust is enhanced by school bus commutes and proximity to roadways. Other variables that are thought to influence exposure include window position, route, length of commute, bus age, meteorological

conditions, and the presence or absence of emission control technology. This project will measure and analyze in-cabin levels of diesel-related pollutants under school bus operating conditions prior to and following the installation of selected emissions control devices. Measurements will be taken of in-cabin and ambient air quality school buses operating over typical bus route conditions (with no children on-board). Proposed testing includes five buses with four to be equipped with emission reduction technologies, a diesel oxidation catalyst (DOC) device and a closed crankcase filtration device (referred to as a *Spiracle*) used with ultra-low sulfur diesel (ULSD). Measurements will be taken prior to and following installation of these retrofit technologies.

Contractor: The University of Texas at Austin
Budget Not to Exceed: \$75,000

Responses to TERC's RFGA and Strategic Directions



NTRD 2006 Solicitations

- RFGA 1
 - 6 received, 3 met requirements
- RFGA 2
 - 2 received and both met requirements
- RFGA 3
 - 40 received, 39 met submission requirements
 - 36 meet minimal scientific/project requirements
 - 17 are verified in at least 1 application seeking verification extension
 - 19 concern new technology not verified yet by either EPA or CARB
- EPA SBIR
 - 141 proposals received with 28 under topic 3, no other details yet
- All proposals currently out for review

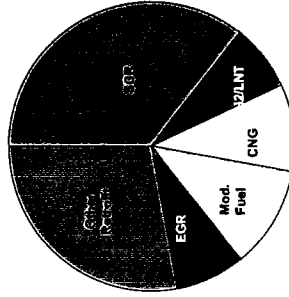


NTRD RFGA 3 Summary

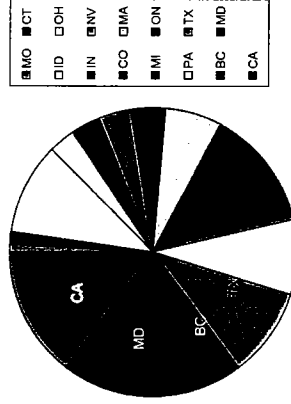
- Grand total of 39 proposals received
 - ~1/3 related to Selective Catalytic Reduction of NOx projects on- and off-road
 - Several proposals for hydrogen assisted NO_x Traps
 - Several for certifying Compressed Natural Gas engines at below current required levels
 - A few related to modified fuels (bio, emulsions, ethanol, gasoline)
 - Remainder are engine based retrofits of which only a few are based on Exhaust Gas Recycling systems
- Several applicants have current NTRD funding
- Most Texas applicants are universities
- >75% of proposals are technically sound
- Review process completed by June 20th
 - Minimum of 2 reviews per proposal
 - ETAC members expertise matched to proposals



NTRD RFGA-3 Funding Requests By Area
(out of \$18,092,285.00 total)



NTRD RFGA-3 Funding Requests by Location
(out of \$18,092,285.00 total)



RFGA-3 Proposed Projects

Type	#	Requested	Total Cost	Comments (RMS)
SCR	12	\$ 6,429,120.00	\$ 10,079,055.00	>90% of good quality
H2/LNT	2	\$ 1,350,000.00	\$ 2,016,132.00	One good, one not so
CNG	3	\$ 1,782,500.00	\$ 3,844,714.00	Do not really fit RFGA 3
Mod Fuel	5	\$ 2,030,890.00	\$ 2,420,498.00	Do not really fit RFGA 3
EGR	3	\$ 1,422,090.00	\$ 1,629,480.00	Varies
Other Retro	11	\$ 5,077,665.00	\$ 6,570,882.00	Ranges from science fiction to good
Sum	36	\$ 18,092,265.00	\$ 26,560,761.00	"Good" projects > \$10,000,000 Requested

TEK



Environmental Technology Advisory Council

- Dr. Jerald A. Caton – *Texas A&M University*
- **Dr. Dan Cohn** – *Massachusetts Institute of Technology*
- Dr. Don Hillebrand* – *Transportation Technology R&D Center/ANL*
- Dennis Johnson – *United States Environmental Protection Agency*
- **Dr. Joe Kubsh** – *Manufacturers of Emission Control Association*
- Dr. Thomas Lanni – *New York State Dept. of Environmental Conservation*
- Barry Liebowitz – *NY State Energy Research and Development Authority*
- **Dr. Ron Matthews** – *University of Texas*
- Bill Van Amburg* – *WestStart-CALSTART*
- Michael P. Walsh* – *International Consultant*
- Richard (Dick) Wilson – *National Environmental Strategies*
- **Bruce Bertelsen**** – *Emissions Advantage (Former Director MECA)*

Bold Known conflict of interest

* Not participating in current review round due to incomplete paperwork (will use as tie-breaker)

** Acting only as reviewer, not an ETAC member



RFGA 3 Proposals Detail

Applicant	Title	Amount	Verified	Total cost
Eco-Energy Solutions	diesel emissions to extend life of old locomotive engines	\$ 660,210.00	yes	\$ 660,210.00
University of Texas - Austin	Super wifes for construction equipment	\$ 439,678.00	yes	\$ 523,928.00
Aerosynthesis LLC	To reduce oxides of nitrogen from diesel engines	\$ 415,480.00	no	\$ 377,340.00
AHL- Tech, Inc	Alternative Fuel/Electric Hybrid	\$ 525,075.00	no	\$ 670,175.00
Converter Technology Inc	Retrofit technology for PM & Nox reduction from construction equipment	\$ 409,240.00	yes	\$ 522,940.00
Cummins Westport	Demonstration/verification/testing of Tech - HD Natural Gas Engine at 0.2 g/bhp.hr Nox	\$ 650,000.00	no	\$ 1,640,000.00
Emissions Solutions Inc	ESI 0.2 Nox natural gas program	\$ 382,500.00	no	\$ 564,714.00
International Truck and Engine Company	Low Nox calibration plus DOC	\$ 290,760.00	no	\$ 177,907.00
Lamar University	Dev and Testing of microwave assisted diesel emissions control device	\$ 141,791.00	no	\$ 587,590.00
MA Turbo/Engine LTD	Low Nox emissions system for marine, power station, and locomotive	\$ 493,900.00	no	\$ 842,241.00
Motive Engineering Company	A novel method of mechanical variable injection timing to reduce NOX	\$ 697,398.00	no	\$ 842,241.00
Oxy-Adder Inc	Smog Dog	\$ 75,000.00	no	\$ 180,000.00
Spearhead Technologies	Fuel rail retrofit device	\$ 150,000.00	no	\$ 1,076,500.00
Ultra-Clean Diesel Technology	Engine retrofit for low nox emissions	\$ 750,000.00	no	\$ 379,330.00
University of Texas - Austin	Dev/Ver of ultralow Nox conversion for ferry-locomotive engines	\$ 303,535.00	no	\$ 315,912.00
University of Texas - Austin	Development and verification of an improved TXLED fuel. Super TXLED	\$ 240,117.00	yes	\$ 394,571.00
University of Texas - Austin	Biodiesel blends in HD vehicles & Equipment	\$ 301,853.00	no	\$ 518,950.00
Van Aaken Developments USA, LLC	EGR/DOC/DPF solution for Nox	\$ 417,830.00	no	\$ 604,230.00
Water Visions Inc	HDDV application test on-road 1, 4, 5	\$ 417,830.00	no	\$ 604,230.00
Water Visions Inc	HDD off-road retrofit kit 1, 4, 2	\$ 550,228.00	no	\$ 769,288.00
Westport Innovations Inc	Development of the next generation HDPI heavy duty product	\$ 750,000.00	no	\$ 1,640,000.00
Mack Trucks	UREA SCR retrofit for select Texas HDDE	\$ 750,000.00	yes	\$ 1,083,076.00
Mack Trucks	HC SCR retrofit of select Texas HDDE	\$ 750,000.00	no	\$ 1,088,930.00
Mack Trucks	Low Nox calibration	\$ 347,430.00	yes	\$ 435,418.00
Combustion Components Associates	SCR for non road applications	\$ 230,750.00	yes	\$ 314,136.00
Engine Control Systems LTD	DOC + SCR system	\$ 560,220.00	yes	\$ 836,798.00
Engine, Fuel & Emissions Engineering, Inc	Demonstration of compact SCR in a diesel ferryboat	\$ 365,000.00	yes	\$ 458,652.00
Engine, Fuel & Emissions Engineering, Inc	Verification of compact SCR in locomotives	\$ 116,635.00	yes	\$ 518,735.00
Extinguish transport systems LLC	Verification of extinguish ADECI SCR system for retrofit of off-road engines	\$ 533,205.00	yes	\$ 738,465.00
Extinguish transport systems LLC	Verification of solid ammonia storage method for extinguish off-road ADECI SCR system	\$ 344,955.00	no	\$ 463,410.00
Extinguish transport systems LLC	Verification extension for extinguish On-Road ADECI SCR system	\$ 529,595.00	yes	\$ 675,000.00
Johnson Matthey	Off-road SCR retrofit system	\$ 749,400.00	yes	\$ 1,273,900.00
Johnson Matthey	On-road SCR retrofit system	\$ 749,400.00	yes	\$ 1,448,400.00
Nett Technologies, Inc	SCR for on- and off-road application	\$ 750,000.00	yes	\$ 1,171,353.00
Analytical Engineering Inc	Exhaust gas treatment devices, other than SCR for retrofit	\$ 600,000.00	no	\$ 720,000.00
Electrocore, Inc	H2/LNC for reduced nox	\$ 750,000.00	no	\$ 1,296,132.00
Rypost, Inc	DPF system with some Nox reduction	\$ 750,000.00	yes	\$ 977,800.00
Clean Air Technologies	Dev/Ver/testing of technologies to reduce Nox emissions from diesel engines	\$ 707,100.00	yes	\$ 977,800.00

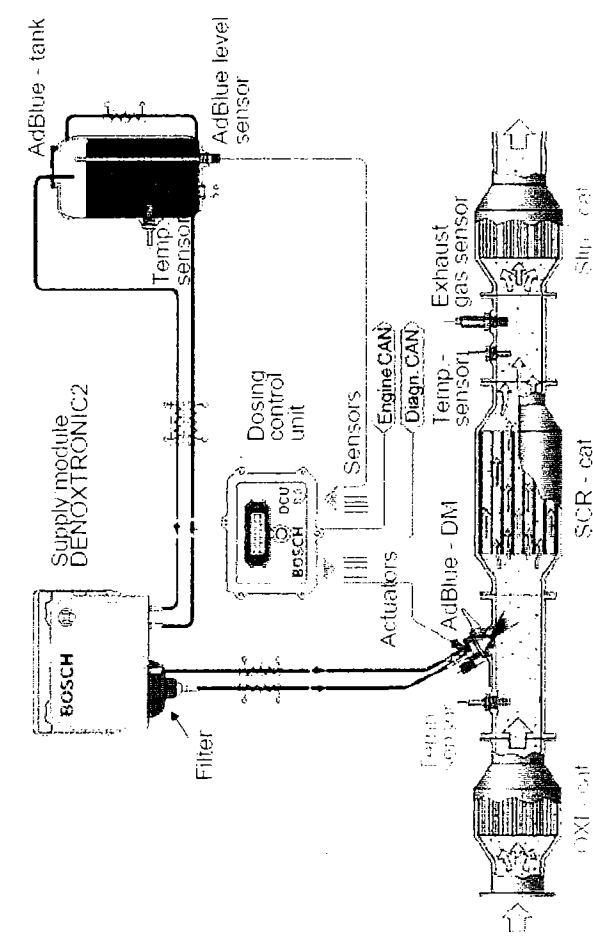


What is the prognosis for NO_x control?

- SCR is closest today to meeting 2010 HD requirements
- Lean NOx Trap
 - Need to solve high temperature deficiencies and cost issues
 - Attractive for Light Duty applications
 - Lean NOx Catalyst shows "renaissance" with hydrogen and new formulations show promise
- Given rapid developments in LNT and LNC, but short timeframe to 2010 EPA rules and maturity of SCR, SCR is preferred for any HD applications
 - HC-based technologies might be better alternatives in the future
 - Once installed and optimized, SCR will be tough to beat



OE Heavy & Medium duty SCR System



Source: (www) BOSCH

TEK

Where do we go from here?

- First of all, we need information
 - We need to know what engines we have or how they are used in order to develop and certify the right technology
 - We need to know what portions of the diesel engine inventory may not be covered by current technology development in order to stimulate specific new technology development
 - Industry needs inventory information to make technology investment decisions (largely independent of external funds availability)
- The diesel engine database must proceed as planned and should in fact be expedited and possibly expanded to a national scope



NTRD Strategic Direction

- Current RFGA-3 proposal submissions include NO_x reduction technologies mostly effective at exhaust temperatures exceeding 200°C
- Detailed inventory information is lacking, but...
 - We know many classes of diesel engine applications have duty cycles resulting in exhaust temperatures below this threshold
 - Refuse haulers, school buses, intercity buses, delivery trucks, ...
 - One could argue that high congestion areas (i.e. non-attainment zones) by definition lead to light duty cycles (on-road)
- RFGA-4 will focus exclusively on addressing NO_x reduction for duty cycles exhibiting low exhaust temps
 - Low temperature catalyst technology
 - Hybrid engine technology



NTRD Strategic Direction

- Need to expedite (time and dollars) the verification process in general and for similar applications of the same engine in particular
- The proposed diesel engine research and testing center is designed to address this need while at the same time integrating R&D addressing the broader issues of diesel engine NO_x reduction
 - EPA and CARB certified testing facility
 - NO_x emissions classification
 - NO_x emissions technology evaluation
 - NO_x emissions technology and existing engine integration
- RFGA-5 will solicit proposals for a Texas based facility



Texas environmental improvement
Environmental
Research through research and science
Consortium

RESOLUTION 1.85

Whereas the Texas Environmental Research Consortium (TERC) is implementing the New Technology Research and Development (NTRD) Program to facilitate the development and verification of new technologies to maximize the reduction of Nitrogen Oxides from diesel fueled vehicles and equipment; and

Whereas TERC's staff and the Houston Advanced Research Center (HARC) have conferred with the Environmental Protection Agency (EPA), the Texas Commission on Environmental Quality (TCEQ) and the Environmental Technology Advisory Council on the strategies TERC should undertake to achieve the goals of the NTRD Program; and

Whereas the EPA and the Environmental Technology Advisory Council have advised TERC that the development and verification of emission reduction technologies may be facilitated and expedited if a Texas Diesel Testing Center is established; and

Whereas TERC's staff and the Houston Advanced Research Center have developed a plan to establish a Texas Diesel Testing Center that would meet the EPA's protocols and specifications, and also support and expedite the development and verification of new emission reduction technologies.

Now, Therefore, Be It Resolved that the Board of Directors of the Texas Environmental Research Consortium hereby authorizes the Houston Advanced Research Center to publish and issue a Request for Grant Assistance for the purpose of receiving proposals from interested parties to support the establishment of the Texas Diesel Testing Center.

Be It Further Resolved that TERC's Executive Director and the Houston Advanced Research Center also are authorized to budget and expend up to \$4.0 million of the NTRD Program's FY 2006 and FY 2007 budget to support development of the Texas Diesel Testing Center.

Adopted and Approved this 13th day of June 2006

Bruce LaBoon, Chairman

Project Summary: RFGA 4 Support of Texas Diesel Test Facility

The EPA has developed the Voluntary Diesel Retrofit Program the objective of which is to "...introduce verified technologies to the market as cost effectively as possible, while providing customers with confidence that verified technologies will provide emission reductions as advertised." In order for a new technology to become verified by the EPA it must go through an extensive verification process. The EPA verification program is intended for commercial-ready technologies. Technologies that are still under development are not eligible for verification. There is a gap, or barrier, to commercialization of new/novel technologies that reduce nitrogen oxide (NOx) emissions from diesel engines.

The current EPA verification program for diesel technologies can be time consuming and costly. To date, only a few of diesel retrofit technologies have been verified through the Voluntary Diesel Retrofit Program. This is due in part to the few facilities in the country certified to carry out these verifications. The verification step can therefore be the bottleneck in getting emission reduction technologies to the marketplace. There are many promising technologies that are in development and have not progressed to the near-commercialization stage in which they are ready for verification. Evaluation of such technologies in a verification facility exasperates the verification bottleneck.

In order to help alleviate the burden on the verification process, a technology screening process is needed to identify those promising technologies that warrant further development and those that are ready to be fast-tracked through the verification process. A screening process, which should be carried out by an independent organization, is also needed to assess the prospects of competing technologies, and to compare technologies for a range of engine types and operating conditions.

In addition, with the advent of hybrid technology and other advancements, there is a strong need for a large chassis dynamometer test facility. The EPA task group developing the verification testing protocol for hybrids is strongly considering having the testing performed at a chassis dynamometer facility.

TERC and HARC have explored alternatives to address the issue of accelerating the development of NOx reduction technologies. A need for a testing facility to work with technology developers has been identified. Conversations have been held with various EPA offices to initiate discussions on how a Texas diesel test facility can complement the EPA verification effort. The EPA has confirmed that there is a strong need to screen technologies and to work with technology vendors prior to verification testing. In addition, there is a need to test verified technologies for alternative applications.

A request for grant applications will be developed and issued to solicit potential projects to expand an existing diesel test facility within the state of Texas to handle the need to screen emission reduction technologies and thereby debottleneck the verification process. The facility

should also be able to test large hybrid trucks. It is anticipated that a total of \$4,000,000 will be awarded for one project.