3-22-15

Gina McCarthy
Administrator
U.S. Environmental Protection Agency

Re: Docket ID No. EPA-HQ-OAR-2010-0108 (40 CFR Part 50, National Ambient Air Quality Standards for Lead; Proposed Rule - Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015, p 278-324.)

In October of 2014, at the LEAD[1] conference in Georgetown, your speech contained the following,

"…because we took action, our kids won't grow up breathing toxic leaded gas fumes."[2]

Unfortunately, this statement is not true for kids who live near lead emitting smelters, other lead emitting industries, and around numerous airports where leaded aviation fuel is still used. These children continue to breathe air tainted with lead. Because you have judged to leave the NAAQS for lead at 150 ng/m^3 (0.15 ug/m^3) these children, albeit "*a small percentile of the population*"[3], will not be protected with "*an adequate margin of safety.*"[4]

I submit this letter of comment on behalf of Stephanie who is 13 months old. Stephanie lives near the largest facility source of lead pollution in Oregon, the Hillsboro Airport.[5] Stephanie's blood lead level is 1,200 ng/dl.[6]

To be compliant with the Clean Air Act[7], I believe the information and analysis contained in the current review materials makes it requisite to lower the NAAQS for lead. Not lowering the NAAQS for lead because there are some "data gaps and uncertainties"[8] is irresponsible. While we are waiting for absolute certainty, some children are at risk. To clear up these "data gaps and uncertainties" will require, if they are even done, a decade or two of studies evaluating maternal and fetal blood lead levels, maternal lead burden at time of conception, ambient air [Pb] levels, consideration of other multimedia lead sources, and correlation with later neurocognitive function (IQ, ADHD, Conduct Disorders, etc.).

Assuming that such studies started tomorrow, the "gaps and uncertainties" will not be eliminated until perhaps 2025 to 2035. That will be too late for Stephanie and the other children that live near sources of lead air pollution. Given what is presently known about lead, including animal and plant studies, waiting for "certainty" is most disheartening, a classic case of "analysis paralysis"[9].

The current standard <u>does not</u> provide "*an adequate margin of safety*" for **<u>all</u>** of the public[10].

If there was a known threshold for the toxicity of lead then not lowering the NAAQS might be defensible. That, however, is not the case. The 2014 <u>Policy Assessment for the Review of the Lead National Ambient Air Quality Standards</u> (PA) recognizes that neurocognitive effects of lead have been demonstrated at the lowest blood levels so far studied.[11] The current review of the NAAQS for lead concludes that no threshold for lead's toxicity has been established[12], though not precluded.[13] EPA's Integrated Risk Information System (IRIS) also concludes there is no threshold for lead's toxicity.[14]

Without a toxicity threshold, not lowering the current NAAQS for lead continues to allow, and can in fact, facilitate[15] **increased** lead emissions.

The 2014 Policy Assessment (PA) states,

> "*Relative to the previous Pb NAAQS* [1.5 ug/m^3], *substantial reduction in estimates of air-related risk is demonstrated across the full set of potential alternative standards simulated (Table 3-10).*"[16]

Please note that the lowest alternative standard simulated was 0.02 ug/m^3.[17]

The 2014 PA also states,

> "*The median air-related IQ loss estimate for the current standard* [0.15 ug/ m^3], *in the Generalized (local) Urban Case Study, newly derived by interpolation from 2007 REA results, falls somewhere within the lower and upper bounds of 1.5 and 3.4 points IQ loss*[18], *respectively* (Table 3-11)." [19]

In comparison, the lowest alternative standard simulated, 0.02 ug/m^3, estimates a median air-related IQ loss which falls somewhere within the lower and upper bounds of 0.3 and 2.6 IQ points[20], a significantly lower loss range than that which is estimated to occur with the current standard of 0.15 ug/m^3. The delta of IQ loss between the current standard of 0.15 ug/ m^3 and the lowest alternative standard simulated of a 0.02 ug/ m^3 is 1.2 (low boundary) and 0.8 (high boundary) IQ points.

The 2015 Proposed Rule states,

> "*Based primarily on studies of FSIQ* [full scale IQ]*, the assessment of the currently available studies, as was the case in the last review, continues to recognize a nonlinear relationship between blood Pb and effects on cognitive function, with a greater incremental effect (greater slope) at lower relative to higher blood Pb levels within the range thus far studied, extending from well above 10 µg/dL to below 5 µg/dL (*2013 *ISA, section 4.3.12).*"[21]

In 2008, previous EPA Administrator Johnson stated,

> "*Ideally air-related (as well as other) exposures to environmental Pb would be reduced to the point that no IQ impact in children would occur.*"[22]

Unfortunately, even though Administrator Johnson lowered the NAAQS for lead ten-fold in 2004, he did not lower the standard sufficiently to achieve that ideal. Your judgement in the present Proposed Rule is to not revise the current NAAQS for lead – citing "gaps and uncertainties". While there are "gaps and uncertainties" the science to date overwhelming points to the almost certain conclusion that lead's toxicity respects no threshold. The "gaps and uncertainties" excuse for not seeking the ideal, for not doing all within your power to protect, with "*an adequate margin of safety*", those children living near lead emitting sources rings hollow.

A decade ago, in 2005, the CDC stated,

> "*Ultimately,* ***all nonessential uses of lead should be eliminated****...all levels of government share responsibility for primary prevention of childhood lead poisoning.*"[23]

Not lowering the NAAQS for lead does not facilitate the CDC's recommendation. Rather, to the contrary, it can do just the opposite. In Hillsboro, Oregon, the Hillsboro Airport was estimated, according to the National Emissions Inventory, to have emitted 0.68 tons of lead in 2008[24]. With a newly constructed additional runway the Federal Aviation Administration (FAA) estimates that lead emissions will increase to 0.9 tons per year.[25] In defense of their "Finding of No Significant Impact" (FONSI) for the additional runway the FAA cited the NAAQS for lead of 0.15 ug/m^3 to support their FONSI from lead pollution due to an additional runway. The FAA relied on the airport owner's consultant's modeling, which estimated air concentrations below the NAAQS of 0.15 ug/m^3. [26]

I urge the Administrator to consider those children still at risk of lead's extreme toxicity, to consider that any amount of lead in a fetus or child's body is likely deleterious and to consider the damage that will occur while we wait for more studies to close the "*gaps*" and remove the "*uncertainties*". Please reconsider your judgement not to revise the NAAQS for lead. The PA, ISA, IRIS, and CDC all provide justification for lowering the standard if you should so judge that lowering the standard is "*requisite*".

Please lower the NAAQS for lead to 0.02 ug/m^3, or better yet, lower the NAAQS for lead to what the EPA has indicated is the "*average pristine ambient lead concentration*" of 0.0005 ug/m^3.[27] Our society has waited much to long to begin to write the final chapter on lead emissions.

Considering "Environmental Justice"[28],

> *"[Environmental Justice[29]] will be achieved when everyone enjoys the same degree of protection from environmental and health hazards."* (EPA Website 3-21-2015[30])

> *"This February [2014] we're launching a yearlong effort to highlight our leadership on environmental justice through our actions and partnerships nationwide. We'll show the progress we've made on Plan EJ 2014 - our roadmap to integrate environmental justice throughout all of EPA's programs and policies. Each office across the country plays a critical role in strengthening our mission to protect health and environment for **every** American. At EPA and across the federal family I'm convinced we'll continue our unwavering pursuit of environmental justice to secure the basic promise of equal opportunity for all."*
> (EPA Administrator 2-5-2014)

I would submit that those children, such as Stephanie, who are on welfare living near lead sources, are not receiving environmental justice.

In closing, I will quote another statement from your 2014 LEAD conference speech.

> *"…let's remind ourselves what we're capable of."*[31]

Please accept this letter of comment as a "reminder".

Thank you,

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[1] The acronym "LEAD" stands for "Leadership Experience and Development". (Initially I thought this was a conference about lead pollution because of the conference name and because lead pollution was mentioned a lot, but later I realized it was a "leadership" conference, not a conference about lead pollution.) Some references to lead pollution in the speech include the following: "…*It was the auto industry that set the pace of the American economy. Unfortunately, also in the 60's, our rivers were burning, future superfund sites were popping up all over, smokestacks were spewing black soot, and cars were fueled by leaded gasoline. All the progress was great but folks began to realize that it came at too high a cost. Sure, leaded gasoline was affordable and reliable; but its full cost didn't show up at the pump. Toxic leaded gas fumes and other pollutants choked our cities, impairing public health. Lead fumes even threatened brain development in our children*. [JIM LUBISCHER - ACTUALLY LEAD FUMES WERE NOT JUST A THREAT TO BRAIN DEVELOPMENT. KNOWLEDGE STARTING IN THE 1970's HAS SHOWN THAT LEAD FUMES MOST CERTAINLY CONTRIBUTED TO BRAIN DAMAGE OF NUMEROUS CHILDREN.] *The, quote, 'price of progress' proved too much to pay. Millions of people demanded cleaner fuel for their cars, and EPA responded. Despite special-interests disputing the science and the costs, EPA phased out leaded gas. And because we took action, our kids won't grow up breathing toxic leaded gas fumes. We can, and must, take on climate change the same way. Acting on climate change is not just a responsibility we must accept for the sake of our children; it's an opportunity we should seize, to retool and resurge with new technologies, new industries, and new jobs… This is our new catalytic-converter-moment. As we work to build a cleaner, low-carbon energy future—let's remind ourselves what we're capable of*." EPA Administrator Gina McCarthy remarks at the Georgetown LEAD Conference, As Prepared, on 10-24-2014. http://yosemite.epa.gov/opa/admpress.nsf/8d49f7ad4bbcf4ef852573590040b7f6/ca425d96d817267585257d7b005c8f40!opendocument (or try: EPA Home > N > Newsroom > Administrator's Speeches > 10/24/2014 Administrator Gina McCarthy, Remarks at Georgetown LEAD Conference, As Prepared)

[2] EPA Administrator Gina McCarthy remarks at the Georgetown LEAD Conference, As Prepared, on 10-24-2014. http://yosemite.epa.gov/opa/admpress.nsf/8d49f7ad4bbcf4ef852573590040b7f6/ca425d96d817267585257d7b005c8f40!opendocument (EPA Home > N > Newsroom > Administrator's Speeches > 10/24/2014 Administrator Gina McCarthy, Remarks at Georgetown LEAD Conference, As Prepared) Also see some excerpts of the speech in footnote #1 above.

[3] "*Thus, we conclude that the current evidence, as considered within the conceptual and quantitative context of the evidence-based framework, and current air monitoring information indicates that the current standard would be expected to achieve the public health policy goal recommended by CASAC in the last Pb NAAQS review that IQ loss on the order of one to two IQ points be 'prevented in all but a small percentile of the population' (73 FR 67000)*." (2014 EPA Policy Assessment for the Review of the Lead National Ambient Air Quality Standards, p 4-32)

[4] Clean Air Act Section 109(b)(1): "*National primary ambient air quality standards, prescribed under subsection (a) shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health.*"

[5] National Emissions Inventory 2008, 2011.

[6] I am a pediatrician and Stephanie (name changed to protect identity) is a 13-month-old patient of mine who lives 0.4 miles away from the largest facility source of lead in Oregon. Stephanie is one of those children who make up "*a small percentile of the population*" that will not be protected with "*an adequate margin of safety*" by your judgement to leave the NAAQS for lead at 150 ng/m^3 (0.15 ug/m^3). Stephanie has a blood lead level of 1,200 ng/dl (1.2 ug/dl). Everyday, Stephanie and her siblings breath air contaminated by aviation leaded gas emissions from "…*one of the largest airplane and helicopter training schools in the United States*." (http://www.flyhaa.com/en/page/about_us) Stephanie lives in a rental house built in 2004. Stephanie's mother told me she would move her children if she could, but she can't. Stephanie's family is on welfare. [Please note that when I last ran the numbers, 85% of my young patients have detectable levels of lead in their blood.]

[7] Clean Air Act Section 109(b)(1): "*National primary ambient air quality standards, prescribed under subsection (a) shall be ambient air quality standards the attainment and maintenance of which in the judgment of the Administrator, based on such criteria and allowing an adequate margin of safety, are requisite to protect the public health.*"

[8] "3. *CASAC Advice '…[a]lthough the current review incorporates a substantial body of new scientific literature, the new literature does not justify a revision to the standards because it does not significantly reduce substantial data gaps and uncertainties (e.g., air-blood Pb relationship at low levels; sources contributing to current population blood Pb levels, especially in children; the relationship between Pb and childhood neurocognitive function at current population exposure levels; the relationship between ambient air Pb and outdoor dust and surface soil Pb concentrations).' In recognition of these limitations in the available information, the CASAC provided recommendations on research to address these data gaps and uncertainties so as to inform future Pb NAAQS reviews*." Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015, p310

[9] "***Analysis paralysis** or **paralysis of analysis** is an anti-pattern, the state of over-analyzing (or over-thinking) a situation so that a decision or action is never taken, in effect paralyzing the outcome…The phrase applies to any situation where analysis may be applied to help make a decision and may be a dysfunctional element of organizational behavior. This is often phrased as paralysis by analysis, in contrast to extinct by instinct (making a fatal decision based on hasty judgment or a gut-reaction).*" Wikipedia (http://en.wikipedia.org/wiki/Analysis_paralysis)

[10] Pursuant to Section 109(b)(1) of the Clean Air Act, the Administrator shall establish a NAAQS for lead that "is requisite to protect the 'public health' ". A strict, and morally applicable, interpretation of "public" health would be the health of all citizens, every member of the state: The legal definition of "public", as found in Black's law dictionary [http://thelawdictionary.org/public/], is:

> "*Pertaining to a state, nation, or whole community; proceeding from, relating to, or affecting the whole body of people or an entire community. Open to all; notorious. Common to all or many; general; open to common use. Morgan v. Cree, 46 Vt. 786, 14 Am. Rep. 640; Crane v. Waters (C. C.) 10 Fed. 621; Austin v. Soule, 36 Vt. 650; Appeal of Eliot, 74 Coun. 586, 51 Atl. 558; 0'IIara v. Miller, 1 Kulp (Pa.) 295. A distinction has been made between the terms "public" aud* [sic] *"general." They are sometimes used as synonymous. The former term is applied strictly to that which concerns all the citizens aud* [sic] *every member of the state; while the latter includes a lesser, though still a large, portion of the community. 1 Greenl. Ev*."

[11] "…*in the case of the current standard level of 0.15 µg/m3, multiplication by the air-to-blood ratio of 7 yields a mean air-related blood Pb level of 1.05 µg/dL, which is half the level of the lowest blood Pb subgroup of pre-school children in which neurocognitive effects have been observed (Table 3-2 above; Miranda et al., 2009) and well below the means of subgroups for which continuous CR functions have been estimated (Table 3-3 above).[15] Such an extension below the lowest studied levels may be viewed as appropriate given the lack of identified blood Pb level threshold in the current evidence base for neurocognitive effects and the need for the NAAQS to provide a margin of safety.[16] We note, however, that the framework IQ loss estimates for still lower potential standard levels represent still greater extrapolations from the current evidence base with corresponding increased uncertainty*." EPA Policy Assessment for the Review of the Lead National Ambient Air Quality Standards, 2014, p 4-33.

[12] Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015: "…*within the range of blood Pb levels investigated in the available evidence base, a threshold level for neurocognitive effects was not identified (73 FR 66984, November 12, 2008; 2006 CD, p. 8-67)*." p287; "…*as in the last review, a threshold blood Pb level with which nervous system effects, and specifically cognitive effects, occur in young children cannot be discerned from the currently available studies (ISA, sections 1.9.3 and 4.3.12)*." p294; "…the PA notes that the evidence in this review, as in the last, does not establish a threshold blood Pb level for neurocognitive effects in young children (ISA, sections 1.9.4 and 4.3.12)." p307; "…*given the lack of identified blood Pb level threshold in the current evidence base for neurocognitive effects*…", p312.

13 "*As concluded in the ISA, however, 'the current evidence does not preclude the possibility of a threshold for neurodevelopmental effects in children existing with lower blood levels than those currently examined' (ISA, section 4.3.13)*". 2015 Proposed Rule, Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015, p 294.

14 EPA's Integrated Risk Information System (IRIS) finds it "*inappropriate*" to specify an RfD (and by extension an RfC) for lead because no threshold for lead's toxicity has been established; that, "*It appears that some of these effects [of lead], particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold*"; and that "*Lead bioaccumulates in the body*..." EPA's Integrated Risk Information System (IRIS) concludes it would be "*inappropriate*" to estimate an RfC for lead because no threshold for toxicity has been shown. See link @ http://www.epa.gov/iris/subst/0277.htm#refinhal IRIS states, "*I.B.1 Inhalation RfC Summary. No RfC is available. See Section I.A for additional information.*" Section I.A details why IRIS does not give an RfD (Reference Concentration for Chronic Oral Exposure) for lead and by extension for RfC (Reference Concentration for Chronic Inhalation Exposure). In short, no RfD (and by extension RfC) for lead is given because RfD and RfC are estimates that are "*likely to be without an appreciable risk of deleterious effects during a lifetime*." The RfD and RfC are both "*based on the assumption that thresholds exist for certain toxic effects*". IRIS goes on to explain, "*EPA considered providing an RfD for inorganic lead in 1985, and concluded that it was inappropriate to develop an RfD, as documented online in the following statement in 1988: A great deal of information on the health effects of lead has been obtained through decades of medical observation and scientific research. This information has been assessed in the development of air and water quality criteria by the Agency's Office of Health and Environmental Assessment (OHEA) in support of regulatory decision-making by the Office of Air Quality Planning and Standards (OAQPS) and by the Office of Drinking Water (ODW). By comparison to most other environmental toxicants, the degree of uncertainty about the health effects of lead is quite low. It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold. The Agency's RfD Work Group discussed inorganic lead (and lead compounds) at two meetings (07/08/1985 and 07/22/1985) and considered it inappropriate to develop an RfD for inorganic lead.*" [The IRIS report is available @ http://www.epa.gov/iris/subst/0277.htm#refinhal]

15 In Hillsboro, Oregon, the Hillsboro Airport was estimated, according to the National Emissions Inventory, to have emitted 0.68 tons of lead in 2008. With a newly constructed additional runway the Federal Aviation Administration (FAA) estimates that lead emissions will increase to 0.9 tons per year. [see footnote #25] In defense of their "Finding of No Significant Impact" (FONSI) for the additional runway the FAA used the NAAQS for lead of 0.15 ug/m^3 to support their FONSI from lead pollution due to an additional runway. The FAA relied on the airport owner's consultant modeling which estimated air concentrations lower than the NAAQS of 0.15ug/m^3 and so stated that they were below the NAAQS. [see footnote #26]

16 2014 Policy Assessment for the Review of the Lead National Ambient Air Quality Standards, p3-61.

17 2014 Policy Assessment for the Review of the Lead National Ambient Air Quality Standards, Table 3-10, p3-60.

18 The numbers used are the "estimates generated [~~are~~] using the C-R function in which we have the highest overall confidence (the log-linear with low-exposure linearization)." (2014 Policy Assessment for the Review of the Lead National Ambient Air Quality Standards, Table 3-11, p3-61)

19 2014 Policy Assessment for the Review of the Lead National Ambient Air Quality Standards p3-62.

20 2014 Policy Assessment for the Review of the Lead National Ambient Air Quality Standards, table 3-11, p3-61.

21 2015 Proposed Rule, Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015, p 294.

22 Federal Register / Vol. 73, No 98 / Tuesday, May 20, 2008, p 29242.

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[23] Preventing Lead Poisoning in Young Children, A Statement by the Centers for Disease Control and Prevention, August 2005, U.S Department of Health and Human Services, Public Health Service, p5.

[24] National Emissions Inventory 2008.

[25] Hillsboro Airport Parallel Runway 12L/30R Final *Supplemental* Environmental Assessment, Volume 1, Table 6-3, p 30.

[26] Hillsboro Airport Parallel Runway 12L/30R Final *Supplemental* Environmental Assessment, Volume 1, p 38-40.

[27] See page 72 of EPA's 2010 Development and Evaluation of an Air Quality Modeling Approach for Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline done at Santa Monica Airport in California. (EPA-420-R-10-007, February 2010): "The combined impacts from on-roadway mobile source Pb exhaust and entrained Pb emissions were shown to be less than the average pristine ambient background concentration of 0.5 ng/m3 and are therefore not expected to be a significant contributor to ambient Pb concentrations levels."

[28] *"J. Executive Order 12898: Federal Actions To Address Environmental Justice in Minority Populations and Low-Income Populations -*

> *The EPA believes that this action will not have disproportionately high and adverse human health or environmental effects on minority, low-income or indigenous populations. The action proposed in this notice is to retain without revision the existing NAAQS for Pb based on the Administrator's conclusion that the existing standards protect public health, including the health of sensitive groups, with an adequate margin of safety. As discussed earlier in this preamble (see section II), the EPA expressly considered the available information regarding health effects among at-risk populations in reaching the proposed decision that the existing standards are requisite*." (Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015, p321)

[29] *"Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work."* (EPA Website 3-21-15 http://www.epa.gov/environmentaljustice/)

[30] http://www.epa.gov/environmentaljustice/

[31] EPA Administrator Gina McCarthy remarks at the Georgetown LEAD Conference, As Prepared, on 10-24-2014. http://yosemite.epa.gov/opa/admpress.nsf/8d49f7ad4bbcf4ef852573590040b7f6/ca425d96d817267585257d7b005c8f40!opendocument (EPA Home > N > Newsroom > Administrator's Speeches – By Date > 10/24/2014 Administrator Gina McCarthy, Remarks at Georgetown LEAD Conference, As Prepared) Also see some excerpts of the speech in footnote #1 above.

2-3-15

Members of the Air Toxics Science Advisory Committee,

Re: Review of ABC for Lead (CAS# 7439-92-1)

Submitted by James T. Lubischer MD
Pediatrician
Aloha, Oregon

A) **Summary of Chronic Inhalation Exposure Values for Lead, Non-Cancer Effects**

EPA/IRIS:	No value listed as "essentially without a threshold".
EPA/PPRTV:	No value listed, defers to IRIS review.
WHO/IARC:	*
OEHHA/ARB adopted:	No value listed. Notes "no threshold" known.**
OEHHA/ARB proposed:	?
CDC/ATSDR:	No value listed as "threshold…has not been identified".
EPA/OAQPS:	NAAQS = 0.15ug/m3. Notes, "…threshold…cannot be discerned…"

[*Lead is "probably carcinogenic to humans". **The Consolidated Table Of OEHHA/ARB Approved Risk Assessment Health Values at page 5 lists an Inhalation Unit Risk $(ug/m3)^{-1}$ for cancer of 1.2E-05 TAC http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/documents/contable.pdf]

B) **Comments**

Lowering Oregon's ABC for lead is justified and necessary.[1]

A lower ABC is necessary because Oregon has 512 facility sources that continue to release lead into our air. According to the National Emissions Inventory two of these sources are estimated to emit over one-half tons per year (tpy). The highest facility source of lead in Oregon is the Hillsboro Airport with estimated emissions of 0.68 tpy in 2008, 0.58 tpy in 2011 and is forecast to emit 0.9 tpy by the year 2016 due to an additional runway.[2] About 10 tons of lead are estimated to be released into Oregon's air each year.[3]

> *"With regard to our understanding of the relationship between exposure or blood Pb levels in young children and neurocognitive effects, the evidence in this review, as in the last, does not establish a threshold blood Pb level for neurocognitive effects in young children (ISA, sections 1.9.4 and 4.3.12)"*
>
> EPA Policy Assessment for the Review of the Lead National Ambient Air Quality Standards May 2014 EPA-452/R-14-001, p 4-17
> http://www.epa.gov/ttn/naaqs/standards/pb/data/140501_pa_pb_fin.pdf

A lower ABC is justified because no threshold for the neurotoxic effects of lead on the developing child's brain has been found. My understanding is that an ABC is a concentration (of an air toxin) below which there results no adverse health effects over a lifetime.[4] Unless a threshold can be established for lead's neurotoxicity the ABC for lead must be zero or perhaps equivalent to what the EPA has considered "the average pristine ambient background concentration of 0.5 ng/m^3…"[5] (0.5 ng/m^3 = 0.0005 ug/m^3)

I strongly recommend ATSAC review the "Risk Assessment" analysis starting at page 4-28 of the 2007 Policy Assessment OAQPS Staff Paper which discusses expected IQ losses for various air quality scenarios. Starting at page 4-34, tables 4-3 through 4-8 show the IQ loss expected and numbers of children affected even at the lowest level examined, 0.02 ug/m^3.[6] (Per page 4-30, when looking at these tables the focus is on the LLL model values.)

As noted above, IRIS, OEHHA/ARB, and CDC/ATSDR do not give chronic inhalation exposure values for lead. IRIS, OEHHA/ARB, and CDC/ATSDR each cite the lack of a threshold for lead toxicity. The EPA's Administrator also acknowledges the lack of a threshold for lead toxicity.[7] Notwithstanding this acknowledgement the Administrator has judged that a revision of the NAAQS for lead of 0.15 ug/m^3 is not requisite to protect the public health with an adequate margin of safety.

It is difficult to reconcile the Administrator's judgement not to revise the NAAQS of 0.15 ug/m^3 with the unanimous acknowledgement that there is no threshold for lead's neurotoxicity. The Administrator is required to determine an air concentration for lead "which is necessary, with an adequate margin of safety, to protect the public health". The judgement by the Administrator to not lower the NAAQS is framed in the recommendations by the Clean Air Advisory Committee (CASAC) in a "March 2007 letter", which stated,

> ``…*a population loss of 1-2 IQ points is highly significant from a public health perspective'' and that ``the primary lead standard should be set so as to protect 99.5% of the population from exceeding that IQ*" [8]

> [an IQ loss of 1-2 points should be] ``*prevented in all but a small percentile of the population*".[9]

So the NAAQS allows some IQ loss for some children. Therefore, the Administrator did not specify a standard that is "*likely to be without an appreciable risk of deleterious effects during a lifetime*" for all children. Also, please note that in 2008 the Administrator stated, "*Ideally air-related (as well as other) exposures to environmental Pb would be reduced to the point that no IQ impact in children would occur*" (73 FR 22998, November 12,20008)."[10] In short, the current proposed rule to not lower the NAAQS for lead of 0.15 ug/m^3 allows for some loss of IQ in some children. Basing Oregon's ABC on the NAAQS will leave some children at risk. We can do better.

~~B~~ C) **Review of relevant sources**

Integrated Risk Information System (IRIS)

IRIS concludes it is "inappropriate" to estimate an RfD (and by extension an RfC) for lead because RfDs and RfCs are estimates of "daily exposure to the human population (including sensitive subgroups) that ~~is~~ [are] likely to be without an appreciable risk of deleterious effects during a lifetime."

IRIS concludes such estimates would be "inappropriate" because no threshold for lead's toxicity has been established. To the contrary, IRIS states, "It appears that some of these effects [of lead], particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold."[11]

IRIS states lead is a "probable human carcinogen" [http://www.epa.gov/iris/subst/0277.htm#refinhal see II.A.1]

IRIS: "I.A.1. Oral RfD Summary… Lead bioaccumulates in the body, primarily in the skeleton." [The IRIS report is available @ http://www.epa.gov/iris/subst/0277.htm#refinhal see fifth paragraph of I.A.1]

IRIS: "II.A.4. Supporting Data for Carcinogenicity…Under certain conditions lead compounds are capable of inducing chromosomal aberrations in vivo and in tissue cultures. Grandjean et al. (1983) showed a relationship between sister chromatid exchange and lead exposure in exposed workers. Lead has been shown, in a number of DNA structure and function assays, to affect the molecular processes associated with the regulation of gene expression (U.S. EPA, 1986b)." [The IRIS report is available @ http://www.epa.gov/iris/subst/0277.htm#refinhal see second paragraph of II.A.4]

Provisional Peer Review Toxicity Values (PPRTVs)

The PPRTVs has no listing for lead. [http://hhpprtv.ornl.gov/quickview/pprtv.php and http://hhpprtv.ornl.gov/quickview/pprtv_compare.php]

"The PPRTV electronic library summarizes provisional toxicity values for contaminants in the table, when no IRIS value on that contaminant is available." [http://hhpprtv.ornl.gov/ > User's Guide, first sentence] IRIS has reviewed lead as noted above.

"Once an IRIS value for a specific chemical becomes available for Agency review, the analogous PPRTV for that same chemical is retired." http://hhpprtv.ornl.gov/issue_papers/Ammonia.pdf p 1, last paragraph.

International Agency for Research on Cancer (IARC)

"Inorganic lead compounds are probably carcinogenic to humans." http://apps.who.int/bookorders/MDIbookPDF/Book/17200087.pdf , on right, second paragraph, line 12.

Office of Environmental Health Hazard Assessment / Air Resources Board (OEHHA/ARB)

OEHHA does not include lead in their Acute, 8-hour and Chronic Reference Exposure Level (REL) Summary. http://www.oehha.ca.gov/air/allrels.html June 2014 [Non-cancer Health Effects (RELs) http://www.oehha.ca.gov/ > home > Air > then at menu on far right choose "Non-cancer health effects (RELs) > "View the Table of OEHHA Acute, 8-hour and Chronic Reference Exposure Level (RELs)"]

The Consolidated Table Of OEHHA/ARB Approved Risk Assessment Health Values contains no listing for non-cancer chronic inhalation effects. p5 @ http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/documents/contable.pdf

"The ARB has identified lead and vinyl chloride as 'toxic air contaminants' with no threshold level of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants. http://www.arb.ca.gov/research/aaqs/aaqs2.pdf > second page, footnote #11 ~~6-4-13~~ California Air Resources Board (6-4-13)

A 1996 Executive Summary by the Staff of the ARB / OEHHA Report "Proposed Identification of Inorganic Lead as a Toxic Air Contaminant" stated, "…the OEHHA staff concurs with the U.S. EPA, the CDC, and the National Academy of Sciences that 10 micrograms per deciliter should be regarded as the level of concern for children. A no observed adverse effect level (NOAEL) has not yet been clearly identified, and an analysis, specifically focusing on the determination of a threshold, was unable to detect one." http://www.arb.ca.gov/toxics/id/summary/leadsum.pdf , p 10, last paragraph.

"If the Board [Air Resources Board] has found that there is not sufficient available scientific evidence to support the identification of a threshold exposure level, the "Threshold" column specifies "None identified." Lead's "Threshold Determination" is "None identified". 2011 http://www.arb.ca.gov/toxics/id/taclist.htm

"In 1996, the ARB established a cancer potency value of 1.2 x 10^{-5} per µg/m^3 for inorganic lead exposure. This value also applies to lead acetate, lead phosphate and lead subacetate." http://www.arb.ca.gov/research/aaqs/caaqs/pb-1/pb-1.htm > History of Lead Quality Standard

The Consolidated Table Of OEHHA/ARB Approved Risk Assessment Health Values at page 5 lists an Inhalation Unit Risk $(ug/m^3)^{-1}$ for cancer of 1.2E-05 TAC http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/documents/contable.pdf

Substances and Disease Registry (ATSDR)

The December 2014 ATSDR Minimal Risk Level list has no listing for lead.
http://www.atsdr.cdc.gov/mrls/pdfs/atsdr_mrls_december_2014.pdf

"MRLs (Minimal Risk Levels) were not derived for lead because a clear threshold for some of the more sensitive effects in humans has not been identified." http://www.atsdr.cdc.gov/toxguides/toxguide-13.pdf > scroll down to "Minimal Risk Levels (MRLs)"

"The body accumulates lead over a lifetime and normally releases it very slowly." [http://www.atsdr.cdc.gov/csem/csem.asp?csem=7&po=9 May need to download PDF and see page 29, "Key Points"; or click on :"Biological Fate" in menu on left of initial page, then go down to "Key Points".]

For the references to "Toxicological Profile for Lead" cited below go to http://www.atsdr.cdc.gov/ToxProfiles/TP.asp?id=96&tid=22 > click on "PDF Version".
"...elemental lead cannot be broken down..." p4 "Toxicological Profile for Lead", US Department of Health and Human Services, Public Health Service Agency for Toxic Substances and Disease Registry, August 2007.

"Fetuses exposed to lead in the womb...may be born *prematurely* and have *lower weights* at birth. Exposure in the womb, in infancy, or in early childhood also may *slow mental development* and cause *lower intelligence* later in childhood. There is evidence that these effects may persist beyond childhood..." p10, last 3 sentences of second paragraph, "Toxicological Profile for Lead", US Department of Health and Human Services, Public Health Service Agency for Toxic Substances and Disease Registry, August 2007.

"Lead can be transferred from the mother to the fetus and also from the mother to infants via maternal milk." p156, line 12 in "Toxicological Profile for Lead", US Department of Health and Human Services, Public Health Service Agency for Toxic Substances and Disease Registry, August 2007.

"…several other population groups at risk for potential exposure to high levels of lead can be identified: preschool-age children and fetuses…" p374, last paragraph first sentence, "Toxicological Profile for Lead", US Department of Health and Human Services, Public Health Service Agency for Toxic Substances and Disease Registry, August 2007.

~~"Lead can be transferred from mother to the fetus and also from the mother to infants via maternal milk." p156, line 12 in "Toxicological Profile for Lead", US Department of Health and Human Services, Public Health Service Agency for Toxic Substances and Disease Registry, August 2007~~. duplicate

"The most important step parents, doctors, and others can take is to prevent lead exposure before it occurs. CDC recommends focusing on primary prevention of lead exposure." [http://www.atsdr.cdc.gov/sites/toxzine/lead_toxzine.html > scroll down to "Governmental Regulations and Recommendations" close to the end; first sentence of fifth paragraph.]

Guidelines For The Identification And Management Of Lead Exposure In Pregnant And Lactating Women, November 2010. U.S. Department of Health and Human Services, Atlanta, GA: "Because there is no apparent threshold below which adverse effects of lead do not occur,…[the] CDC has not identified an allowable exposure level, level of concern, or any other bright line intended to connote a safe or unsafe level of exposure for either mother or fetus." (page iv, line 2); "Lead readily crosses the placenta by passive diffusion and has been measured in the fetal brain as early as the end of the first trimester, so primary prevention of exposure is particularly important to reduce risk." (page 27, fourth "Key Points")
http://www.cdc.gov/nceh/lead/publications/LeadandPregnancy2010.pdf

Office of Air Quality Planning and Standards (OAQPS)

The National Ambient Air Quality Standard for Lead is 0.15 ug/m^3 with a rolling 3 month average.

http://www.epa.gov/oar/oaqps/ > Under "Air Quality" choose "National Ambient Air Quality Standards. (NAAQS)".

[To find the Federal Register cited below go to http://www.gpo.gov/fdsys/granule/FR-2008-11-12/E8-25654 > In the "Actions" box on the left choose "Browse the Federal Register" > 2015 > January > Monday, January 5 > Environmental Protection Agency > choose "PDF" or "Text" (In the "Text" choice you can copy sentences easily).]
EPA Administrator acknowledges that no threshold has been found for the neurotoxic effects of lead. See the Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015: "…within the range of blood Pb levels investigated in the available evidence base, a threshold level for neurocognitive effects was not identified (73 FR 66984, November 12, 2008; 2006 CD, p. 8-67)." p287, line 13 of "PDF" or line 7 of "Text"; "…as in the last review, a threshold blood Pb level with which nervous system effects, and specifically cognitive effects, occur in young children cannot be discerned from the currently available studies (ISA, sections 1.9.3 and 4.3.12)." p294, line 21 of "PDF"; or in "Text" go to first sentence of the paragraph beginning with "We additionally note…" ; "…the PA notes that the evidence in this review, as in the last, does not establish a threshold blood Pb level for neurocognitive effects in young children (ISA, sections 1.9.4 and 4.3.12)." p307, line 10 in "PDF" ; line 8 in "Text"; "…given the lack of identified blood Pb level threshold in the current evidence base for neurocognitive effects…", p312, third column line 10 in "PDF"; or line 17 of paragraph beginning with "In drawing conclusions…" in the "Text" version.

EPA's 2013 Integrated Science Assessment for Lead, page lxxxviii, last sentence of first paragraph (EPA/600/R-10/075F | June 2013 | ~~www.epa.gov~~) states,"…there is no evidence of a threshold below which there are no harmful effects on cognition from Pb [lead] exposure." [Go to http://cfpub.epa.gov/ncea/cfm/recordisplay.cfm?deid=255721 > Downloads > Lead ISA Final Report with Errata Sheet (PDF)]

"The EPA concludes that a causal relationship is likely to exist between Pb exposure and cancer, based primarily on consistent, strong evidence from experimental animal studies, but inconsistent epidemiological evidence (ISA, section 4.10.5). Lead has also been classified as a probable human carcinogen by the International Agency for Research on Cancer, based mainly on sufficient animal evidence, and as reasonably anticipated to be a human carcinogen by the U.S. National Toxicology Program (ISA, section 4.10)."[12]

Thank you,

James T. Lubischer MD

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[1] Per the Clean Air Act, Oregon has the authority to establish ambient air quality standards "which are more stringent than the national standards." CFR Title 40, Chapter 1, Subchapter C, Part 50, Section 50.2(d) gives Oregon the authority to establish a lower standard for lead that the NAAQS. §50.2 Scope. 50.2(d): "The proposal, promulgation, or revision of national primary and secondary ambient air quality standards shall not prohibit any State or Indian country from establishing ambient air quality standards for that State or area under a tribal CAA program or any portion thereof which are more stringent than the national standards." [See http://www.ecfr.gov/cgi-bin/text-idx?SID=e8d697599f0308b726c8c2c1409d9288&node=se40.2.50_12&rgn=div8]

[2] See page 30, Table 6-3, of the 2/14 Hillsboro Airport Parallel Runway 12L/30R Final *Supplemental* Environmental Assessment.)

[3] About 10 tons of lead are emitted in Oregon every year. According to the 2011 National Emissions Inventory [http://www.epa.gov/ttn/chief/net/2011inventory.html , scroll down to "Maps and Fusion Tables" > Lead Table > Filter > State > Or] there are 512 facility sites in Oregon that emit lead into the air, the overwhelming majority being airports. Oregon's top emitting airports' collectively emit over 3 tons of lead just in the landing-takeoff cycles at airports. (The Port of Portland estimates that Hillsboro Airport alone will emit 0.9 tons by 2016– See page 30, Table 6-3, of the 2/14 Hillsboro Airport Parallel Runway 12L/30R Final *Supplemental* Environmental

Assessment.) In 2008 an additional 5.3 tons was emitted by aircraft during the "cruise" phase of flight. [See Calculating Piston - Engine Aircraft Airport Inventories for Lead for the 2008 National Emissions Inventory, by the Assessment and Standards Division Office of Transportation and Air Quality U.S. Environmental Protection Agency @ http://www.epa.gov/otaq/regs/nonroad/aviation/420b10044.pdf .

4 Pursuant to OAR 340-246-0090, Oregon's Ambient Benchmark Concentrations (ABC) are "…concentrations of air toxics that serve as goals in the Oregon Air Toxics Program. They are based on human health risk and hazard levels considering sensitive populations." Also, "Oregon air toxics benchmarks are based on concentration levels that would result in a cancer risk of one-in-a-million additional cancers based on a lifetime of exposure. For non-carcinogens, the benchmarks are levels you could breathe for a lifetime without any non-cancer health effects." [DEQ website @ http://www.deq.state.or.us/aq/toxics/benchmark.htm .]

5 See page 72 of EPA's 2010 Development and Evaluation of an Air Quality Modeling Approach for Lead Emissions from Piston-Engine Aircraft Operating on Leaded Aviation Gasoline done at Santa Monica Airport in California. (EPA-420-R-10-007, February 2010): "The combined impacts from on-roadway mobile source Pb exhaust and entrained Pb emissions were shown to be less than the average pristine ambient background concentration of 0.5 ng/m3 and are therefore not expected to be a significant contributor to ambient Pb concentrations levels."

6 Review of the National Ambient Air Quality Standards for Lead: Policy Assessment of Scientific and Technical Information, OAQPS Staff Paper, November 2007, EPA-452/R-07-013. http://www.epa.gov/ttn/naaqs/standards/pb/data/20071101_pb_staff.pdf

7 Federal Register / Vol. 80, No. 2 / Monday, January 5, 2015: "…within the range of blood Pb levels investigated in the available evidence base, a threshold level for neurocognitive effects was not identified (73 FR 66984, November 12, 2008; 2006 CD, p. 8-67)." p287; "…as in the last review, a threshold blood Pb level with which nervous system effects, and specifically cognitive effects, occur in young children cannot be discerned from the currently available studies (ISA, sections 1.9.3 and 4.3.12)." p294; "…the PA notes that the evidence in this review, as in the last, does not establish a threshold blood Pb level for neurocognitive effects in young children (ISA, sections 1.9.4 and 4.3.12)." p307; "…given the lack of identified blood Pb level threshold in the current evidence base for neurocognitive effects…", p312.

8 Federal Register Volume 73, Number 219 (Wednesday, November 12, 2008, page 67000. http://www.gpo.gov/fdsys/pkg/FR-2008-11-12/pdf/E8-25654.pdf

9 Ibid at page 67000. (In paragraph that starts with "In their July 2008 advice…)

10 Ibid at page ~~289.~~ 67004 (In paragraph that starts with "As noted in the proposal…")

11 EPA's Integrated Risk Information System (IRIS) concludes it would be "*inappropriate*" to estimate an RfC for lead because no threshold for toxicity has been shown. See link @ http://www.epa.gov/iris/subst/0277.htm#refinhal IRIS states, "*I.B.1 Inhalation RfC Summary. No RfC is available. See Section I.A for additional information.*" Section I.A details why IRIS does not give an RfD (Reference Concentration for Chronic Oral Exposure) for lead and by extension for RfC (Reference Concentration for Chronic Inhalation Exposure). In short, no RfD (and by extension RfC) for lead is given because RfD and RfC are estimates that are "*likely to be without an appreciable risk of deleterious effects during a lifetime*." The RfD and RfC are both "*based on the assumption that thresholds exist for certain toxic effects*". IRIS goes on to explain, "*EPA considered providing an RfD for inorganic lead in 1985, and concluded that it was inappropriate to develop an RfD, as documented online in the following statement in 1988: A great deal of information on the health effects of lead has been obtained through decades of medical observation and scientific research. This information has been assessed in the development of air and water quality criteria by the Agency's Office of Health and Environmental Assessment (OHEA) in support of regulatory decision-making by the Office of Air Quality Planning and Standards (OAQPS) and*

by the Office of Drinking Water (ODW). By comparison to most other environmental toxicants, the degree of uncertainty about the health effects of lead is quite low. It appears that some of these effects, particularly changes in the levels of certain blood enzymes and in aspects of children's neurobehavioral development, may occur at blood lead levels so low as to be essentially without a threshold. The Agency's RfD Work Group discussed inorganic lead (and lead compounds) at two meetings (07/08/1985 and 07/22/1985) and considered it inappropriate to develop an RfD for inorganic lead." [The IRIS report is available @ http://www.epa.gov/iris/subst/0277.htm#refinhal]

[12] Footnote 24 at page 290 of the EPA Administrator's Proposed Rule which may be found @ http://www.gpo.gov/fdsys/pkg/FR-2015-01-05/pdf/2014-30681.pdf

BUSINESS CASE ASSESSMENT TO PROVIDE MOGAS AT PORTLAND-HILLSBORO AIRPORT

PREPARED FOR THE:

PORT OF PORTLAND

PREPARED BY:

KB ENVIRONMENTAL SCIENCES, INC.

DECEMBER 15, 2014

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EXECUTIVE SUMMARY

This report documents an assessment designed and performed to evaluate the feasibility of providing unleaded, ethanol-free, fuel (commonly known as "mogas") at Portland-Hillsboro Airport (HIO), in addition to the other aviation fuels currently offered at the airport. Presently, the fixed base operators (FBOs) at HIO sell two types of aviation fuels: (i.) avgas - a lead-containing fuel normally referred to as 100LL (low lead) and (ii.) jet fuel.

In order to address this and other relevant topics regarding the possible offering of mogas at HIO, the assessment included research into the recent history of the use of avgas and mogas by the aviation industry nationwide and the on-going federal program to ultimately replace and phase-out 100LL. The research also involved contact and interviews with representatives from the mogas supply industry and representatives from other airports in Oregon and elsewhere in the U.S. that are presently selling mogas. Another important component of the assessment was an evaluation of the HIO aircraft fleet and a 2014 survey of more than 300 pilots affiliated with HIO that was conducted for this study to determine if they can (and would) use mogas if it were offered.

Based upon the research conducted in support of this this assessment, the following essential findings are noteworthy:

- **Avgas Replacement Fuel** - The FAA has established a program and performance metric to make available by 2018 an unleaded replacement fuel for leaded aviation gasoline that is usable by most GA aircraft. Following that milestone, a phase-out period for the leaded fuels would likely extend to 2024 (i.e., approximately 10 years from now) at the earliest.
- **Mogas Use** - Although mogas has been available since the early 1980s, it is still a "niche" fuel as only 120 airports nationwide (i.e., less than one percent) presently offer it for sale. Of these, only two are in Oregon: Lebanon State and Grants Pass Airports.
- **Mogas Versus Avgas** – The amount of mogas throughput compared to avgas varies considerably from airport-to-airport with a range of 3 to 55 percent but their involvement with mogas is seemingly unique with the based aircraft fleet playing an important role.
- **HIO Fleet Characteristics** - Few, if any, of the airports that offer mogas compare closely to HIO in terms of total GA aircraft operational levels, fleet mix and clientele. In other words, HIO has substantially more operations and an overall GA aircraft fleet that is more "business-related" than any of the other airports evaluated.
- **Mogas Availability** - Mogas is available from at least three distributors located proximal (i.e., <30 miles) to HIO. Depending on the volume of fuel delivered, the cost of mogas from these suppliers presently ranges from \$3.25 to \$3.50/gal., presently a four-year low.
- **Potential Mogas Use and Price at HIO** - Based upon an assessment of the GA aircraft that are affiliated with HIO, as little as 8.5 percent or as much as 29.5 percent of evaluated aircraft can currently use mogas were it offered at HIO. Nearly 80 percent of those responding to survey conducted in 2014 for this study said they would purchase mogas fuel for \$4.99 or less at HIO.
- **Business Case Assessment** - The findings of this assessment show potentially favorable business outcomes for offering mogas at HIO, depending on some basic affirmative conditions, reasonable assumptions and cooperative features.

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Table of Contents

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I. INTRODUCTION

This report documents an assessment commissioned by the Port of Portland (the Port) for use in evaluating unleaded, ethanol-free, fuel (commonly known as "mogas") as a potential alternative to 100LL at the Hillsboro Airport (HIO) in addition to the other aviation fuels currently offered at the Airport. The scope of work was prepared in consultation with the Port and with input from the Hillsboro Aviation Roundtable Exchange (HARE) Leaded Fuel Subcommittee in response to concerns about the potential health effects of lead-containing fuel. This report is intended to provide pertinent information on mogas fuel availability, its potential use, and some potential limitations that the Port and others should consider in evaluating the viability for its use at HIO.

Presently, the fixed base operators (FBOs) at HIO sell two types of aviation fuels fuel in accordance with the Minimum Standards established for this airport: (i.) avgas - a lead-containing fuel normally referred to as 100LL (low lead) and (ii.) jet. As discussed in later sections, a portion of the piston-engine aircraft fleet at HIO and elsewhere across the U.S. must use the 100LL fuel to achieve certain aircraft operating performance and safety-related requirements, otherwise undesired incidents, including engine failure, may occur. By comparison, a smaller portion of the piston-engine aircraft fleet is configured and certified to use mogas, either through original design, or via a Supplemental Type Certification (STC).[1] However, because mogas in not available at HIO, this component of the general aviation (GA) fleet utilizes 100LL unless the mogas is purchased off-site. If mogas were sold at HIO, it would provide an alternative to 100LL for those piston-engine aircraft that are certified to use the unleaded fuel.

Purpose of the Report

This report describes the outcome of an assessment designed and conducted to evaluate the feasibility and business case of providing mogas at Portland-Hillsboro Airport (HIO).

While lead has been eliminated from automotive gasoline for some time, avgas will continue to contain lead until an on-going federal program is complete to develop, test, and certify a no-lead replacement fuel for aircraft. As noted, some piston aircraft engines require the use of leaded fuels as an operational safety issue, because without the lead additive, the fuel octane levels would be too low for those engines. However, because of the potential health issues, a goal was established by FAA to develop an unleaded replacement fuel by 2018 that is usable by most general aviation aircraft.

In evaluating the feasibility of offering mogas at HIO, this assessment addressed a number of related questions and issues that are considered to be "key", including:

"Key" Questions & Issues

- What portion of the GA aircraft fleet operating at HIO could use mogas?
- If mogas were readily available, what would it cost, how much would be used, and what would be a reasonable selling price?

[1] A Supplemental Type Certificate (STC) is a national aviation authority-approved major modification or repair to an existing type certified aircraft, engine or propeller. As it adds to the existing type certificate, it is deemed "supplemental". Such certificates are under the purview of the Federal Aviation Administration (FAA).

- What are the start-up requirements, potential conflicts and/or special considerations for offering mogas, including equipment, license/permits, insurance, HIO Minimum Standards, etc. and how soon could those requirements be accomplished?
- What would be the on-going operations and maintenance (O/M) costs associated with the mogas sales activity?
- Once mogas sales were commenced, how long would it be continued (i.e., would it continue beyond the phase-out of 100LL)?

In order to address these and other relevant topics regarding the possible offering of mogas at HIO, the assessment also included research into the recent history of the use of avgas and mogas by the aviation industry nationwide and the on-going federal program to ultimately replace and phase-out 100LL. The research also involved contact and interviews with representatives from the mogas supply industry and representatives from other airports in Oregon and elsewhere in the U.S. that are presently selling mogas in addition to 100LL. Another important component of the assessment was a survey of more than 300 pilots affiliated with HIO to determine if they can and would use mogas if it were offered at the airport. The findings and conclusions of this assessment from all those activities are described in subsequent sections of this report.

II. HISTORY, UTILIZATION AND AVAILABILITY OF AVIATION FUELS

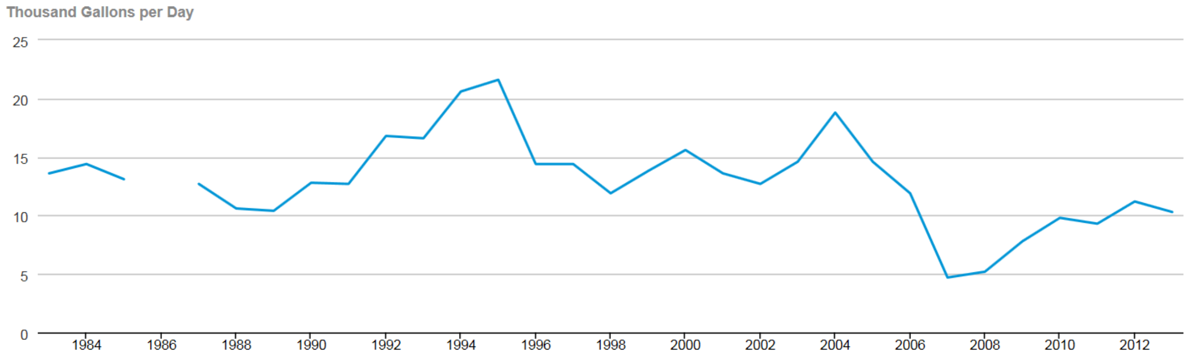
At one time, all gasoline produced for piston engines contained some lead to boost octane levels and deliver optimum performance for those engines. This included automobiles, aircraft, farm and construction equipment, and others. In response to emerging concerns over the effects of lead on human health, the federal Clean Air Act Amendments of 1990 represented the final step in a gradual reduction of lead in gasoline that began in the early 1970s and resulted in its elimination from automotive fuel by the end of 1995. During the time of the transition period, the attrition of the older automobile models requiring leaded fuel was accommodated by the development of the modern auto engines designed for unleaded fuels and other emission control features. According to the U.S. Environmental Protection Agency, the phase-out of lead from automotive fuels reduced the amount of airborne lead concentrations throughout the country by 89 percent between 1984 and 1995.[2]

Avgas (100LL) Fueling

As mentioned above, avgas continues to contain lead as an additive because some aircraft piston engines still require it for performance- and safety-related considerations. However, by way of perspective, the total avgas sold per year in the U.S. does not constitute one percent of the automotive fuel sold and, like automotive fuel, total avgas sales have trended downward over the past 30 years both nationwide and in Oregon.[3]

[2] U.S. Environmental Protection Agency, *Leaded Gas Phase-out / Air Quality Factsheet*, June 1995.
[3] U.S. Energy Information Administration, *Petroleum & Other Liquids/Aviation Gasoline Retail Sales*, October 1, 2014.

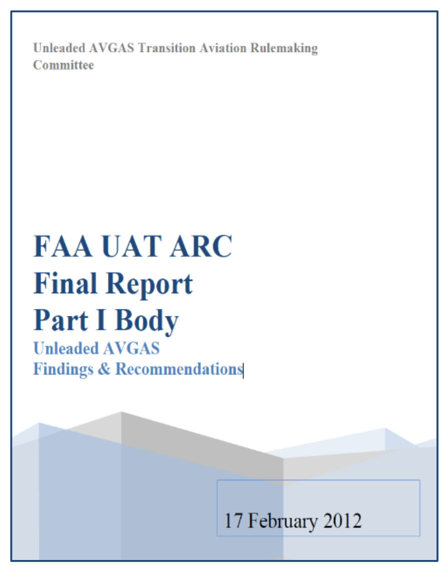
Avgas Sales in Oregon



Source: U.S. Energy Information Administration, *Petroleum & Other Liquids*, 2014.
Missing 1986 data in original figure.

Various grades of avgas are identified using the ASTM Motor Octane Number (MON) combined with the following alpha-designations to indicate lead content: low lead (LL); very low lead (VLL); or unleaded (UL). Almost all the avgas on the U.S. market today is low lead 100 MON avgas (or 100LL). This grade satisfies the requirement of all piston engines using avgas, regardless of their performance level. Of note, it is acceptable to use 100LL in engines designed and certified for lower-octane levels, but it is unacceptable to use the lower-octane fuels in the higher performance engines designed for higher-octane. In other words, it is safe to increase octane levels, but decrease them. It is also worth noting that piston engines are not designed to use jet fuel.

While the general cycle for attrition within the U.S. automobile fleet accommodated the phase-out of leaded fuel for cars, the life-expectancy and limited obsolescence turnover in the aviation fleet, in general, and the GA fleet, in particular, has extended the time that a substantial portion of GA aircraft still requires leaded fuel. Nevertheless, the Federal Aviation Administration (FAA), in 2010, established a program and performance metric to make available by 2018 an unleaded replacement fuel for leaded aviation gasoline that is usable by most GA aircraft.[4] From this, the FAA's *Unleaded Av Gas Transition Aviation Rule Making Committee* (FAA UAT ARC) developed a "flight plan" on how this objective would be accomplished.[5]



FAA's Unleaded Avgas Transition Plan

In its 2013 report to the U.S. Congress, the FAA describes a three-stage, 11-year schedule commencing in 2014 that encompasses "preparatory, project, and deployment stages" of the program to develop, test, and certify a replacement fuel for avgas by 2018.[6] Significantly, the deployment stage following that milestone date is forecast to continue until the new fuel production can be "ramped-up" and it is readily

[4] FAA, *Aviation Fuel Research and Development Report to Congress*, July 25, 2013.
[5] FAA UAT ARC, *Final Report, Part I Body, Unleaded AVGAS, Findings & Recommendations*, February 2012.
[6] FAA, *Aviation Fuel Research and Development Report to Congress*, July 25, 2013.

available nation- and fleet-wide. Following that milestone, a phase-out plan will be implemented for the leaded fuels. In light of these factors, the currently anticipated end of the program would extend to 2024 (10 years from now) at the earliest.

Avgas Replacement Fuel Timeline

Year										
2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Select Fuels	Phase I Testing	Phase II Testing & Certification			Deployment Phase and Development of Avgas Phase-out Plan					

Source: KB Environmental Sciences, Inc. 2014, adapted from the FAA UAT ARC Report, 2012.

Meanwhile, until the FAA's avgas replacement fuel program is complete, continuing to make a no-lead alternative available, such as mogas, for those aircraft that are certified to use it, remains a viable option. Notably, production of mogas is not as simple as substituting automobile gasoline. Mogas requires a different composition than used for autos. The constraining issue is that almost all automobile gasoline contains at least some part ethanol, by current regulation. Aviation piston-engine aircraft that can use unleaded fuel cannot use fuel that contains ethanol. Because ethanol absorbs water from the air, the resulting mixture may corrode fuel lines, gaskets, and other parts. Thus, the main distinction between commonly-available automobile fuel and aviation mogas is that the mogas is ethanol-free.

Within the field of aviation, the ethanol-free characteristic of mogas essentially makes it a "niche market" product. That is, there has not been an incentive for the production of this fuel in substantial quantities. Moreover, although mogas has been available since the early 1980s, only 120 airports nationwide (i.e., less than one percent) presently offer it for sale. Of these, only two are in Oregon and include Lebanon State and Grants Pass airports located approximately 85 and 250 nautical miles south of HIO, respectively.

III. MOGAS PROVIDERS AND SUPPLIERS

Because mogas is somewhat unique within the overall context of aircraft fueling and not presently offered at HIO, this assessment sought the experience and insights from several providers of the product. For example, the two Oregon airports mentioned above were contacted as were a number of other airports offering mogas that are located out-of-state. Among the information gained through these interviews and correspondence were the key highlights summarized in **Table 1.**

Table 1
Information Obtained from Airports that Offer Mogas

Airport (State)	General Characteristics	Relevant Information
Anderson (ID)	Small GA airport in northwest U.S.	▪ Mogas = 13% of avgas sales. ▪ Fuel sales are down 5% overall in 2014.
Fayetteville (AR)	Medium-sized GA airport in central U.S.	▪ Mogas = 3% of avgas sales.
Grants Pass (OR)	Oregon GA airport with new mogas service.	▪ Refurbished fuel truck used for storage and delivery. ▪ Mogas sales started Aug. 2014. Orders 1,000 gal. /delivery.
Lebanon State (OR)	Small GA airport with	▪ Dispenses more mogas than avgas (55/45%).

Airport (State)	General Characteristics	Relevant Information
	small GA aircraft. Little corporate aviation.	▪ Non-aviation customers (i.e., boats, antique cars, ATVs, etc.) also buy mogas.
Lee's Summit (MO)	Medium-sized GA airport in north-central U.S.	▪ Mogas sales increasing with more STC aircraft, light sport/experimental and transient aircraft. ▪ Mogas = 7% of avgas sales. ▪ Use mogas to fuel airport vehicles and equipment.
Norridgewock (ME)	Small GA airport in northeast U.S. with little-to-no corporate aviation.	▪ Stores mogas in aboveground tank with self-service. ▪ Mogas = 7% of avgas throughput. ▪ Predicts an increase in mogas sales when others learn of the availability. ▪ Mogas "shelf-life" not as long as avgas.
Page Field (FL)	Medium-sized GA airport with flight-school.	▪ Sell 1,000 gal./month of mogas from a 1,500 gal. tank. ▪ Sometimes difficult obtaining mogas. ▪ Flight school on-site is largest mogas user.
Sebring (FL)	Medium-sized GA airport with aircraft manufacturer on-site.	▪ Most mogas used for light-sport GA aircraft manufactured on-site. ▪ Mogas = 25% of all fuel sold (including jet).
Southern Maine Aviation (ME)	Small GA airport in northeast U.S.	▪ Mogas = 5% of all fuel sold. ▪ Also sells mogas to seaplane customers. ▪ 3,000 gals. last 6 months.
Vance Brand Longmont (CO)	Medium-sized airport in western U.S.	▪ Mogas = 10% of avgas sales. ▪ Non-aviation customers also buy mogas.

Source: KB Environmental Sciences, Inc. 2014
Airports are listed in alphabetical order.
The terms "small, medium and large" as applied to airport size are generally relative to HIO.

From the information summarized in the preceding table, combined with the inter-personal discussions between the surveyors and respondents, several findings and observations are potentially useful to the assessment of providing mogas at HIO and they include the following (listed in alphabetical order):

- **Airport Comparability to HIO** – Because the nationwide pool of airports that provide mogas is so small, it is very difficult to find any airports currently providing mogas that closely compare to HIO in terms of GA aircraft operational levels, fleet mix and clientele. In other words, HIO has substantially more operations and the overall GA aircraft fleet that is more "business-related" than any of the airports surveyed. For example, nearby Lebanon State Airport is characterized by small GA aircraft operated by casual (i.e., "weekend") flyers. By comparison, HIO serves both fixed wing and rotorcraft aircraft representing a diverse range of activities such as pilot training, sightseeing, personal flying, agricultural spraying, fractional business jet operations and emergency medical services. Over 70 percent of the hours flown by GA aircraft at HIO are for business purposes.

HIO Differences

There are important differences between HIO and most other airports where mogas is provided. The most significant of these are the greater number of operations and the strong business-orientation of the airport.

- **Mogas Popularity** – None of the airports contacted expressed a desire to stop selling mogas or any other misgivings over offering the fuel. A few remarked that providing mogas to customers that could use it was good for the aviation industry by making flying more affordable. On the other hand, some respondents believed that many GA aircraft owners are now quite accustomed to using avgas and not very incentivized to use mogas even if it were available.

- **Mogas Sales Outlook** – Some respondents predicted that mogas usage could increase if light sport aircraft ownership becomes more prevalent and/or as other GA aircraft operators obtain STC certification. Others speculated that when knowledge spreads that an airport offers mogas, non-based aircraft will fly to the airport to buy the fuel.
- **Mogas Storage and Dispensing** – Some airports reported that storing mogas in a truck-tanker and selling it by "self-serve" dispensing was a considerable convenience, cost-savings and more in alignment with the expectations of a typical mogas user.
- **Mogas Versus Avgas Throughputs** – The amounts of mogas throughput compared to avgas varies considerably from airport-to-airport. With a low of 3 percent at Fayetteville Airport (AR) to a high of 55% at Lebanon State Airport (OR), each airport's involvement with mogas is seemingly unique. For example, Lebanon Airport mogas sales involve a substantial number of non-aeronautical users (i.e., boat and antique car owners) as discussed below. However, it is likely that the types of based aircraft at an airport plays an important role (see discussion above regarding *Airport Comparability* to HIO)**.**
- **Non-aviation Sales of Mogas** – In some cases (i.e., Lebanon State and Lee's Summit Airports), mogas sales are partly attributable to non-aircraft use (i.e., antique cars, airport equipment, etc.). This supplemental market would not likely apply to HIO due to security restrictions and the availability of non-ethanol-containing fuel at a number of local service stations in the area.

Mogas Availability & Price

Similar to automotive gasoline, the price of mogas is presently at historic lows and there are several suppliers located in OR making it competitively priced. However, this drop in market conditions is expected to be temporary.

This information will be reported upon again in **Section VI**, in support of the *Findings and Conclusions* of this report.

Additional research was undertaken in support of this assessment to ascertain the availability of suppliers of mogas in the Hillsboro/Portland area as well as its cost. Again, this was achieved from information provided by current mogas sellers, phone calls and internet searches. From this, it was determined that mogas is available from at least two distributors located proximal to HIO: (i.) Sheldon Oil Co. located in Tillamook, OR and (ii.) Bretthauer Oil Co. located in Hillsboro, OR. Depending on the volume of fuel delivered, the cost of mogas from these suppliers presently ranges from \$3.25 to \$3.50/gal. It is noteworthy that because of their similarities, mogas prices fluctuate closely with automobile gas prices – which are presently at a four-year low.

IV. POTENTIAL FOR MOGAS USE AT HIO

As a further and case-specific means of assessing the potential use of mogas at HIO, three relevant but independent investigations were also conducted of conditions at the airport: (i.) History of Avgas Utilization; (ii.) GA Fleet Mogas Utilization Potential; and (iii.) Aircraft Owner/Operator Profiles and Preferences. The approaches and outcomes of this research are discussed below.

A. History of Avgas Utilization

The history of 100LL avgas throughput at HIO is considered important to this assessment insofar as it is part of the basis for determining how much mogas might be sold if it were offered at the airport. In other words, it is considered likely that mogas use at HIO will in large part be attributable to aircraft that presently use avgas but would switch to mogas if it were available. Therefore, the record of 100LL avgas sales at HIO for the eight-year period 2006 to 2013 was evaluated and the findings are summarized in the **Table 2**.

As shown, while the volume of 100LL at HIO moved both upwards and downwards over time, the overall trend was a measurable decline, with the final year (i.e., 2013) 15 percent less than the first year (i.e., 2006). Overall, the downward trend represented an average decline of about 2.35 percent/year. For comparative purposes and as a check of reasonableness, data for the entire U.S. avgas sales for the past 30 years (1983 to 2013) were also evaluated. Nationwide, the average annual decline in avgas use over that period was found to be a very comparable 2.3 percent/year.[7]

Table 2
Annual Throughput of Avgas (100LL) at HIO

Year	100LL Throughput (Gallons/Year)	% Change Year-to-Year
2006	331,641	--
2007	368,210	+11
2008	428,252	+16
2009	377,816	-12
2010	392,567	+4
2011	345,079	-12
2012	308,706	-11
2013	281,923	-9
Total % Change 2006-13		-15
Avg. Annual % Change 2006-13		-2.35

Source: KB Environmental Sciences, Inc. based on data provided by the Port of Portland.

For completeness and as a final note on this matter, if the partial-year sales for calendar 2014 (i.e., January to September) are extrapolated to a full-year, the annual total will be almost 313,000 gallons - an increase over 2013 of approximately 10 percent. That would be the first positive year-to-year change since 2010. Therefore, as discussed below, the assessment considered this apparent rebound in forecasting how much aviation fuel may be sold in future years at HIO.[8]

B. HIO-Affiliated GA Fleet Mogas Utilization Potential

The purpose of this HIO aircraft fleet evaluation was to ascertain the approximate percentage of piston aircraft at, and in the vicinity of, the airport that can potentially utilize mogas. To this end, a variety of data sources were compiled to produce a listing of aircraft, by Airworthiness Certificate Registration Number (i.e., tail number or "N" number), that are: (i.) based at HIO; (ii.) operate locally in the vicinity of

[7] U.S. Energy Information Administration, Petroleum & Other Liquids/Aviation Gasoline Retail Sales, release date October 1, 2014; www.eia.gov/dnav/pet/hist/

[8] An average of the actual sales of avgas at HIO for 2013 and the extrapolated total for 2014 is approximately 297,400 gallons.

HIO; or (iii.) have conducted itinerant operations at HIO within the past year. Specific data sources (and most recent year of data available) consulted for this analysis include:

- Oregon Department of Aviation Aircraft Database (2013)
- FAA Based Aircraft Inventory of HIO (2008)
- HIO Storage Management Systems Tenant Listing (2014)
- Tower Park Condo Association Annual Report (2013)
- Flight Data feed for HIO purchased from Flightaware (2014)

The FAA Tail Number Registry was then consulted to determine the type (e.g., reciprocating), make (e.g., Lycoming), and model (e.g., O-360-A4K) of engine associated with each tail number according to the current Airworthiness Certificate. These results were then filtered so as to only include reciprocating, 2-cycle, 4-cycle and turboshaft engines that can use aviation fuels (i.e., avgas or mogas) rather than Jet A, diesel or some other similar fuels. From this inventory, a listing of 1,121 unique aircraft records was generated that met these criteria.

For each of the above-identified aircraft, the following data sources (in order of preference) were then consulted to aid in determining, to the extent possible, if the associated engine could use mogas:

- Engine manufacturer service bulletins and operating manuals
- FAA Type Certificate Data Sheets (TCDS)
- Public domain websites

Sample of HIO Aircraft Fleet

Notably, engine configuration information necessary to make a definitive judgment on fuel compatibility is sometimes generalized in the Tail Number Registry, such that a 100-percent definitive determination on whether an engine can use mogas is **sometimes precluded. That is, engine configuration prefixes are** usually retained in the registration data (e.g., those that tell whether something is turbocharged, opposed, left-turning, etc.), whereas configuration suffixes that provide more information on power rating, magneto application, accessories, etc., are often omitted. These suffixes are important with respect to fuel compatibility. For instance, an aircraft equipped with the Lycoming O-540-J3D6 engine may simply be listed as having an "O-540 series" engine for the purposes of tail number registration, and the "J3D6" suffix is important to determining accepted fuels for that engine.

Accordingly, the following categorizations (e.g., Yes, Likely, etc.) were applied when making a determination of what portion of the 1,121 identified aircraft/engines could use mogas. For ease of understanding, relevant examples are also provided as follows:

HIO Affiliated Aircraft Fleet Mogas Use Categorizations

- **Yes**: It is certain based on available information that the specified engine can use mogas.

  Example: One aircraft is registered with a "Lycoming IO-540-D4A5" reciprocating engine. Lycoming's Service Instruction 1070 (SI 1070) specifies that any IO-540-D variant can use 93 AKI mogas.

- **Likely**: Engine information is generalized such that it cannot be said with certainty that the equipped engine can burn mogas. However, information is available that indicates that a majority of engines in that same "family" (i.e., >75 %) can use it.

  Example: One aircraft is registered with a "Lycoming O-320 series" reciprocating engine. According to SI 1070 there are five variants within this family (i.e., O-320-A, -B, -C, -D, or -E) that can burn 93 anti-knock index (AKI) mogas; there is one variant that cannot (O-320-H). Because 83 percent of the engine variants in this family can burn the fuel, it is likely that the listed engine is one of them.

- **Maybe**: Engine information is generalized such that it cannot be said with certainty that the equipped engine can burn mogas. However, information is available that indicates that some share of engines in that same "family" (i.e., 75 percent or less) can use it.

  Example: One aircraft is registered with a "Lycoming IO-360 series" reciprocating engine. SI 1070 indicates that only four of the ten variants within the IO-360 family can use 93 AKI mogas. Therefore, the aircraft is categorized as "MAYBE"

- **No**: It is certain based on available information that the specified engine can NOT use mogas.

  Example: One aircraft is registered with a "Lycoming VO-360-A" reciprocating engine. Lycoming's Service Instruction 1070 (SI 1070) specifies that this variant cannot burn mogas.

- **Unknown**: Sufficient data are unavailable to make a determination.

For ease of reference, **Table 3** presents the results of the HIO aircraft fleet evaluation. As shown, approximately 8.5 percent of the 1,121 registrants can definitively use mogas according to available information. However, an additional 21.0 percent can also likely use the fuel. In other words, overall, as little as 8.5 percent or as much as 29.5 percent of this sampling of evaluated aircraft can currently use mogas were it offered at HIO.

Table 3
HIO-Affiliated Aircraft Fleet Mogas Utilization Potential

Mogas Use Category	Aircraft Count	Percent	
		Category	Cumulative
Yes	95	8.5	8.5
Likely	236	21.1	**29.5**
Maybe	186	16.6	46.1
No	508	45.3	91.4
Unknown	96	8.6	100.0
Totals	1,121	100.0	--

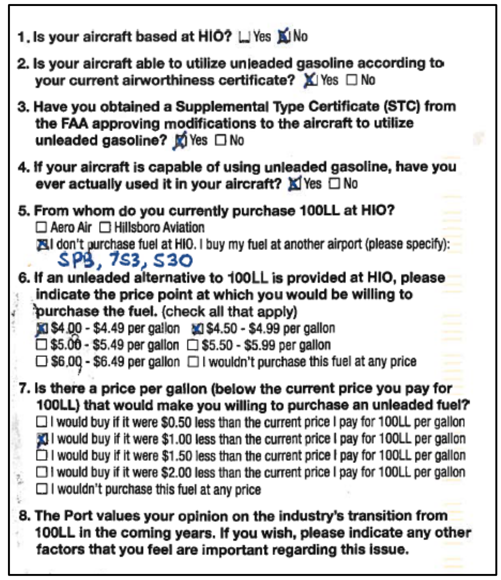
Source: KB Environmental Sciences, Inc., 2014

C. Aircraft Owner/Operator Profiles and Preferences

In order to assess pilot disposition toward using mogas at HIO (if it were offered), an eight-question, hard-copy, mail-back survey was distributed in 2014 to 5,060 individuals as part of this study. Entitled the *2014 Pilot Fuel Study*, those sent mogas fuel surveys were identified from a listing of pilots whose physical address is registered to one of 74 cities in Oregon and Washington, according to information available from the FAA (circa 2012).

Each of the eight survey questions falls into one of the four main categories described below:

- **General Diagnostics** - The three questions within this category sought to characterize the sample of respondents based on flying habits pertinent to this business case assessment, including: where they base their aircraft; where they currently purchase their fuel; and, most importantly, whether they can currently utilize mogas.
- **Focus Questions** - Of the respondents indicating that they can currently utilize mogas (i.e., the "Focus Group"), two additional questions were posed to better define the nature of their current ability to use the fuel, and whether or not they've actually used it.


1. Is your aircraft based at HIO? ☐ Yes ☒ No
2. Is your aircraft able to utilize unleaded gasoline according to your current airworthiness certificate? ☒ Yes ☐ No
3. Have you obtained a Supplemental Type Certificate (STC) from the FAA approving modifications to the aircraft to utilize unleaded gasoline? ☒ Yes ☐ No
4. If your aircraft is capable of using unleaded gasoline, have you ever actually used it in your aircraft? ☒ Yes ☐ No
5. From whom do you currently purchase 100LL at HIO?
   ☐ Aero Air ☐ Hillsboro Aviation
   ☒ I don't purchase fuel at HIO. I buy my fuel at another airport (please specify): SPB, 7S3, S30
6. If an unleaded alternative to 100LL is provided at HIO, please indicate the price point at which you would be willing to purchase the fuel. (check all that apply)
   ☒ $4.00 - $4.49 per gallon ☒ $4.50 - $4.99 per gallon
   ☐ $5.00 - $5.49 per gallon ☐ $5.50 - $5.99 per gallon
   ☐ $6.00 - $6.49 per gallon ☐ I wouldn't purchase this fuel at any price
7. Is there a price per gallon (below the current price you pay for 100LL) that would make you willing to purchase an unleaded fuel?
   ☐ I would buy if it were $0.50 less than the current price I pay for 100LL per gallon
   ☒ I would buy if it were $1.00 less than the current price I pay for 100LL per gallon
   ☐ I would buy if it were $1.50 less than the current price I pay for 100LL per gallon
   ☐ I would buy if it were $2.00 less than the current price I pay for 100LL per gallon
   ☐ I wouldn't purchase this fuel at any price
8. The Port values your opinion on the industry's transition from 100LL in the coming years. If you wish, please indicate any other factors that you feel are important regarding this issue.

Sample Survey Response Card

- **Willingness to Pay** - Price point information was solicited from the respondents, including the "Focus Group" above, to help indirectly inform the business case analysis on suitable prices for the mogas fuel if it were offered at HIO.
- **Other Feedback** - One additional question was added to solicit general information that might prove useful to this assessment.

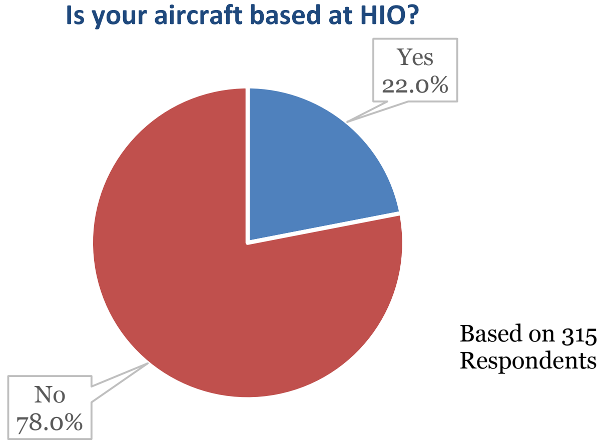
Of the 5,060 Pilot Survey cards distributed, 315 have responded. For most of the questions described above, something less than full responses were returned. However, in the following discussion of survey responses, some indication of the non-responses can be inferred.

A. General Diagnostics

As described above, three diagnostic questions were included in the survey to characterize the sample of respondents in terms of their flying habits. Responses for each of these three questions are presented and discussed below:

Question 1: Is your aircraft based at HIO? **Figure 1** depicts the responses to this question, which indicate

Figure 1:
Is your aircraft based at HIO?

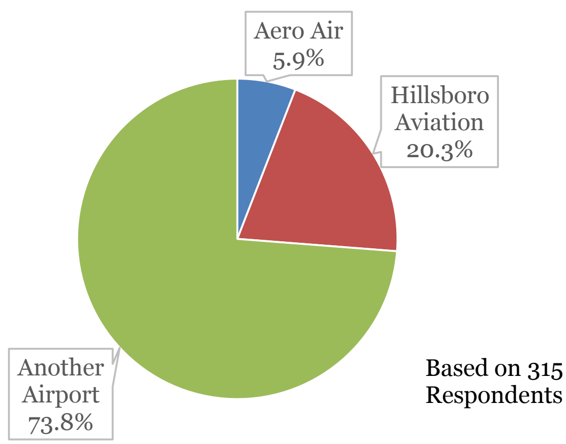


that 22 percent (or 65) of the respondents who answered the question are currently based at HIO, whereas the remaining 78 percent (or 231) are not. The question received only nine non-responses (3 percent). Overall this question affirms that there is at least some degree of local responsivity in the obtained sample.

Question 2: From whom do you currently purchase 100LL at HIO?

Roughly 26 percent (or 80) of the respondents who answered this survey question purchase fuel from one of the two Hillsboro Airport FBOs (i.e. Hillsboro Aviation or Aero Air), with the larger share of respondents indicating that they buy at Hillsboro Aviation (**Figure 2**). Of note, a significant share of respondents (73.8 percent, or 225) indicate that they currently purchase fuel at another airport entirely. Overall, the question received only 12 non-responses (or 3.9 percent of the total responses).

Figure 2:
From whom do you currently purchase 100LL at HIO?



Additional insight on the "off-airport" fuel purchasing captured within the survey responses is detailed on **Table 4** below. Where available and applicable, current fuel prices at the airport are denoted, as well as whether or not self-service fueling is available.

Overall, most of the responses identified a "local" airport as the alternative fueling source, although airports in California (RDD) and Montana (7S6) were also captured. The top five airports for refueling are: Scappoose (SPB), Twin Oaks (7S3), Aurora (UAO), Grove Field (1W1) and Mulino (4S9). Lebanon airport, the only airport that offers mogas within this set, is the sixth most frequently used. Nearly 83 percent of the respondents purchase their fuel where self-service is available, and roughly 62 percent of them purchase for less than $5.75 per gallon.

Also of note, two private airports are identified (OR66 and WA87) albeit with less than one percent of the responses each. HIO is also identified within this listing only insofar as a given respondent replied that they fuel up at both HIO and another airport.

Anecdotal responses identified on **Table 4** largely comprise statements that do not identify an airport specifically, voice complaint that HIO prices are too high, or relay that the pilot currently purchases premium autogas at an automotive fueling station.

Table 4
Reported Fuel Providers to HIO Affiliated Aircraft

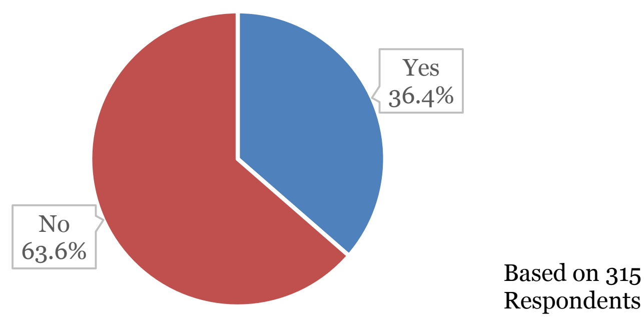
ICAO Designation	Airport Name	% of Replies	Current Fuel Prices			
			100LL		Mogas	
			FS	SS/PS	FS	SS/PS
1W1	Grove Field Airport	5.0	-	$5.50	-	-
4S9	Mulino State Airport	5.0	-	$5.89	-	-
5S9	Valley View Airport	0.6	*	*	*	*
7S3	Stark's Twin Oaks Airport	14.4	-	$5.49	-	-
7S5	Independence State Airport	3.8	-	$5.70 - $5.75	-	-
7S6	White Sulphur Springs Airport	0.6	-	$5.66	-	-
7S9	Lenhardt Airpark	4.4	-	$5.70	-	-
BDN	Bend Municipal Airport	1.3	$5.49	$4.99	-	-
DLS	Dalles Municipal Airport	0.6	-	$5.69	-	-
HIO	Portland-Hillsboro Airport	2.5	$6.25 - $6.40	--	-	-
KLS	Southwest Washington Regional Airport	1.3	-	$5.95	-	-
MMV	McMinnville Municipal Airport	1.9	$5.99	$5.84	-	-
ONP	Newport Municipal Airport	0.6	$5.99	$5.75	-	-
OR66	Beaver Oaks Airport	0.6	*	*	*	*
PDX	Portland International Airport	1.9	$6.21	--	-	-
RDD	Redding Municipal Airport	0.6	$6.60	$6.55	-	-
S12	Albany Municipal Airport	0.6	-	$5.48	-	--
S30	Lebanon State Airport	6.3	-	$5.60	-	$4.70
S49	Miller Memorial Airpark	0.6	*	*	*	*
SLE	McNary Field Airport	0.6	$6.25	$5.75	-	-
SPB	Scappoose Industrial Airpark	23.1	-	$5.55	-	-
TTD	Portland-Troutdale Airport	3.8	$5.80	--	-	-
UAO	Aurora State Airport	8.1	$5.87 - $6.00	$5.80 - $5.97	-	-
VUO	Pearson Field Airport	4.4	-	$6.05	-	-
WA87	Parkside Airport	0.6	*	*	*	*
--	Anecdotal Responses	6.9	*	*	*	*

Source: KB Environmental Sciences, Inc. 2014.
-- Not offered; * No information available or not applicable; FS = Full Service; SS = Self Service/Pump Service
Note: HIO is included in the respondent pool only insofar as a given respondent replied that they fuel at HIO and another airport.

Question 3: Is your aircraft able to use unleaded gasoline according to your current airworthiness certificate?

Of the 294 responses received to this question (indicating a 3.6 percent nonresponse rate), 36.4 percent of the respondents (or 107) identified that they are currently able to burn mogas in their

Figure 3:
Is your aircraft able to utilize unleaded gasoline according to your current airworthiness certificate?



aircraft (**Figure 3**). As previously described, these 107 respondents comprise the "Focus Group" of potential current mogas users toward which the next set of questions are geared.

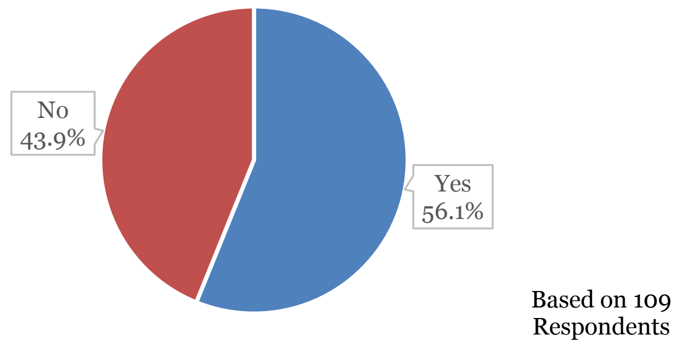
B. Focus Questions

Responses to two additional questions presented below were evaluated, with a specific focus on the group of 107 respondents that positively indicated that they are able to use mogas based on their current airworthiness certificate. Again, these questions focus on better defining their current ability to use the fuel, and whether or not they've actually used it.

Question 4: Have you obtained a Supplemental Type Certificate (STC) from the FAA approving modifications to the aircraft to utilize unleaded gasoline?

The intent of this question was to segregate the 107 responses between those pilots that can use mogas "straight out of the box" versus those who have made an effort to modify their aircraft to use it by way of obtaining an STC. When discounting the non-response rate (8.4 percent, or nine responses) the results (**Figure 4**) show that a slightly larger portion of the respondents (56.1 percent, or 55 responses) have obtained an STC than not (43.9 percent, or 43 responses).

Figure 4:
Have you obtained a Supplemental Type Certificate (STC) from the FAA approving modifications to the aircraft to utilize unleaded gasoline?

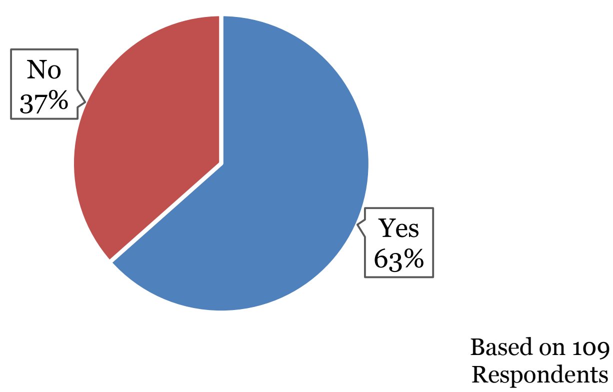


Question 5: If your aircraft is capable of using unleaded gasoline, have you ever actually used it in your aircraft?

This question was designed to differentiate those within the focus group that have a potential aversion to using mogas even though their aircraft is certificated to do so. Reasons for this may include decreased engine performance, additional engine wear, lack of availability, or even personal preference, some of which are denoted in the "Other Feedback" section of the survey.

Figure 5 demonstrates that, when discounting the three nonresponses (or 2.8 percent), at least some portion of the "Focus Group" of 107 pilots able to use mogas do not use it for one reason or another. Specifically, 63 percent of the respondents have actually used mogas in their engine whereas 37 percent have not

Figure 5:
If your aircraft is capable of using unleaded gasoline, have you ever actually used it in your aircraft?



C. Willingness to Pay

Two questions were included in the survey soliciting respondents to either directly specify (i.e., indicate a dollars-per-gallon price point) or indirectly imply (i.e., indicate some price below that which they currently pay for their fuel) their willingness to purchase mogas at HIO. Responses to these two questions are presented both in terms of the total sample (i.e., 305 respondents) as well as the "Focus Group" (i.e., the 107 respondents indicating they can use mogas). Evaluating the results in this way prevents the exclusion of participants who cannot use the fuel now, but would do so if it were offered, up to and including making modifications to their aircraft to do so.

Question 6: If an unleaded alternative to 100LL is provided at HIO, please indicate the price point at which you would be willing to purchase the fuel.

When looking at all 186 responses of the 305 (a 39 percent nonresponse rate), 22.4 percent of the respondents would not purchase mogas regardless of the price (**Figure 6**). The greatest level of respondents, 35.4 percent would purchase the fuel at the lowest possible price point of $4.00 to $4.49 per gallon, and some portion of this group would also purchase the fuel if it were more expensive. Over half of the respondents (56.3 percent) would purchase the fuel for $4.99 or less.

When focusing in on only those who indicated they can currently use mogas (**Figure 7**), the nonresponse rate drops to 10.3 percent, and only 7.3 percent of those responding stated they would not purchase fuel at HIO at any price. Nearly 80 percent of those responding would purchase the fuel for $4.99 or less at HIO.

Figure 6:
If an unleaded alternative to 100LL is provided at HIO, please indicate the price point at which you would be willing to purchase the fuel - All Respondents

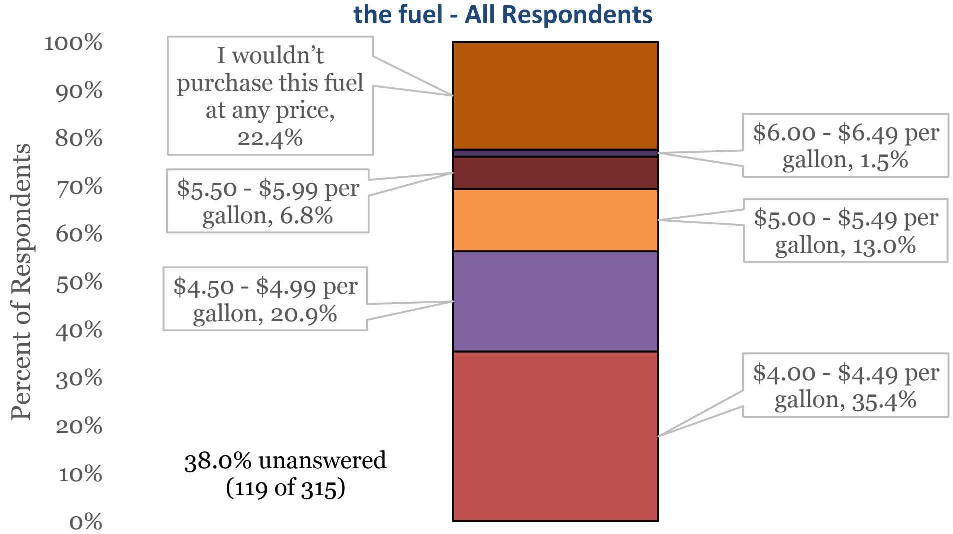
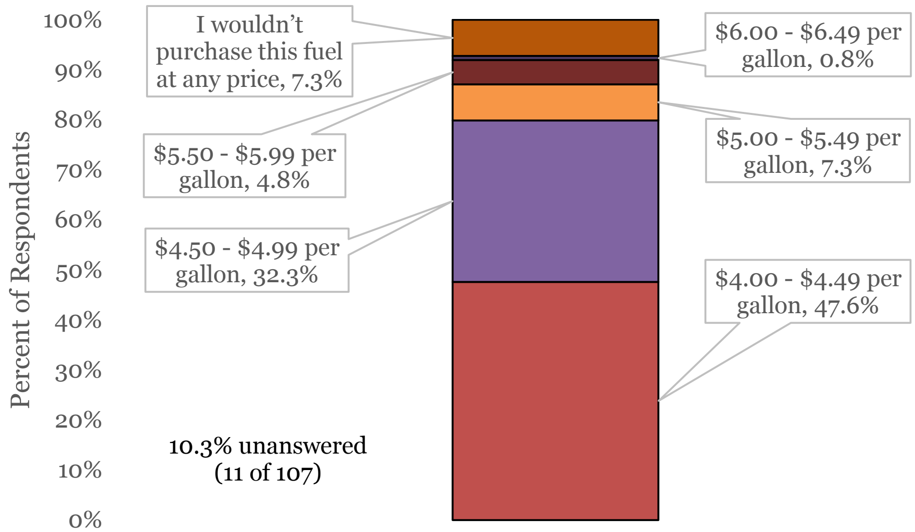


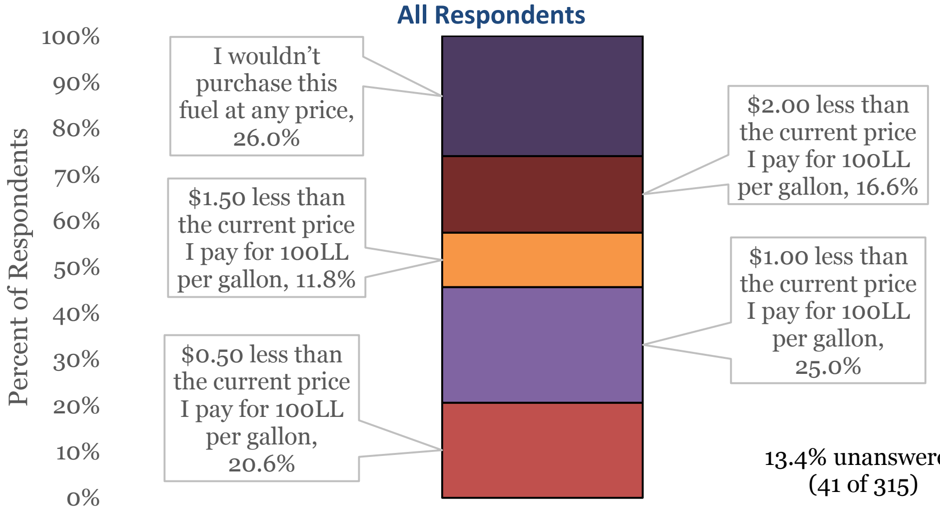
Figure 7:
If an unleaded alternative to 100LL is provided at HIO, please indicate the price point at which you would be willing to purchase the fuel - Can Use Mogas Respondents



Question 7: Is there a price per gallon (below the current price you pay for 100LL) that would make you willing to purchase the fuel?

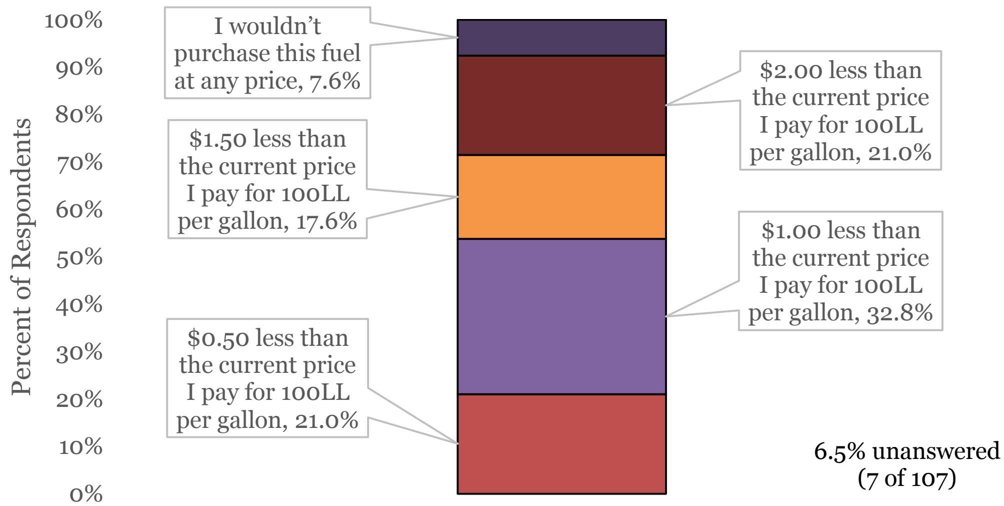
When phrasing the willingness-to-pay question slightly differently, more responses were received overall (a 13.4 percent nonresponse rate, or 41 or the 305 sampled). However, a similar level of respondents (26 percent) indicated they would not purchase the fuel if offered at HIO regardless of the cost savings to them (**Figure 8**). Roughly 45 percent of the respondents indicated they would purchase mogas at HIO if it were a dollar (or more) cheaper than what they pay right now for 100LL.

Figure 8:
Is there a price per gallon (below the current price you pay for 100LL) that would make you willing to purchase an unleaded fuel? All Respondents



Finally, **Figure 9** represents the survey results for only the 107 respondents that can currently burn mogas. Comparable to Question 6, the nonresponse rate decreases (to 6.5 percent unanswered), as does the percentage of responses that indicate a refusal to purchase the fuel (7.6 percent). Again, most respondents would purchase at a price at least one dollar cheaper than what they pay for avgas now.

Figure 9:
Is there a price per gallon (below the current price you pay for 100LL) that would make you willing to purchase an unleaded fuel?
Can Use Mogas Respondents



D. Other Feedback

Additional feedback received in response to the survey can be reduced to the following 10 trends or themes, some of which are not germane to the research:

- Current aircraft does not burn the fuel but otherwise willing to use it;
- Leave well enough alone, and wait for the unleaded avgas transition to culminate;
- Concerns over flight safety, engine reliability, engine longevity;
- Conversion is too costly or impossible for older machinery;
- Short-term storage or infrastructure costs;
- Assure it does not contain ethanol and/or is certified for use by either FAA or engine manufacturers;
- HIO fuel prices are too high;
- Bring self-serve to HIO;
- Consider providing a lead scavenger as a fuel additive to HIO pilots that use 100LL; and
- Expression of thanks for considering/providing an unleaded option at HIO.

Additionally, the flight school director of Hillsboro Aero Academy, LLC offered the following specific feedback when responding to the survey:

> "Many of our aircraft could use unleaded fuel without modification. There are however a few AC in the fleet that cannot use unleaded fuel (R-44, some of the Seminoles)….To consider using unleaded fuel as a viable option for the fleet we would need to ensure that it is priced at or below our cost for 100LL and that we would have ready access to it for getting it into our fleet in a timely manner (via trucks)."

V. BUSINESS CASE ASSESSMENT FOR MOGAS AT HIO

This section of the report presents the Business Case Assessment for providing mogas at HIO. This analysis was conducted following conventional economic practices based principally upon the expected investment and other on-going costs that would be associated with providing the fuel at the airport. The central aim was to determine how much sales of mogas would be required to adequately offset the costs to establish mogas service at HIO.

A. Assessment Scenarios and Basic Premises

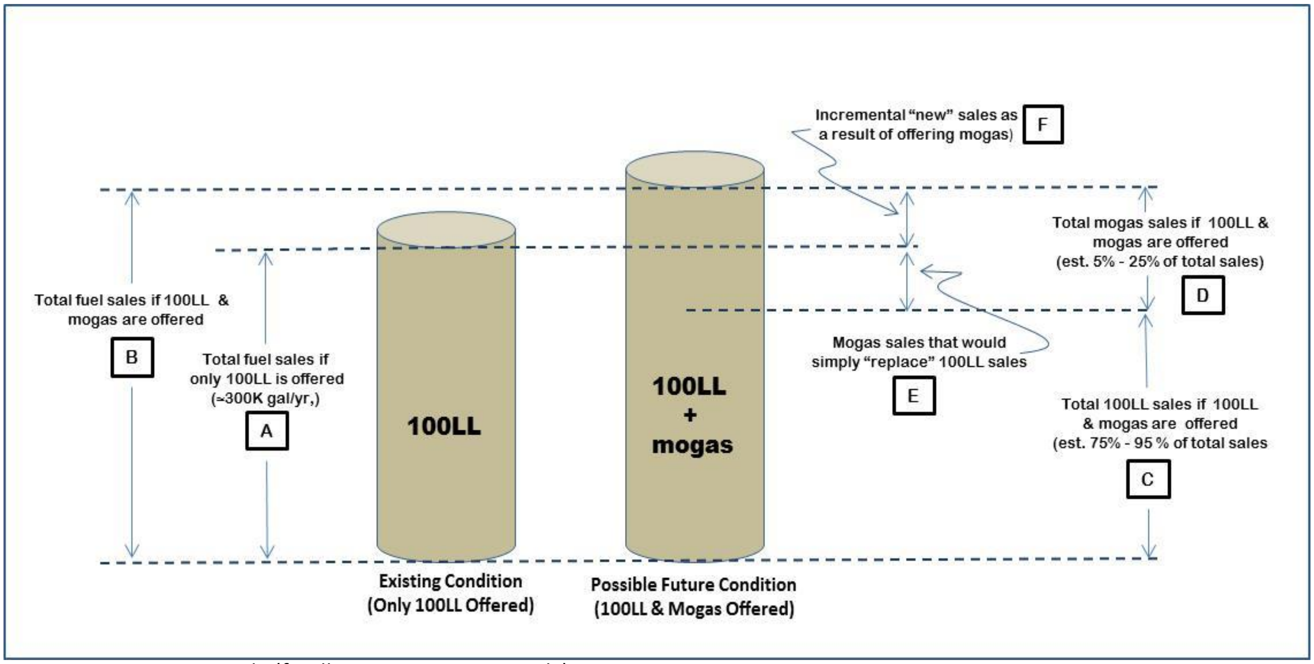
For the purposes of this assessment, two separate arrangements (or "scenarios") were evaluated: (i.) the *New Vendor for Mogas Sales Approach* and (ii.) the *Existing FBO Mogas Sales Approach*. In the first scenario, an entity presently doing business on the Airport, but not an FBO seller of fuel, would set up and operate a separate mogas sales operation (i.e., the "*New Vendor"*). In the second scenario, one of the existing FBOs would basically set up and operate a mogas sales operation as an addition to their present avgas sales activity.

Business Case Scenarios

> Two core scenarios were evaluated for providing mogas at HIO: (i.) the *New Vendor* and (ii) the *Existing FBO* approaches. For comparative purposes, much of the supporting data and underlying assumptions were the same for both as was the central objective – to determine what level of mogas sales would adequately offset the costs for providing the fuel as an option for those who can use it in their aircraft.

In either scenario, the costs to put the mogas sales in place and continue them over time would be largely the same. The overall amount of fuel sold (avgas plus mogas) would also be expected to be approximately the same in both scenarios. However, the principal distinction, in terms of the business assessment, would be in the revenues available to offset the costs. This can best be explained by referring to **Figure 10** below, which illustrates potential mogas sales as part of overall future fuel sales at HIO.

Figure 10:
Mogas Sales as Part of Overall Potential Fuel Sales



Note: Figure is not to scale (for illustration purposes only)
Source: KB Environmenal Sciences, Inc. 2014.

For ease of understanding, the following bullet points are intended to provide interpretation and explanation of the main features of the figure:

- **Position "A"** - indentifies the amount of 100LL avgas presently sold at HIO, with only 100LL offered. As noted and discussed in **Section IV**, as a reasonable assumption based on an analysis of recent sales and a general year-to-year trend, this volume is approximately 297,400 gals./year (average of the last full year of data and extrapolation of present year data).
- **Position "B"** - indicates that, if mogas were also offered at HIO, it can be expected that total sales of 100LL and mogas would be more than if only 100LL were offered. The existing data are insufficient to predict how much more total sales may be with both fuels offered, as discussed further below. However, it is reasonable to assume that some "new" sales of fuel would occur by virtue of the purchase of mogas at HIO by aircraft owners who may presently be purchasing mogas elsewhere, but would purchase it at HIO, if it were available there.
- **Positions "C" and "D"** - illustrate that, of that new total fuel throughput ("B"), some would be 100LL and some would be mogas.[9]
- **Position "E"** - represents that portion of the mogas sales ("D") that would simply be replacing avgas sales (e.g., fuel customers at HIO who presently purchase 100LL, but can and would use mogas, if it were made available).

[9] Research of other airports presently selling both fuels indicate the percent mogas of total sales ranges from 5 percent to 25 percent, as an average.

- **Position "F"** - represents the "new" or "incremental" sales of mogas over and above those mogas sales that would simply be "replacing" 100LL sales (e.g., customers who may come from elsewhere to purchase mogas at HIO, if it were available).

Again, the main disctinction between the two scenarios is that, under the *New Vendor for Mogas Sales* arrangement, the revenues available to offset the fuel provider's costs would be those associated with the total mogas sales (i.e., position "D" in **Figure 10**). The fact that some of those sales would be replacing mogas sales lost by the FBOs is an "externality" of this scenario; unfortuate for the existing FBOs, but irrelevant to the business case for the new vendor.

By comparison, under the *FBO Mogas Sales* scenario, only the revenues from the incremental mogas sales (i.e., over and above the mogas sales that would "replace" or "displace" 100LL sales) would be available to offset the costs for providing the fuel. In **Figure 10**, this is represented at position "F." The revenues associated with the "replacement" sales (i.e., position "E") are revenues the FBO would have earned otherwise from 100LL sales.

"Key" Elements of the HIO Mogas Business Plan

There are two facets of the plan to offer mogas at HIO that are "key" to its assessment: (i.) the majority of mogas sales are expected to displace what otherwise would be 100LL sales and (ii.) there will likely be an "incremental" increase in total avgas/mogas sales due to its availability.

Each of the two possible mogas sales scenarios is evaluated below, with assumptions and methods discussed for each. Results for the two scenarios are preseted and discussed at the end of this section.

B. New Vender for Mogas Sales Approach (Scenario No. 1)

Under this scenario, mogas would be offered for sale at HIO by a new (non-FBO) entity that presently does business—but does not offer fuel—at the airport. Importantly, further analysis would be required to determine if this scenario is possible at HIO considering the Airport Minimum Standards for this airport. For example, the FAA requires minimum standards that dictate the following:

- Ensure safe and efficient operation of the airport,
- Do not convey or protect an exclusive right to any operator, and
- Maintain compliance with Federal Grant Assurances.

Presently, only FBOs can provide fuel at HIO under HIO's minimum standards. The standards establish the minimum requirements for fuel storage capacity, environmental protection, liability insurance, and conformance with the Airport Master Plan.

Moreover, conformance with these minimum standards is necessary for the Port to maintain compliance with federal grant requirements. Currently the majority of federal funding for airports comes from the Federal Aviation Administration's (FAA) Airport Improvement Program (AIP). The AIP is designed to provide funds for planning and development at public-use airports. As part of receiving funds through the AIP program, the Port is required to provide grant assurances. Of the grant assurances, two are of particular importance to the issue of minimum standards: non-economic discrimination and non-exclusive rights. These two grant assurances are intended to ensure that airports receiving federal funds are operated in a manner that creates a level playing field for similarly situated companies and/or individuals wishing to provide commercial aeronautical services to the public.

1. Overall Framework

The business case assessment for this concept used a model that compares the revenue-earning potential from the sale of mogas at HIO against the initial investment costs to implement the selling of mogas, plus the operating and maintenance (O&M) costs to continue the business activity over a specified period of time.

Business Case Model

The following equation represents the parameters that were used in the model employed for this analysis:

BP = (PV)R – (PV)I + (PV)O&M – (PV)S

Where:

BP =	Dollar value of the Business Potential of the activity that would be earned over the analysis period; may be positive (profit) or negative (loss) value.
(PV)R =	Present value of the stream of gross Revenue that would be earned from the business activity over the period of the analysis.
(PV)I =	Present value of the initial Investment costs to put the business activity into place and the continued Investment in product (i.e., mogas) required in each year.
(PV)O&M =	Present value of the stream of Operating and Maintenance costs that would be required to allow the business activity to continue uninterrupted for the analysis period.
(PV)S =	Present value of the Salvage value of any equipment or infrastructure at the end of the analysis period; also sometimes referred to as "residual value."

Outputs of the model—in addition to the basic positive or negative BP discussed above—include an internal rate of return (IRR) and a "payback period" (i.e., that year of the analysis period at which the stream of revenues, minus the stream of O/M costs, off-sets the initial investment costs to the extent that BP changes from a negative to a positive value).

2. Time Period of the Analysis

In both scenarios evaluated, it was assumed that 2016 would be the first full year of mogas availability at HIO. This hypothetical schedule would allow the year 2015 for the budgeting, planning/design, and construction of the infrastructure required to provide mogas - should it be decided to provide the fuel at the airport.

The length of the time of the analysis was assumed to be from 2015 through 2026. This is based on the assumption that mogas sales would be continued until the time of general

Mogas Era Expectancy at HIO

If mogas were available at HIO by 2016 - it could remain a fuel option for at least 10 years as the new no-lead replacement fuel is developed, tested and deployed and the phase-out of 100LL ensues.

phase-out of 100LL avgas, at which time a new unleaded aviation fuel will have been certified for fleet-wide use. As noted above in **Section II**, the FAA's present schedule for development, testing, and certifying a no-lead replacement fuel continues to near the end of year 2018. Following that would be a deployment phase for the new fuel and phase-out period for 100LL, for which the duration is expected to last until mid-2024. However, for this assessment, another 2½ years was conservatively added to the mid-2024 date to reach the 2026 timeframe.

It is quite possible that there still may be a market for mogas sales even after the replacement fuel is deployed for fleet-wide use, but it is not considered reasonable in this assessment to speculate what part of the aviation fuel market mogas could represent once the replacement fuel is deployed and assimilated. In the HIO case, and until 100LL is phased out, the assessment assumed the mogas market share based on real historic data from locations were mogas is regularly sold in competition with 100LL. In addition, the HIO "Pilot Survey" summarized in **Section IV** gives an indication of what the mogas market share may be at HIO (see discussion of "Revenues" below).

3. Discount Rate

The discount rate is the analytical tool that allows revenues and costs in future years to be converted to values at a single point in time, usually the present. It is recognition that there is a "time value of money" and that funds spent or earned in future years have less value than the same amount in the present day. The discount rate also typically includes a consideration of the riskiness or uncertainty of the undertaking. In this case, two discount rates were tested—7 percent and 10 percent—in order to measure the sensitivity of that assumption.

Revenues (R)

Simply stated, this model component is an estimate of how much annual gross revenue the seller of mogas at HIO could expect to earn in each of the analysis years. This value is calculated as the anticipated number of gallons of mogas that would be sold, times the sales price that would be charged.

As mentioned above, existing data are insufficient to make a prediction as to how much mogas could be sold at HIO, if it were offered. As summarized above, the study did collect mogas sales data from other airports where it is offered in addition to 100LL. However, none of those airports compare sufficiently well to HIO that conclusions may be drawn from their experience. An analysis of the aircraft fleet affiliated with HIO indicated that more than one-fourth could "likely" use mogas, but there is no indication as to how much fuel that portion of the fleet uses overall. The 2014 Pilot Fuel Survey produced "yes" or "no" answers as to whether pilots would (or could) use mogas, but no data relative to the amount of fuel used was collected.

Based on the lack of sufficient data for predicting mogas sales, it was determined that the study should test different levels(s) of mogas sales to determine what would "bracket" positive and negative business results. The assumptions tested in this regard are discussed further below.

Mogas as a Percentage of Avgas

As mentioned above, at airports currently selling mogas in addition to 100LL, the data vary widely as to the amount of mogas as a percent of overall piston-engine fuel sales. For the present study, it was determined to test 5 percent, 10 percent, and 15 percent, to determine what level of overall sales would be required to offset the costs of offering mogas as an option. The low end of this range agrees generally with the lowest data from airports presently offering mogas. The high end of the range is well below the highest data from other airports (see **Table 1**). Therefore, these assumptions are appropriately conservative for the present study.

Mogas Throughput

Next, an assumption was required as to what would be the overall total gallons of piston-engine aviation fuel sold at HIO (of which mogas sales would be assumed 5, 10, or 15 percent, as discussed above). For that assumption, the analysis looked at the recent history and trends at HIO, as summarized in **Section IV**. Also considered in this assumption were long-term trend data for total U.S. aviation fuel sales. Significantly, the 7-year trend at HIO and the 30-year trend nation-wide agree to within a decimal of a percent. They reveal that the total number of gallons of avgas sold has trended downward on average about 2.3 percent per year.

One approach to forecast the total amount of aviation fuel that may be sold at HIO in the first analysis year would be to simply use the last full year's data (year 2013). However, that may somewhat understate the potential for aviation fuel sales at HIO. As discussed in **Section IV**, partial data for 2014 indicates there will be an approximate 10 percent increase in gallons sold during 2014 over 2013. As a reasonable compromise, the assessment used an average of the 2013 (last full year) total gallons sold and the projected 2014 gallons sold, the result being approximately 297,400 gallons/year.

It was also assumed that, with the addition of mogas, total sales (i.e., 100LL + mogas) would increase by a modest 5 percent. Once again, this assumption was made for the sake of testing, not as a prediction or projection. The result was an assumption that the first full year's overall fuel sales would be approximately 312,000 gallons. For each succeeding year, the study assumed the total gallons sold would go down following the -2.3 percent/year trend, as noted above.

Expected Mogas Price at HIO

Despite the current low wholesale cost of mogas, the research for this assessment indicates that the first-year price of $4.99/gal. (inclusive of markup, profit pumpage fee, etc.) is reasonable with an annual 3.9% annual escalation.

Mogas Price

While the analysis assumed the number of gallons of mogas sold would decline over the analysis period, the other important component of "Revenues"—price charged for the mogas—was assumed to go up year-to-year, also following historic trends. Data from the U.S. Energy Information Administration reveals the national average yearly <u>increase</u> in the price per gallon of avgas sold has substantially outpaced and more than offset the <u>decline</u> in total gallons sold. In fact, the 30-year national trend in aviation gasoline price increase has averaged about 3.9 percent/year, the result being that 1.5 times the revenues were earned on sales of one-half the amount of fuel, comparing year 2013 to 1983.[10]

For this assessment, it was assumed the first-year price charged for mogas would be $4.99/gallon. That would include the estimated cost to purchase the product from the supplier (the base price), plus a markup for operating margin and profit, and including the fuel flowage fee of $0.0834/per gallon. For

[10] U.S. Energy Information Administration, *Petroleum & Other Liquids/Aviation Gasoline Retail Sales*, October 1, 2014.

the remaining years of the analysis, it was assumed the base price would increase following historic trends at 3.9 percent/year but that the Port's fuel flowage fee would remain the same. Finally, it is worth noting that this $4.99/gallon price for mogas is lower than the average prices charged for 100LL by FBOs anywhere in the U.S. during October 2014.[11]

4. Investment Costs (I)

This model component has two parts: (i) the estimated "up-front" costs to put into place the infrastructure for storing and dispensing mogas at HIO and (ii) the continued investment in purchasing the mogas from a supplier. The initial costs would be limited to the first year of the analysis period when the investment would be made in the equipment and infrastructure to start up mogas sales.

For determining the "up-front" costs, the assessment assumed a scenario under which a self-serve station would be installed, whereby customers could taxi up and dispense their own mogas. This, would be similar to the mogas dispensing operation at Lebanon and other airports. It was also assumed that the infrastructure required to accomplish this may include the following:

Infrastructure & Equipment Needs

- Storage tank, including containment and safety features as required by law/permits.
- Piping and pumping equipment sufficient to get the fuel from the storage tank to the aircraft or truck.
- Retail pump station for dispensing, including safety features as required by regulation, credit card hardware/software, etc.
- Signing/pavement markings to direct aircraft traffic, if needed.
- Phone station for self-serve customers to contact HIO representative if trouble is encountered.
- Surveillance camera(s) tied to whatever security system HIO has in operation.

An estimate of the cost to install and start-up the mogas sales activity is approximately $80,000, based on independent estimates from three industry sources. To be conservative, this study assumed the overall start-up costs would be $100,000.

The second part of the Investment (I) component is the on-going investment required to purchase the mogas product for resale. To determine an appropriate assumption for this investment cost, the research considered mogas supply sources presently offering the product in Oregon. In addition to helping determine a reasonable assumption for cost of the product, the contact with suppliers also helped to establish the availability of the product and to identify any issues associated with handling it. From this research, it was assumed the first year cost to purchase the product from the supplier(s) would be $4.00/gallon.[12] As discussed above in the discussion of "Revenues (R)," it was assumed the

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[11] AirNav.com, *Fuel Price Report (Summary of Fuel Prices at 3,588 FBOs Nationwide)*, October 2014.

[12] It should be noted that, at the time of publishing of this assessment, fuel prices are at an all-time low. The prices quoted in the recent contact with suppliers were somewhat lower than the $4.00/gallon assumption. However, it is expected the present record-low prices will quickly adjust to a more normal level and the assessment took this into consideration in establishing the $4.00/gallon assumption. A supplier in Oregon advised that the $4.00/gallon level was his expectation as to the highest level that mogas wholesale prices may reach in the near-term. Therefore, the $4.00/gallon assumption for this analysis represents an appropriately conservative approach.

price/gallon would increase in each succeeding year by approximately 3.9 percent, following the 30-year national trend in aviation gasoline costs.

5. Operation and Maintenance Costs (O&M)

This component of the model includes those costs for routine and periodic maintenance of the mogas-storage/dispensing equipment and infrastructure necessary to allow continuation of the activity, as well as the on-going operations costs. For the maintenance cost assumption, the assessment relied upon information from industry sources who provided estimates of costs for fuel filter and miscellaneous equipment replacements of $800 - $1,100 per year.

> **Expected O&M Costs for Mogas**
>
> O&M costs include periodic replacement of tank system parts, insurance, permit fees and other contingencies. Also included are manpower costs to operate and maintain the system on a part-time basis.

For on-going operations costs, it was assumed there would be the staff cost associated with attending to the "new" business activity of fuel sales. It was assumed the new vendor would cover this with part of the time of an existing staff (i.e., it would not require hiring new staff). It was further assumed this staff cost would be about $13,000/year, based on the expectation of approximately 1/3 time for a mid-wage staff, including minimal overhead. As noted at the outset of the discussion of this scenario, it was assumed the "new vendor" would be an entity presently offering other services on the airport, but not fuel sales. By adding fuel sales, there would be some requirement for that vendor's existing staff to devote to the fuel business, even if it were self-serve (e.g., delivery acceptance, testing, equipment maintenance, etc.).

Another component of operating costs would be the $0.0834/gallon "fuel flowage fee" paid to the Port. In each analysis year, that fee is simply multiplied times the number of gallons assumed sold in that year to determine this cost. Other items of lesser cost in this category include finance costs, insurance premiums, business license fees, permit fees and other miscellaneous administrative costs and contingencies, which were assumed to cumulatively total approximately $5,000/year.

6. Salvage Value (S)

Often, as is the case with this assessment, some part(s) of the up-front investment costs will be for equipment or infrastructure that will have a useful life expectancy that extends beyond the end of the analysis period. As an example, a fuel storage tank is generally expected to have a useful life of approximately 30 years, with proper care and maintenance. If such a tank were installed and used to store mogas for the 12-year period of this analysis, it would have additional useful life at the end of that time. It could, for example, be converted to store whatever no-lead fuel is deployed for fleet-wide use after the completion of the on-going FAA leaded-fuel replacement program.

This item is also sometimes referred to as "residual" value and is usually calculated based on the remaining useful life as a portion of the total useful life, multiplied times the initial investment cost. The resulting value is placed in the final year of the analysis period and discounted to present value, with the useful life expectancy of the equipment determined from coordination with on-going users of similar equipment and manufacturers' data.

B. FBO Mogas Sales Approach (Scenario No. 2)

Under this scenario, mogas would be offerd for sale by an existing FBO that is, at present, offering 100LL as piston engine fuel at HIO. Importantly, this arrangment is consistent with the Port's *Minimum Standards* that only FBOs are allowed to sell retail aviation fuels at the airport.

Scenario No. 2: Existing FBO

This scenario is presently consistent with the Port's *Minimum Standards* for fuel sales at HIO and is based on many of the same conditions analyzed under Scenario No. 1 (*New Vendor*). The other main differences are that only revenues from "incremental" sales of mogas can be used to offset the costs and that no additional staff are anticipated under this arrangement.

1. Overall Framework

For this analysis, it is anticipated that if an FBO were to begin offering mogas in addition to 100LL, some of the mogas buyers would be customers who previously or otherwise would purchase 100LL—but if mogas were available, they would purchase it instead. In other words, these sales would essentially be mogas sales that would merely "replace" what otherwise would have been 100LL sales for the FBO.

However, based upon feedback from other airports that offer mogas, it is also expected that there would be some incremental mogas sales "over-and-above" the sales that would simply replace 100LL sales. In other words, these would be customers who may be purchasing mogas elsewhere and instead would now purchase it at HIO because it is available, closer, or more convenient for some other reason(s).[13]

Importantly, under this concept, it is the revenues from the "incremental" mogas sales that can be used in the business assessment to offset the costs of offering and sustaining the sale of mogas at HIO by the FBO (see previous discussion and **Figure 10**).

2. Assessment Details

For this scenario, two assumptions were tested for the "incremental" increase in overall fuel sales that would result with the addition of mogas sales. While, as a practical matter, it is almost certain that some incremental increase would occur with the offer of the mogas product, there is a lack of hard evidence to place a value on it. For this study, the levels tested were 5 percent and 10 percent "incremental" sales. The 5 percent assumption would equate to approximately 15,600 gallons of mogas sold to "new" or "incremental" fuel customers per year, or an average 1,300 gallons per month. Of course, the 10 percent "incremental" sales assumption would represent twice that level of "incremental" fuel sales.

For the purposes of this business case assessment scenario, assumptions were much the same as used in Scenario 1. They are summarized below:

Scenario No. 2 Conditions & Assumptions

- **Time Period** – An 12-year analysis period from 2015 through 2026 was assumed, with implementation and commissioning occurring during 2015, the first full year of mogas sales

[13] Other reasons could include (but may not be limited to) aircraft owners/operators that resume flying because the fuel is more affordable and the emerging use of lightweight sport aircraft.

being 2016, and sales continuing until the anticipated phase-out of 100LL and its replacement with a new no-lead fuel in 2026.

- **Mogas Purchase Price** - A first year mogas purchase price of $4.00/gallon from a local supplier (based on recent discussion and correspondence with Oregon suppliers of mogas).
- **Mogas Sales Price** - First year sales price of $4.99/gallon to end user.
- **Sales Trend** - Total gallons/sold/year will go down following 30-year national trend at -2.3 percent/year.
- **Price Trend** - Price per gallon will go up following 30-year national trend at 3.9 percent/year.
- **Fuel Flowage Fee** - Based on existing conditions, a fee of $0.0834/gal. is assumed.
- **Initial Invenstment Costs** - Initial investment costs for installing mogas tank, piping, pump, safety/security, card reader, etc. = approxiately $100,000.
- **Facility Life Expectancy** - Tank life expectancy will be 30 years (per industry sources).
- **Regulatory Fees** - $400 initial tank registration and $135 for renewal each following year (per Oregon Dept. of Environmental Quality).
- **O&M Costs** - Routine maintenance costs for filters, hose replacements, etc. = $700/year average (per industry sources). Insurance and miscellaneous operations costs = $5,000/year. Since existing FBOs already have staff engaged in fuel sales, it was assumed no new staff costs would be incurred with the addition of mogas.

C. Business Assessment Outcomes

The business case assessments performed for the two scenarios described above are summarized and discussed in this section. For ease in understanding the results, three indices of potential effectiveness are presented for each scenario: (i.) Business Potential (BP), (ii.) Payback Period, and (iii.) Internal Rate of Return. The following explains each of these indices, which were also briefly discussed in **Section V**.

Business Case Indices

- **Business Potential (BP)** – This is the sum of the present value of the stream of year-to-year positive (or negative) earnings (or losses) for that scenario for the 12-year analysis period.
- **Payback Period** – This is that year of the analysis in which "BP" changes from a negative to a positive value and represents the point in time where initial investments have been recouped and revenues are continuing to exceed operation and maintenance costs. For those scenarios showing a 12-year Payback Period, the final payback was due to the "Salvage Value" being added at the end of the analysis (see discussion of "Salvage Value" in **Section V**).
- **Internal Rate of Return** – This is a measure of the average annual return on investment represented by revenues, minus costs. By definition, the internal rate of return is that discount rate at which the present value of revenues would be exactly level with the present value of costs at the end of the analysis.

HIO Mogas Business Case Results

The testing of different assumptions in this analysis allows "bracketing" the levels of mogas sales that would be required to achieve positive business results for either the *New Vendor* or the *Existing FBO* options.

These results are presented in **Table 5** below and discussed as follows:

Business Case Results

- **Scenario 1: *New Vendor for Mogas Sales*** – Under this arrangement, if mogas sales were limited to only 5 percent of overall total piston-engine fuel sales, the business potential (BP) value would not become positive during the analysis period, at either discount rate tested. At the 10 percent level of total sales, the arrangement would marginally "break even" at the 7 percent discount rate, but not at the 10 percent rate. If mogas sales could reach the 15 percent level of total fuel sales, the analysis shows a modest positive result, with a payback period of 6-7 years, depending on discount rate, and an internal rate of return of 24 percent.
- **Scenario 2: *Existing FBO Mogas Sales*** – Under this arrangement, if the "incremental" mogas sales would only reach the level of 5 percent of total sales, the business activity would not have a positive result, almost breaking even at the 7 percent discount rate, but not at the 10 percent discount rate. If the "incremental" mogas sales were to reach the 10 percent level, the *FBO Mogas Sales* scenario would show modestly positive results, with a payback period of 6-7 years, depending on the discount rate, and a rate of return of 25 percent.

Table 5:
Business Case Assessment - Summary of Results

Scenario 1: New Vendor for Mogas Sales				
Index of Effectiveness	**Discount Rate**	**Mogas = 5% of Total Fuel Sales**	**Mogas = 10% of Total Fuel Sales**	**Mogas = 15% of Total Fuel Sales**
Business Potential (BP)	7%	($102,203)	$5,098	$112,400
	10%	($101,508)	($11,532)	$ 78,444
Payback Period	7%	none	12 years	6 years
	10%	none	none	7 years
Internal Rate of Return	--	(11 %)	8 %	24 %

Scenario 2: Existing FBO Mogas Sales			
Index of Effectiveness	**Discount Rate**	**"Incremental" Mogas Sales = 5%**	**"Incremental" Mogas Sales = 10%**
Business Potential (BP)	7%	($515)	$117,104
	10%	($16,398)	$ 82,230
Payback Period	7%	none	6 years
	10%	none	7 years
Internal Rate of Return	--	7 %	25 %

Source: KB Environmental Sciences, Inc. 2014.
Notes: See the Appendix for the Business Case Assessment back-up information and data.

E. Qualifying Statements

As a final note to the Business Case Assessment, it should be noted that this analysis deals with one of the most variable and hard-to-predict consumer items in our economy - fuel. Few other commodities experience the price variability, supply-demand changes, and sensitivity to national and global events as do petroleum products.

This assessment considered short- and long-term trends, research of the aircraft fleet affiliated with HIO, pilot survey responses, on-going government research and development, actual experience at other airports, and other sources to arrive at a reasonable set of assumptions to test. At the same time, it must be realized that unforeseen events, occurrences and/or opportunities could have substantial changing effects on some of these important inputs to the assessment. While not meant to be all-inclusive, the following listing is indicative of the types of conditions that remain unaccounted for with assessments such as this.

Potential Uncertainties & Enhancements

- **Fuel Availability & Costs** - Overall petroleum product availability could be upset or interrupted by international events. Conversely, petroleum availability could be somewhat enhanced by increased U.S. production. Whatever substantial changes could occur in petroleum availability would have an upward or downward effect on petroleum prices, followed usually be changes in demand.
- **Time Period** - The time period of the analysis is based on the current FAA schedule for development of a replacement no-lead fuel for 100LL. If that schedule should not hold, and the deployment of the new fuel should be delayed, there would be a longer time period for the mogas marketability.
- **Cooperative Features** - Investment costs assumed in the assessment for the set-up of mogas sales at HIO may be improved upon, reducing the up-front costs that must be offset by sales. Such examples may include (but are not necessarily limited to) the following:
  - Assistance from fuel suppliers by way of providing fuel storage/dispensing equipment (one Oregon fuel supplier has indicated possible interest in such an arrangement).
  - Use of existing storage tanks at HIO that are presently unused or available for repurposing.
  - Use of small (i.e., less than 5,000 gallons) mobile storage tanks.
  - A temporary (or “trial”) arrangement whereby mogas is offered on an experimental arrangement to ascertain the attractiveness and viability of offering this fuel on a more permanent basis.
- **Reduction of Lead Emissions** – Depending on the amount of mogas used as an alternative to 100LL, the reduction in lead emissions could range from 0.05 to 0.1 tons/year associated with aircraft that purchase the fuel at HIO. However, this reduction would occur throughout the entire flight and not necessarily be confined to the area around the airport.

VI. CONCLUSIONS & RECOMMENDATIONS

This assessment has been performed to evaluate the business potential of offering mogas in addition to 100LL avgas at HIO. At its simplest, the assessment aimed to determine what level of mogas sales would be required to offset the costs to offer mogas at HIO. Based upon the outcomes of this assessment, the following essential findings are noteworthy:

HIO Airport

- **Avgas Replacement Fuel** - The FAA has established a program and performance metric to make available by 2018 an unleaded replacement fuel for leaded aviation gasoline that is usable by most GA aircraft. Following that milestone, a deployment period for the new fuel and phase-out period for the leaded fuels would likely extend to 2024 (10 years from now) at the earliest.
- **Mogas Use** - Although mogas has been available since the early 1980s, it is still a “niche” fuel as only 120 airports nationwide (i.e., less than one percent) presently offer it for sale. Of these, only two are in Oregon (Lebanon and Grants Pass).
- **Mogas Versus Avgas** – The amount of mogas throughput compared to avgas varies considerably from airport-to-airport with a range of 3 to 55 percent, with the high end of the range being an airport that also sells mogas to non-aviation users.
- **HIO Fleet Characteristics** - Few, if any, of the airports that offer mogas compare closely to HIO in terms of GA aircraft operational levels, fleet mix and cliental. In other words, HIO has substantially more operations and the overall GA aircraft fleet that is more “business-related” than any of the other airports.
- **Mogas Availability** - Mogas is available from at least three wholesale distributors located proximal to HIO. Depending on the volume of fuel delivered, the cost of mogas from these suppliers presently ranges from $3.25 to $3.50/gal. - which are presently at a four-year low.
- **Potential Mogas Use and Price at HIO** – According to an assessment of the GA aircraft that are affiliated with HIO, as little as 8.5 percent or as much as 29.5 percent of this sampling of evaluated aircraft can currently use mogas were it offered at HIO. Nearly 80 percent of those responding would purchase the fuel for $4.99 or less at HIO.
- **Business Case Assessment** - In order for the addition of mogas sales at HIO to be a modestly-positive business proposition, a “new vendor” would have to achieve mogas sales levels approaching 15 percent of all piston-engine fuel sales. If an existing FBO were to add mogas sales in addition to on-going 100LL sales, an “increment” of new total fuel sales between 5 percent and 10 percent would be required to make the undertaking profitable.

It is recommended that the information and data contained in this report be considered when evaluating the feasibility of providing mogas at HIO in addition to the other fuels that are presently offer at the airport.

[End of Report]

REFERENCES

U.S. Environmental Protection Agency, Leaded Gas Phaseout / Air Quality Factsheet, June 1995.

Federal Aviation Administration, Fact Sheet—Leaded Aviation Fuel and the Environment, June 19, 2013.

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U.S. Energy Information Administration, Petroleum & Other Liquids/Aviation Gasoline Retail Sales, release date October 1, 2014; www.eia.gov/dnav/pet/hist/ .

AirNav.com, Fuel Price Report (Summary of Fuel Prices at 3,588 FBOs Nationwide, October 214; www.airnav.com/fuel/report.

DISCLAIMER

This report was designed and prepared in good faith to aid in the feasibility and business case assessments of providing mogas at HIO in addition to the other fuels that are currently provided at the airport. Nothing in this report should be used or relied upon regarding the actual use of any type of aviation fuel in aircraft or other forms of conveyance as it pertains to engine mechanics, the environment or pilot/public safety.

APPENDIX

SCENARIO: New Vendor for Mogas Sales (Mogas = 5% of Overall Sales) - 7% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.07	
2016 100LL + Mogas:	312,000	gallons
2016 Mogas Sales:	0.05	as part of total
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year
1st Year Staff Costs:	13,000	$/year (1/3 time mid-level, plus O/H)
Staff $ Yrly. Increase:	1.025	/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9346		100,000	400		(93,832)	
2	2016	0.8734	77,844	62,400	19,736		(3,749)	(97,581)
3	2017	0.8163	79,013	63,337	20,831		(4,208)	(101,789)
4	2018	0.7629	80,199	64,287	20,335		(3,375)	(105,164)
5	2019	0.7130	81,403	65,253	21,448		(3,778)	(108,942)
6	2020	0.6663	82,625	66,232	20,970		(3,051)	(111,992)
7	2021	0.6227	83,865	67,226	22,102		(3,402)	(115,395)
8	2022	0.5820	85,124	68,235	21,643		(2,767)	(118,162)
9	2023	0.5439	86,402	69,260	22,794		(3,075)	(121,237)
10	2024	0.5083	87,699	70,299	22,355		(2,519)	(123,756)
11	2025	0.4751	89,015	71,355	23,526		(2,787)	(126,543)
12	2026	0.4440	90,351	72,426	23,108	60,000	24,340	(102,203)

NOTE: BP = (PV)R - ((PV)I + (PV)O&M - (PV)S)

IRR= -11.34%

SCENARIO: New Vendor for Mogas Sales (Mogas = 5% of Overall Sales) - 7% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Mogas Sold (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	15,600	4.99	77,844
3	2017	15,243	5.18	79,013
4	2018	14,894	5.38	80,199
5	2019	14,553	5.59	81,403
6	2020	14,219	5.81	82,625
7	2021	13,894	6.04	83,865
8	2022	13,576	6.27	85,124
9	2023	13,265	6.51	86,402
10	2024	12,961	6.77	87,699
11	2025	12,664	7.03	89,015
12	2026	12,374	7.30	90,351

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Mogas Sold (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		15,600	4.00	62,400
3	2017		15,243	4.16	63,337
4	2018		14,894	4.32	64,287
5	2019		14,553	4.48	65,253
6	2020		14,219	4.66	66,232
7	2021		13,894	4.84	67,226
8	2022		13,576	5.03	68,235
9	2023		13,265	5.22	69,260
10	2024		12,961	5.42	70,299
11	2025		12,664	5.63	71,355
12	2026		12,374	5.85	72,426

Operations & Maintenance Costs (O&M)

Year #	Year	Mogas Sold (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	Staff Costs ($)	TOTAL O&M ($)
1	2015			400					400
2	2016	15,600	0.0834	135	300		5,000	13,000	19,736
3	2017	15,243	0.0834	135	300	800	5,000	13,325	20,831
4	2018	14,894	0.0834	135	300		5,000	13,658	20,335
5	2019	14,553	0.0834	135	300	800	5,000	14,000	21,448
6	2020	14,219	0.0834	135	300		5,000	14,350	20,970
7	2021	13,894	0.0834	135	300	800	5,000	14,708	22,102
8	2022	13,576	0.0834	135	300		5,000	15,076	21,643
9	2023	13,265	0.0834	135	300	800	5,000	15,453	22,794
10	2024	12,961	0.0834	135	300		5,000	15,839	22,355
11	2025	12,664	0.0834	135	300	800	5,000	16,235	23,526
12	2026	12,374	0.0834	135	300		5,000	16,641	23,108

SCENARIO: New Vendor for Mogas Sales (Mogas = 5% of Overall Sales) - 10% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.10	
2016 100LL + Mogas:	312,000	gallons
2016 Mogas Sales:	0.05	as part of total
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year
1st Year Staff Costs:	13,000	$/year (1/3 time mid-level, plus O/H)
Staff $ Yrly. Increase:	1.025	/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9091		100,000	400		(91,273)	
2	2016	0.8264	77,844	62,400	19,736		(3,547)	(94,820)
3	2017	0.7513	79,013	63,337	20,831		(3,873)	(98,693)
4	2018	0.6830	80,199	64,287	20,335		(3,022)	(101,715)
5	2019	0.6209	81,403	65,253	21,448		(3,290)	(105,005)
6	2020	0.5645	82,625	66,232	20,970		(2,584)	(107,589)
7	2021	0.5132	83,865	67,226	22,102		(2,804)	(110,393)
8	2022	0.4665	85,124	68,235	21,643		(2,218)	(112,611)
9	2023	0.4241	86,402	69,260	22,794		(2,397)	(115,008)
10	2024	0.3855	87,699	70,299	22,355		(1,911)	(116,919)
11	2025	0.3505	89,015	71,355	23,526		(2,056)	(118,975)
12	2026	0.3186	90,351	72,426	23,108	60,000	17,466	(101,508)

NOTE: BP = (PV)R - ((PV)I + (PV)O&M - (PV)S) IRR= -11.34%

SCENARIO: New Vendor for Mogas Sales (Mogas = 5% of Overall Sales) - 10% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Mogas Sold (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	15,600	4.99	77,844
3	2017	15,243	5.18	79,013
4	2018	14,894	5.38	80,199
5	2019	14,553	5.59	81,403
6	2020	14,219	5.81	82,625
7	2021	13,894	6.04	83,865
8	2022	13,576	6.27	85,124
9	2023	13,265	6.51	86,402
10	2024	12,961	6.77	87,699
11	2025	12,664	7.03	89,015
12	2026	12,374	7.30	90,351

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Mogas Sold (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		15,600	4.00	62,400
3	2017		15,243	4.16	63,337
4	2018		14,894	4.32	64,287
5	2019		14,553	4.48	65,253
6	2020		14,219	4.66	66,232
7	2021		13,894	4.84	67,226
8	2022		13,576	5.03	68,235
9	2023		13,265	5.22	69,260
10	2024		12,961	5.42	70,299
11	2025		12,664	5.63	71,355
12	2026		12,374	5.85	72,426

Operations & Maintenance Costs (O&M)

Year #	Year	Mogas Sold (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	Staff Costs ($)	TOTAL O&M ($)
1	2015			400					400
2	2016	15,600	0.0834	135	300		5,000	13,000	19,736
3	2017	15,243	0.0834	135	300	800	5,000	13,325	20,831
4	2018	14,894	0.0834	135	300		5,000	13,658	20,335
5	2019	14,553	0.0834	135	300	800	5,000	14,000	21,448
6	2020	14,219	0.0834	135	300		5,000	14,350	20,970
7	2021	13,894	0.0834	135	300	800	5,000	14,708	22,102
8	2022	13,576	0.0834	135	300		5,000	15,076	21,643
9	2023	13,265	0.0834	135	300	800	5,000	15,453	22,794
10	2024	12,961	0.0834	135	300		5,000	15,839	22,355
11	2025	12,664	0.0834	135	300	800	5,000	16,235	23,526
12	2026	12,374	0.0834	135	300		5,000	16,641	23,108

SCENARIO: New Vendor for Mogas Sales (Mogas = 10% of Overall Sales) - 7% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.07	
2016 100LL + Mogas:	312,000	gallons
2016 Mogas Sales:	0.10	as part of total
Yrly. Sales <u>Decline</u>:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price <u>Increase</u>:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year
1st Year Staff Costs:	13,000	$/year (1/3 time mid-level, plus O/H)
Staff $ Yrly. Increase:	1.025	/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9346		100,000	400		(93,832)	
2	2016	0.8734	155,688	124,800	21,037		8,604	(85,228)
3	2017	0.8163	158,025	126,673	22,102		7,550	(77,678)
4	2018	0.7629	160,397	128,575	21,577		7,816	(69,862)
5	2019	0.7130	162,805	130,505	22,662		6,872	(62,990)
6	2020	0.6663	165,249	132,464	22,156		7,082	(55,908)
7	2021	0.6227	167,730	134,453	23,261		6,238	(49,670)
8	2022	0.5820	170,248	136,471	22,775		6,403	(43,267)
9	2023	0.5439	172,803	138,520	23,900		5,648	(37,620)
10	2024	0.5083	175,397	140,599	23,436		5,776	(31,844)
11	2025	0.4751	178,030	142,710	24,583		5,102	(26,742)
12	2026	0.4440	180,703	144,852	24,140	60,000	31,840	5,098
NOTE: BP = (PV)R - ((PV)I + (PV)O&M - (PV)S)							IRR=	7.88%

SCENARIO: New Vendor for Mogas Sales (Mogas = 10% of Overall Sales) - 7% Discount Rate (Page 2 – Backup)

Revenues (R)

Year #	Year	Mogas Sold (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	31,200	4.99	155,688
3	2017	30,486	5.18	158,025
4	2018	29,787	5.38	160,397
5	2019	29,105	5.59	162,805
6	2020	28,439	5.81	165,249
7	2021	27,788	6.04	167,730
8	2022	27,151	6.27	170,248
9	2023	26,529	6.51	172,803
10	2024	25,922	6.77	175,397
11	2025	25,328	7.03	178,030
12	2026	24,748	7.30	180,703

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Mogas Sold (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		31,200	4.00	124,800
3	2017		30,486	4.16	126,673
4	2018		29,787	4.32	128,575
5	2019		29,105	4.48	130,505
6	2020		28,439	4.66	132,464
7	2021		27,788	4.84	134,453
8	2022		27,151	5.03	136,471
9	2023		26,529	5.22	138,520
10	2024		25,922	5.42	140,599
11	2025		25,328	5.63	142,710
12	2026		24,748	5.85	144,852

Operations & Maintenance Costs (O&M)

Year #	Year	Mogas Sold (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	Staff Costs ($)	TOTAL O&M ($)
1	2015			400					400
2	2016	31,200	0.0834	135	300		5,000	13,000	21,037
3	2017	30,486	0.0834	135	300	800	5,000	13,325	22,102
4	2018	29,787	0.0834	135	300		5,000	13,658	21,577
5	2019	29,105	0.0834	135	300	800	5,000	14,000	22,662
6	2020	28,439	0.0834	135	300		5,000	14,350	22,156
7	2021	27,788	0.0834	135	300	800	5,000	14,708	23,261
8	2022	27,151	0.0834	135	300		5,000	15,076	22,775
9	2023	26,529	0.0834	135	300	800	5,000	15,453	23,900
10	2024	25,922	0.0834	135	300		5,000	15,839	23,436
11	2025	25,328	0.0834	135	300	800	5,000	16,235	24,583
12	2026	24,748	0.0834	135	300		5,000	16,641	24,140

SCENARIO: New Vendor for Mogas Sales (Mogas = 10% of Overall Sales) - 10% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.10	
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2016 Mogas Sales:	0.10	as part of total
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year
1st Year Staff Costs:	13,000	$/year (1/3 time mid-level, plus O/H)
Staff $ Yrly. Increase:	1.025	/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9091		100,000	400		(91,273)	
2	2016	0.8264	155,688	124,800	21,037		8,141	(83,131)
3	2017	0.7513	158,025	126,673	22,102		6,949	(76,182)
4	2018	0.6830	160,397	128,575	21,577		6,997	(69,185)
5	2019	0.6209	162,805	130,505	22,662		5,984	(63,201)
6	2020	0.5645	165,249	132,464	22,156		6,000	(57,201)
7	2021	0.5132	167,730	134,453	23,261		5,140	(52,061)
8	2022	0.4665	170,248	136,471	22,775		5,132	(46,929)
9	2023	0.4241	172,803	138,520	23,900		4,403	(42,526)
10	2024	0.3855	175,397	140,599	23,436		4,381	(38,145)
11	2025	0.3505	178,030	142,710	24,583		3,764	(34,381)
12	2026	0.3186	180,703	144,852	24,140	60,000	22,849	(11,532)

NOTE: BP = (PV)R - ((PV)I + (PV)O&M - (PV)S)

IRR= 7.88%

SCENARIO: New Vendor for Mogas Sales (Mogas = 10% of Overall Sales) - 10% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Mogas Sold (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	31,200	4.99	155,688
3	2017	30,486	5.18	158,025
4	2018	29,787	5.38	160,397
5	2019	29,105	5.59	162,805
6	2020	28,439	5.81	165,249
7	2021	27,788	6.04	167,730
8	2022	27,151	6.27	170,248
9	2023	26,529	6.51	172,803
10	2024	25,922	6.77	175,397
11	2025	25,328	7.03	178,030
12	2026	24,748	7.30	180,703

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Mogas Sold (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		31,200	4.00	124,800
3	2017		30,486	4.16	126,673
4	2018		29,787	4.32	128,575
5	2019		29,105	4.48	130,505
6	2020		28,439	4.66	132,464
7	2021		27,788	4.84	134,453
8	2022		27,151	5.03	136,471
9	2023		26,529	5.22	138,520
10	2024		25,922	5.42	140,599
11	2025		25,328	5.63	142,710
12	2026		24,748	5.85	144,852

Operations & Maintenance Costs (O&M)

Year #	Year	Mogas Sold (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	Staff Costs ($)	TOTAL O&M ($)
1	2015			400					400
2	2016	31,200	0.0834	135	300		5,000	13,000	21,037
3	2017	30,486	0.0834	135	300	800	5,000	13,325	22,102
4	2018	29,787	0.0834	135	300		5,000	13,658	21,577
5	2019	29,105	0.0834	135	300	800	5,000	14,000	22,662
6	2020	28,439	0.0834	135	300		5,000	14,350	22,156
7	2021	27,788	0.0834	135	300	800	5,000	14,708	23,261
8	2022	27,151	0.0834	135	300		5,000	15,076	22,775
9	2023	26,529	0.0834	135	300	800	5,000	15,453	23,900
10	2024	25,922	0.0834	135	300		5,000	15,839	23,436
11	2025	25,328	0.0834	135	300	800	5,000	16,235	24,583
12	2026	24,748	0.0834	135	300		5,000	16,641	24,140

SCENARIO: New Vendor for Mogas Sales (Mogas = 15% of Overall Sales) - 7% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.07	
2016 100LL + Mogas:	312,000	gallons
2016 Mogas Sales:	0.15	as part of total
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year
1st Year Staff Costs:	13,000	$/year (1/3 time mid-level, plus O/H)
Staff $ Yrly. Increase:	1.025	/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9346		100,000	400		(93,832)	
2	2016	0.8734	233,532	187,200	22,338		20,957	(72,875)
3	2017	0.8163	237,038	190,010	23,374		19,309	(53,566)
4	2018	0.7629	240,596	192,862	22,820		19,007	(34,559)
5	2019	0.7130	244,208	195,758	23,876		17,521	(17,038)
6	2020	0.6663	247,874	198,696	23,342		17,215	177
7	2021	0.6227	251,595	201,679	24,420		15,878	16,054
8	2022	0.5820	255,371	204,706	23,908		15,573	31,627
9	2023	0.5439	259,205	207,779	25,007		14,370	45,997
10	2024	0.5083	263,096	210,898	24,517		14,071	60,069
11	2025	0.4751	267,045	214,064	25,639		12,990	73,059
12	2026	0.4440	271,054	217,278	25,172	60,000	39,341	112,400

NOTE: BP = (PV)R - ((PV)I + (PV)O&M - (PV)S)

IRR= 24.05%

SCENARIO: New Vendor for Mogas Sales (Mogas = 15% of Overall Sales) - 7% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Mogas Sold (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	46,800	4.99	233,532
3	2017	45,728	5.18	237,038
4	2018	44,681	5.38	240,596
5	2019	43,658	5.59	244,208
6	2020	42,658	5.81	247,874
7	2021	41,681	6.04	251,595
8	2022	40,727	6.27	255,371
9	2023	39,794	6.51	259,205
10	2024	38,883	6.77	263,096
11	2025	37,992	7.03	267,045
12	2026	37,122	7.30	271,054

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Mogas Sold (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		46,800	4.00	187,200
3	2017		45,728	4.16	190,010
4	2018		44,681	4.32	192,862
5	2019		43,658	4.48	195,758
6	2020		42,658	4.66	198,696
7	2021		41,681	4.84	201,679
8	2022		40,727	5.03	204,706
9	2023		39,794	5.22	207,779
10	2024		38,883	5.42	210,898
11	2025		37,992	5.63	214,064
12	2026		37,122	5.85	217,278

Operations & Maintenance Costs (O&M)

Year #	Year	Mogas Sold (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	Staff Costs ($)	TOTAL O&M ($)
1	2015			400					400
2	2016	46,800	0.0834	135	300		5,000	13,000	22,338
3	2017	45,728	0.0834	135	300	800	5,000	13,325	23,374
4	2018	44,681	0.0834	135	300		5,000	13,658	22,820
5	2019	43,658	0.0834	135	300	800	5,000	14,000	23,876
6	2020	42,658	0.0834	135	300		5,000	14,350	23,342
7	2021	41,681	0.0834	135	300	800	5,000	14,708	24,420
8	2022	40,727	0.0834	135	300		5,000	15,076	23,908
9	2023	39,794	0.0834	135	300	800	5,000	15,453	25,007
10	2024	38,883	0.0834	135	300		5,000	15,839	24,517
11	2025	37,992	0.0834	135	300	800	5,000	16,235	25,639
12	2026	37,122	0.0834	135	300		5,000	16,641	25,172

SCENARIO: New Vendor for Mogas Sales (Mogas = 15% of Overall Sales) - 10% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.10	
2016 100LL + Mogas:	312,000	gallons
2016 Mogas Sales:	0.15	as part of total
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year
1st Year Staff Costs:	13,000	$/year (1/3 time mid-level, plus O/H)
Staff $ Yrly. Increase:	1.025	/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9091		100,000	400		(91,273)	
2	2016	0.8264	233,532	187,200	22,338		19,830	(71,443)
3	2017	0.7513	237,038	190,010	23,374		17,771	(53,672)
4	2018	0.6830	240,596	192,862	22,820		17,017	(36,655)
5	2019	0.6209	244,208	195,758	23,876		15,259	(21,396)
6	2020	0.5645	247,874	198,696	23,342		14,583	(6,813)
7	2021	0.5132	251,595	201,679	24,420		13,083	6,270
8	2022	0.4665	255,371	204,706	23,908		12,482	18,753
9	2023	0.4241	259,205	207,779	25,007		11,204	29,957
10	2024	0.3855	263,096	210,898	24,517		10,672	40,629
11	2025	0.3505	267,045	214,064	25,639		9,583	50,212
12	2026	0.3186	271,054	217,278	25,172	60,000	28,232	78,444

NOTE: BP = (PV)R - ((PV)I + (PV)O&M - (PV)S)

IRR= 24.05%

SCENARIO: New Vendor for Mogas Sales (Mogas = 15% of Overall Sales) - 10% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Mogas Sold (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	46,800	4.99	233,532
3	2017	45,728	5.18	237,038
4	2018	44,681	5.38	240,596
5	2019	43,658	5.59	244,208
6	2020	42,658	5.81	247,874
7	2021	41,681	6.04	251,595
8	2022	40,727	6.27	255,371
9	2023	39,794	6.51	259,205
10	2024	38,883	6.77	263,096
11	2025	37,992	7.03	267,045
12	2026	37,122	7.30	271,054

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Mogas Sold (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		46,800	4.00	187,200
3	2017		45,728	4.16	190,010
4	2018		44,681	4.32	192,862
5	2019		43,658	4.48	195,758
6	2020		42,658	4.66	198,696
7	2021		41,681	4.84	201,679
8	2022		40,727	5.03	204,706
9	2023		39,794	5.22	207,779
10	2024		38,883	5.42	210,898
11	2025		37,992	5.63	214,064
12	2026		37,122	5.85	217,278

Operations & Maintenance Costs (O&M)

Year #	Year	Mogas Sold (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	Staff Costs ($)	TOTAL O&M ($)
1	2015			400					400
2	2016	46,800	0.0834	135	300		5,000	13,000	22,338
3	2017	45,728	0.0834	135	300	800	5,000	13,325	23,374
4	2018	44,681	0.0834	135	300		5,000	13,658	22,820
5	2019	43,658	0.0834	135	300	800	5,000	14,000	23,876
6	2020	42,658	0.0834	135	300		5,000	14,350	23,342
7	2021	41,681	0.0834	135	300	800	5,000	14,708	24,420
8	2022	40,727	0.0834	135	300		5,000	15,076	23,908
9	2023	39,794	0.0834	135	300	800	5,000	15,453	25,007
10	2024	38,883	0.0834	135	300		5,000	15,839	24,517
11	2025	37,992	0.0834	135	300	800	5,000	16,235	25,639
12	2026	37,122	0.0834	135	300		5,000	16,641	25,172

SCENARIO: FBO Mogas Sales (Incremental Sales = 5% of Total) - 7% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.07	
Incremental Sales %	0.05	expressed as decimal
Total Fuel Sales:	312,000	gallons
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9346		100,000	400		(93,832)	
2	2016	0.8734	77,844	62,400	6,736		7,606	(86,226)
3	2017	0.8163	79,013	63,337	7,506		6,669	(79,557)
4	2018	0.7629	80,199	64,287	6,677		7,045	(72,512)
5	2019	0.7130	81,403	65,253	7,449		6,204	(66,309)
6	2020	0.6663	82,625	66,232	6,621		6,511	(59,797)
7	2021	0.6227	83,865	67,226	7,394		5,757	(54,040)
8	2022	0.5820	85,124	68,235	6,567		6,007	(48,033)
9	2023	0.5439	86,402	69,260	7,341		5,331	(42,702)
10	2024	0.5083	87,699	70,299	6,516		5,532	(37,170)
11	2025	0.4751	89,015	71,355	7,291		4,926	(32,244)
12	2026	0.4440	90,351	72,426	6,467	60,000	31,728	(515)

NOTE: BP = (PV)R - (PV)I + (PV)O&M - (PV)S

IRR= 6.98%

SCENARIO: FBO Mogas Sales (Incremental Sales = 5% of Total) - 7% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Incremental (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	15,600	4.99	77,844
3	2017	15,243	5.18	79,013
4	2018	14,894	5.38	80,199
5	2019	14,553	5.59	81,403
6	2020	14,219	5.81	82,625
7	2021	13,894	6.04	83,865
8	2022	13,576	6.27	85,124
9	2023	13,265	6.51	86,402
10	2024	12,961	6.77	87,699
11	2025	12,664	7.03	89,015
12	2026	12,374	7.30	90,351

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Incremental (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		15,600	4.00	62,400
3	2017		15,243	4.16	63,337
4	2018		14,894	4.32	64,287
5	2019		14,553	4.48	65,253
6	2020		14,219	4.66	66,232
7	2021		13,894	4.84	67,226
8	2022		13,576	5.03	68,235
9	2023		13,265	5.22	69,260
10	2024		12,961	5.42	70,299
11	2025		12,664	5.63	71,355
12	2026		12,374	5.85	72,426

Operations & Maintenance Costs (O&M)

Year #	Year	Incremental (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	TOTAL O&M ($)
1	2015			400				400
2	2016	15,600	0.0834	135	300		5,000	6,736
3	2017	15,243	0.0834	135	300	800	5,000	7,506
4	2018	14,894	0.0834	135	300		5,000	6,677
5	2019	14,553	0.0834	135	300	800	5,000	7,449
6	2020	14,219	0.0834	135	300		5,000	6,621
7	2021	13,894	0.0834	135	300	800	5,000	7,394
8	2022	13,576	0.0834	135	300		5,000	6,567
9	2023	13,265	0.0834	135	300	800	5,000	7,341
10	2024	12,961	0.0834	135	300		5,000	6,516
11	2025	12,664	0.0834	135	300	800	5,000	7,291
12	2026	12,374	0.0834	135	300		5,000	6,467

SCENARIO: FBO Mogas Sales (Incremental Sales = 5% of Total) - 10% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.10	
Incremental Sales %	0.05	expressed as decimal
Total Fuel Sales:	312,000	gallons
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9091		100,000	400		(91,273)	
2	2016	0.8264	77,844	62,400	6,736		7,197	(84,076)
3	2017	0.7513	79,013	63,337	7,506		6,138	(77,938)
4	2018	0.6830	80,199	64,287	6,677		6,307	(71,631)
5	2019	0.6209	81,403	65,253	7,449		5,403	(66,228)
6	2020	0.5645	82,625	66,232	6,621		5,516	(60,713)
7	2021	0.5132	83,865	67,226	7,394		4,744	(55,969)
8	2022	0.4665	85,124	68,235	6,567		4,815	(51,154)
9	2023	0.4241	86,402	69,260	7,341		4,156	(46,997)
10	2024	0.3855	87,699	70,299	6,516		4,196	(42,801)
11	2025	0.3505	89,015	71,355	7,291		3,634	(39,167)
12	2026	0.3186	90,351	72,426	6,467	60,000	22,769	(16,398)

NOTE: BP = (PV)R - (PV)I + (PV)O&M - (PV)S

IRR= 6.98%

SCENARIO: FBO Mogas Sales (Incremental Sales = 5% of Total) - 10% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Incremental (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	15,600	4.99	77,844
3	2017	15,243	5.18	79,013
4	2018	14,894	5.38	80,199
5	2019	14,553	5.59	81,403
6	2020	14,219	5.81	82,625
7	2021	13,894	6.04	83,865
8	2022	13,576	6.27	85,124
9	2023	13,265	6.51	86,402
10	2024	12,961	6.77	87,699
11	2025	12,664	7.03	89,015
12	2026	12,374	7.30	90,351

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Incremental (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		15,600	4.00	62,400
3	2017		15,243	4.16	63,337
4	2018		14,894	4.32	64,287
5	2019		14,553	4.48	65,253
6	2020		14,219	4.66	66,232
7	2021		13,894	4.84	67,226
8	2022		13,576	5.03	68,235
9	2023		13,265	5.22	69,260
10	2024		12,961	5.42	70,299
11	2025		12,664	5.63	71,355
12	2026		12,374	5.85	72,426

Operations & Maintenance Costs (O&M)

Year #	Year	Incremental (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	TOTAL O&M ($)
1	2015			400				400
2	2016	15,600	0.0834	135	300		5,000	6,736
3	2017	15,243	0.0834	135	300	800	5,000	7,506
4	2018	14,894	0.0834	135	300		5,000	6,677
5	2019	14,553	0.0834	135	300	800	5,000	7,449
6	2020	14,219	0.0834	135	300		5,000	6,621
7	2021	13,894	0.0834	135	300	800	5,000	7,394
8	2022	13,576	0.0834	135	300		5,000	6,567
9	2023	13,265	0.0834	135	300	800	5,000	7,341
10	2024	12,961	0.0834	135	300		5,000	6,516
11	2025	12,664	0.0834	135	300	800	5,000	7,291
12	2026	12,374	0.0834	135	300		5,000	6,467

SCENARIO: FBO Mogas Sales (Incremental Sales = 10% of Total) - 7% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.07	
Incremental Sales %	0.10	expressed as decimal
Total Fuel Sales:	327,000	gallons
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9346		100,000	400		(93,832)	
2	2016	0.8734	163,173	130,800	8,162		21,147	(72,685)
3	2017	0.8163	165,622	132,764	8,900		19,558	(53,127)
4	2018	0.7629	168,109	134,756	8,039		19,312	(33,816)
5	2019	0.7130	170,632	136,779	8,779		17,877	(15,938)
6	2020	0.6663	173,194	138,833	7,921		17,618	1,680
7	2021	0.6227	175,794	140,917	8,664		16,324	18,004
8	2022	0.5820	178,433	143,032	7,808		16,059	34,063
9	2023	0.5439	181,111	145,179	8,554		14,892	48,955
10	2024	0.5083	183,830	147,359	7,701		14,625	63,580
11	2025	0.4751	186,589	149,571	8,449		13,573	77,153
12	2026	0.4440	189,390	151,816	7,598	60,000	39,951	117,104

NOTE: BP = (PV)R - (PV)I + (PV)O&M - (PV)S

IRR= 24.58%

SCENARIO: FBO Mogas Sales (Incremental Sales = 10% of Total) - 7% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Incremental (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	32,700	4.99	163,173
3	2017	31,951	5.18	165,622
4	2018	31,219	5.38	168,109
5	2019	30,505	5.59	170,632
6	2020	29,806	5.81	173,194
7	2021	29,123	6.04	175,794
8	2022	28,457	6.27	178,433
9	2023	27,805	6.51	181,111
10	2024	27,168	6.77	183,830
11	2025	26,546	7.03	186,589
12	2026	25,938	7.30	189,390

Investment Costs (I)

Year #	Year	Tank / Pump / etc.	Incremental (gal)	Investment Price / gal	Investment Costs
1	2015	100,000			100,000
2	2016		32,700	4.00	130,800
3	2017		31,951	4.16	132,764
4	2018		31,219	4.32	134,756
5	2019		30,505	4.48	136,779
6	2020		29,806	4.66	138,833
7	2021		29,123	4.84	140,917
8	2022		28,457	5.03	143,032
9	2023		27,805	5.22	145,179
10	2024		27,168	5.42	147,359
11	2025		26,546	5.63	149,571
12	2026		25,938	5.85	151,816

Operations & Maintenance Costs (O&M)

Year #	Year	Incremental (gal)	Flowage Fee ($/gal)	Permit Fees ($)	Routine Maint. ($)	Periodic Maint. ($)	Misc. O&M ($)	TOTAL O&M ($)
1	2015			400				400
2	2016	32,700	0.0834	135	300		5,000	8,162
3	2017	31,951	0.0834	135	300	800	5,000	8,900
4	2018	31,219	0.0834	135	300		5,000	8,039
5	2019	30,505	0.0834	135	300	800	5,000	8,779
6	2020	29,806	0.0834	135	300		5,000	7,921
7	2021	29,123	0.0834	135	300	800	5,000	8,664
8	2022	28,457	0.0834	135	300		5,000	7,808
9	2023	27,805	0.0834	135	300	800	5,000	8,554
10	2024	27,168	0.0834	135	300		5,000	7,701
11	2025	26,546	0.0834	135	300	800	5,000	8,449
12	2026	25,938	0.0834	135	300		5,000	7,598

SCENARIO: FBO Mogas Sales (Incremental Sales = 10% of Total) - 10% Discount Rate (Page 1 - Summary)

Assumptions:

Discount Rate:	0.10	
Incremental Sales %	0.10	expressed as decimal
Total Fuel Sales:	327,000	gallons
Yrly. Sales Decline:	0.0229	(30-year national trend & HIO trend 2006-13)
Supplier Price/gal:	4.00	$/gallon
Sales Price/gal:	4.99	$/gallon
Yrly. Price Increase:	0.0388	(30-year national trend)
Flowage Fee/gal:	0.0834	$/gallon
Tank/Pump, etc:	100,000	$
Tank Life Expectancy:	30	years
Tank Permit Yr. 1:	400	$
Tank Permit Other Yrs:	135	$
Filter Replacements:	300	$/year
Hose Replacements:	800	$/ea. two years
Ins./Finance/Misc.	5,000	$/year

			All Values Expressed as $US					
Analysis Year	Calendar Year	PV Factor	Gross Revenues (R)	Investment Costs (I)	Opns. & Maint. Costs (O&M)	Salvage Value (S)	Business Potential (BP)	Cumulative BP
1	2015	0.9091		100,000	400		(91,273)	
2	2016	0.8264	163,173	130,800	8,162		20,009	(71,264)
3	2017	0.7513	165,622	132,764	8,900		18,001	(53,263)
4	2018	0.6830	168,109	134,756	8,039		17,289	(35,973)
5	2019	0.6209	170,632	136,779	8,779		15,569	(20,405)
6	2020	0.5645	173,194	138,833	7,921		14,925	(5,480)
7	2021	0.5132	175,794	140,917	8,664		13,451	7,972
8	2022	0.4665	178,433	143,032	7,808		12,872	20,844
9	2023	0.4241	181,111	145,179	8,554		11,611	32,455
10	2024	0.3855	183,830	147,359	7,701		11,092	43,547
11	2025	0.3505	186,589	149,571	8,449		10,014	53,560
12	2026	0.3186	189,390	151,816	7,598	60,000	28,669	82,230

NOTE: BP = (PV)R - (PV)I + (PV)O&M - (PV)S

IRR= 24.58%

SCENARIO: FBO Mogas Sales (Incremental Sales = 10% of Total) - 10% Discount Rate (Page 2 - Backup)

Revenues (R)

Year #	Year	Incremental (gals)	Sales Price/gal	Revenues
1	2015			
2	2016	32,700	4.99	163,173
3	2017	31,951	5.18	165,622
4	2018	31,219	5.38	168,109
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Back Cover)

“<u>Preventing Lead Poisoning in Young Children</u>” *

A Statement by the Centers for Disease Control and Prevention
August 2005

U.S Department of Health and Human Services,
Public Health Service

“The U.S. Department of Health and Human Services has established an ambitious goal of eliminating elevated blood lead levels (BLLs) in children by 2010... Recent research on lead’s health effects at low levels, which suggests **societal benefits from preventing even low level lead exposure in childhood**, underscores the importance of this public health goal.” p1

“...**because no level of lead in a child’s blood can be specified as safe, primary prevention must serve as the foundation of the effort [to prevent childhood lead poisoning]**.” p1
“Efforts to eliminate lead exposures through primary prevention have the greatest potential for success.” p3

“Since 1991, CDC has emphasized the need to make primary prevention of lead poisoning through interventions that control or eliminate lead hazards before children are exposed, a high priority...CDC’s Advisory Committee on Childhood Lead Poisoning Prevention recently issued updated recommendations **calling for the nation to focus on primary prevention of childhood lead poisoning**.” p3

“Ultimately, **all nonessential uses of lead should be eliminated**...all levels of government share responsibility for primary prevention of childhood lead poisoning.” p5

“...the approach needed is clear: **identify and address existing lead hazards before children are exposed**, otherwise hundreds of thousands of children will be placed at risk needlessly. The overall reduction of lead in the environment will benefit all children.” p8

“The overall weight of available evidence **supports an inverse (negative) association between BLLs < 10 ug/dL and the cognitive function of children**...For health endpoints other than cognitive function (i.e., other neurologic functions, stature, sexual maturation, and dental caries), consistent associations exist between BLLs <10 ug/dL and poorer health indicators.” Appendix p iv

“...even at the lower exposure levels that prevail today, typical body burdens of lead are likely to be much higher than those present in pre-industrial humans, which by one estimate corresponded to a BLL of 0.016 ug/dL...” p3

“... a majority [of studies] revealed that both crude and adjusted associations were **consistent with an adverse effect: IQ decreases with increasing levels of blood lead**.” Appendix p9

“Lead is the most extensively studied environmental neurotoxicant. Animal and in vitro studies have provided abundant information concerning biochemical and physiologic changes caused by lead. Along with clinical and epidemiological data, **this evidence has clearly established that lead is toxic to the developing and mature nervous system**.” Appendix p14

“**Lead associated cognitive and behavioral effects have, not surprisingly, been associated with an increased risk of failure to complete high school**.” Appendix B-4

*Excerpts selected by Jim Lubischer. Emphasis (bold) added. Submitted to HAIR 5-10-12.

PAFI
Piston Aviation Fuels Initiative
Future Unleaded Aviation Gasoline

EAA AirVenture 2016

July 26, 2016

Presenters

Walter Desrosier
Vice President of Engineering and Maintenance
General Aviation Manufacturers Association (GAMA)

Doug Macnair
Vice President Government Relations
Experimental Aircraft Association (EAA)

Peter White
Manager, Alternative Fuels Program Staff, AIR-20
Federal Aviation Administration (FAA)

David Oord
Senior Director, Government Affairs, Regulatory
Aircraft Owners & Pilots Association

Why Are We Discussing This?
Tetra-Ethyl Lead

Challenges to long-term leaded fuel availability

- Petitions and suits by environmental organizations
  - EPA is being sued to determine if airborne lead emissions from GA A/C endanger public health
- Pending EPA regulation
  - Reduced ambient air quality standards
  - Endangerment finding – lead emissions from GA A/C
- Market forces
  - Single source of Tetra-ethyl lead
  - Lead phased out of most every other product
  - Local areas are putting pressure on airports to eliminate lead

Environmental Considerations

<u>Clean Air Act (CAA)</u>

- 42 U.S. Code § 7571 (Clean Air Act) gives the EPA authority to establish emissions standards on any pollution /source determined to endanger public health
- EPA must consult with the FAA in establishing these standards
  - Standards should take into account technological feasibility and must not significantly increase noise or adversely affect safety
- The FAA is compelled by 49 USC 44714 to "prescribe standards for the composition …of an aircraft fuel… to eliminate aircraft emissions (that the EPA) decides…endanger the public health"

Note……….There are currently no active or planned exhaust gas emission standards applicable to aviation reciprocating engines. Turbine aviation engines, however, are subject to emission standards.

Summary
Environmental Considerations

- The EPA has not proposed to ban leaded AVGAS
- The EPA are at the first step of a long process and have made no decisions
- EPA is committed to working closely with FAA, States, Industry and user groups to keep piston-engine aircraft flying in an environmentally acceptable and safe manner throughout the U.S.
- The EPA cannot take unilateral action to ban lead without FAA and public involvement

The Solution?

The industry/government collaborative effort known as the Piston Aviation Fuels Initiative (PAFI)

Funded by congress, FAA and industry in-kind support

Research, Development, Implementation and Transition Must Be a Collaborative Effort

No one can do this alone

Consensus and the marketplace must drive the solution and yet the marketplace is broken/constrained

Fuel must be affordable and satisfy the existing fleet to the greatest degree possible

PAFI Mission

"The mission of PAFI is to evaluate candidate unleaded replacement fuels and identify those fuels best able to technically satisfy the needs of the existing aircraft fleet while also considering the production, distribution, cost, availability, environmental and health impacts of those fuels."

PAFI Overview

PAFI is a robust joint government/industry initiative established at the request of a broad cross section of the aviation and petroleum industries and consumer representatives

- Formed in response to the UAT ARC Final Report
- Process for the identification, evaluation and deployment of the most promising unleaded replacements for 100LL
  - technically satisfy the needs of the existing aircraft fleet
  - considers production, distribution, cost, availability, environmental and health impacts
- Goal is data to support FAA ***fleetwide authorization*** and ASTM specification

PAFI Funding

- President's Budget Request Shows Full Funding for Unleaded Avgas Program through 2018
  - ✓ Annual FY Budget Request Approximately $6 million
- Congress has authorized ~$6 million in fiscal years 2014-2016
  - ✓ Funding supports the PAFI test program at the FAA William J. Hughes Technical Center and outside contractors
- Industry In-Kind Support
  - ✓ Fuel development and supply for testing program
  - ✓ Technical expertise for qualification and testing methods
  - ✓ Equipment and services and/or conduct for test program
  - ✓ Program oversight and management

PAFI Steering Group (PSG)

Purpose

- ✓ Facilitates, coordinates, expedites, promotes, and oversees the PAFI program
- ✓ Coordinates resources and support necessary to execute the program
- ✓ Engages industry stakeholders for allocation of expertise and resources to support task groups and the PAFI test program

Members

AOPA – Aircraft Owners and Pilots Association

EAA – Experimental Aircraft Association

GAMA – General Aviation Manufacturers Association

NATA – National Air Transportation Association

NBAA – National Business Aviation Association

FAA - Federal Aviation Administration

PAFI Support Groups

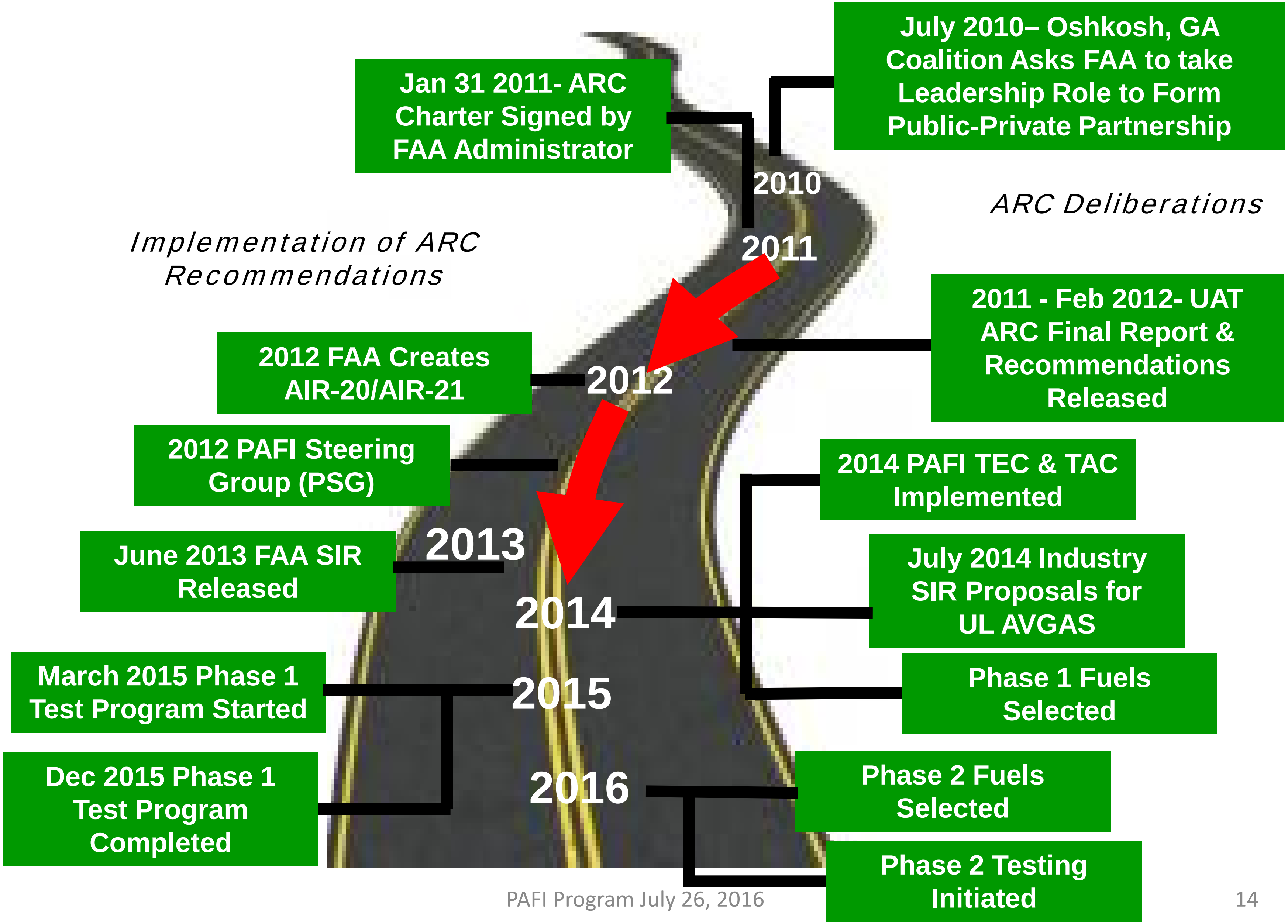
- Technical Advisory Committee (TAC)
  - **Reports to PAFI Steering Group (PSG)**
  - Membership represents aviation product and fuel manufacturers
  - Venue to provide industry “in-kind” support – technical & equipment
- Technical Evaluation Committee (TEC)
  - **Reports to FAA**
  - FAA consultants and employees vetted for COI within areas of expertise necessary to evaluate fuels to criteria
  - Responsible for Phase I and Phase 2 fuel evaluation & selection
  - TEC Mission is now complete – *no more downselects*

Distinct and Separate Support Groups with **NO** interconnections

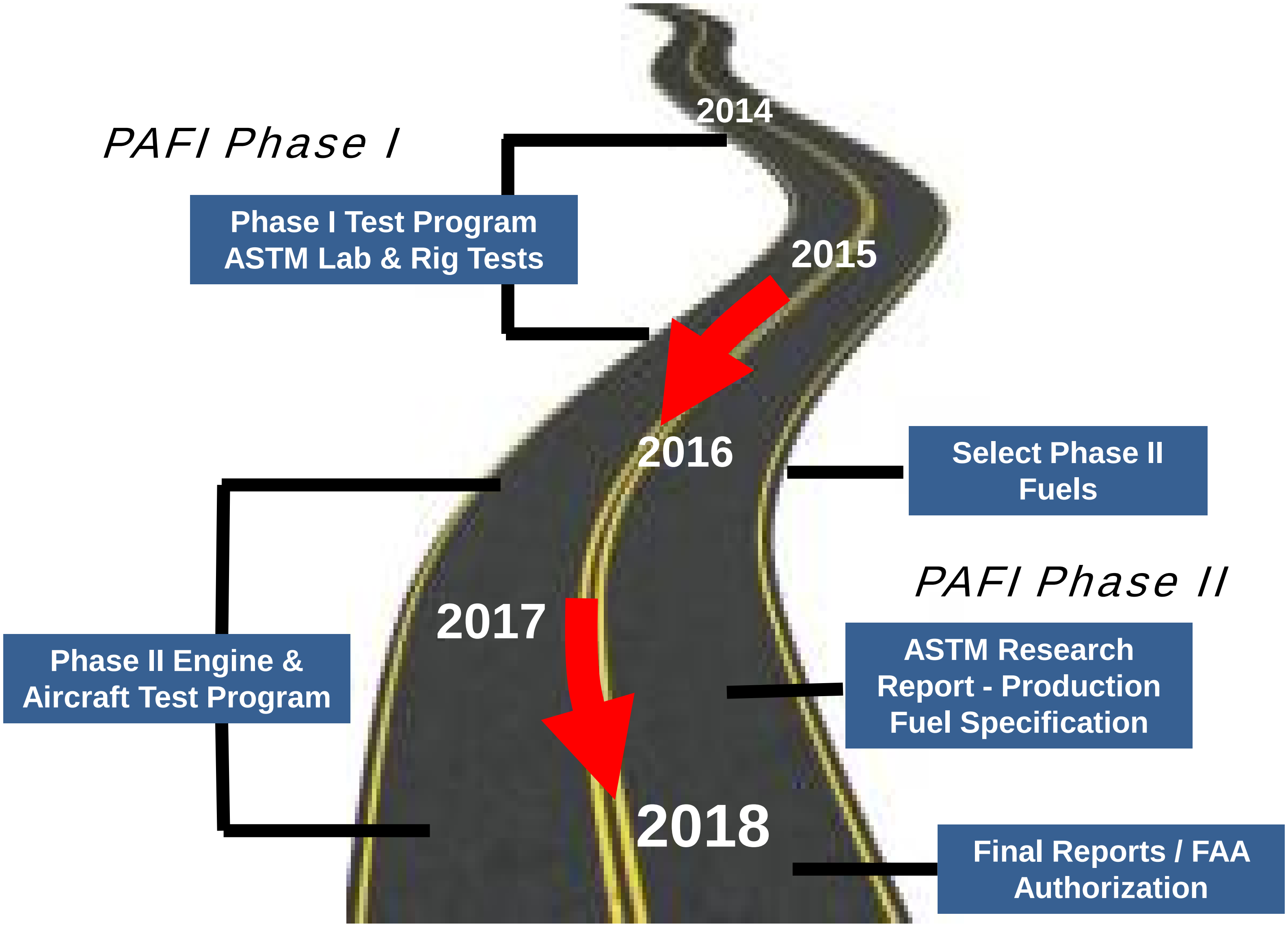
Key Takeaways

- Piston Aviation Fuels Initiative (PAFI)
  - Implemented, funded and in process
  - Fleet-wide approval is the primary goal
  - Two phase test program – Phase 1 completed earlier this year
  - Completion of PAFI - 2018
  - Supported and funded by Congress and FAA
  - PAFI is not “picking” a fuel but rather qualifying the best fuels for use
- Supply of current leaded avgas remains stable

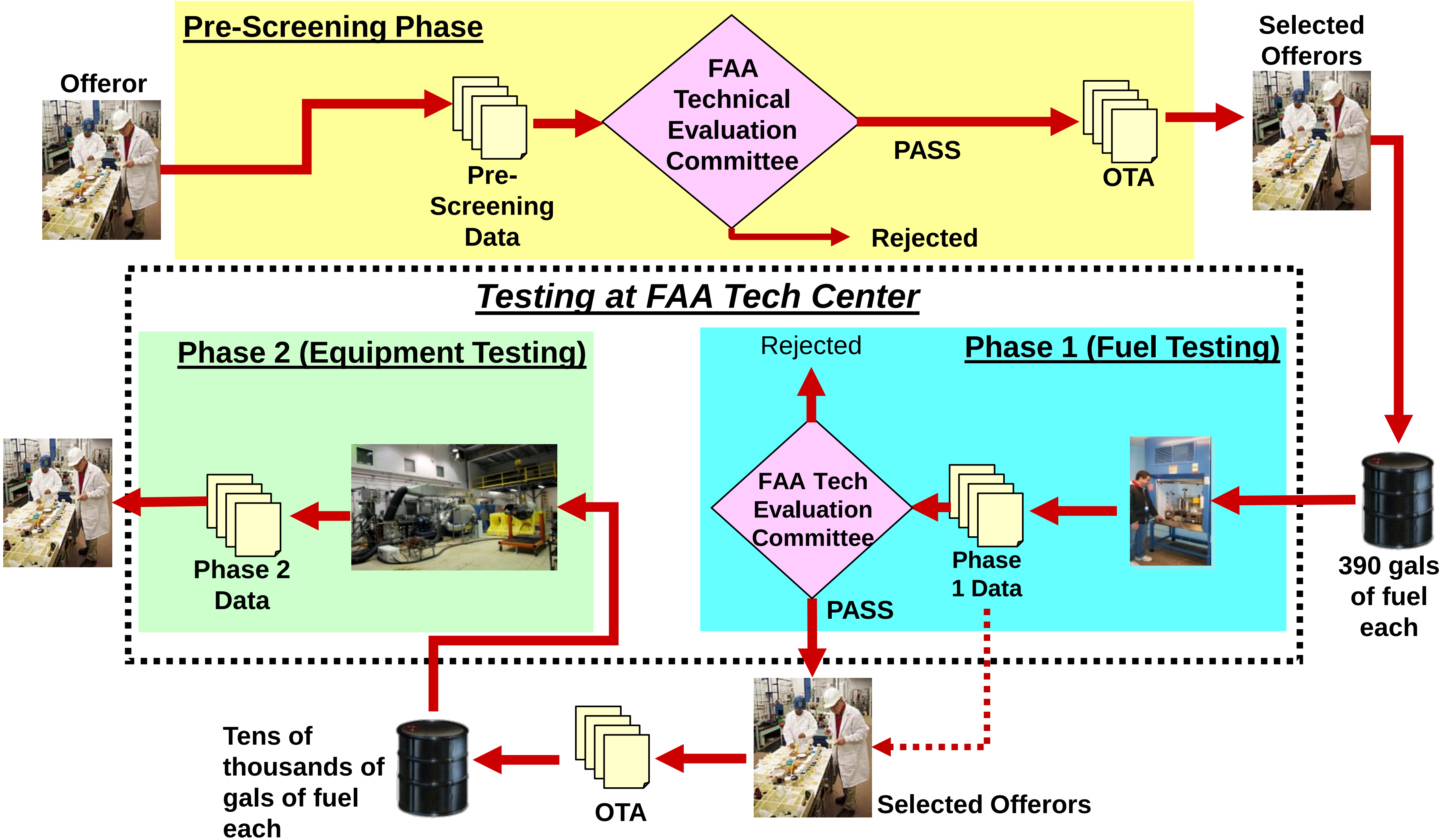
Path To Unleaded Avgas – Where we Are



Path To Unleaded Avgas – Where We Are Going



FAA Technical Center's Role in PAFI Test Program



Think This Is Just About Octane?

- Octane requirement is just the tip of the iceberg
  - Avgas has many qualities necessary to control adverse outcomes in our aircraft and engines
  - Evaluating the impact of completely new fuel chemistry on the full history of aircraft production is an immensely complicated undertaking

FAA Technical Center Test Program

Phase I – Lab, Rig, Engine and Environmental/Toxicity Assessment

- ✓ Laboratory Testing
- ✓ Materials Compatibility Testing
- ✓ Limited engine testing – performance, detonation, emissions, starting
- ✓ Environmental and Toxicology research and report
- ✓ Fit-for-Purpose Rig Testing
  - Rig #1, Low Temperature Flow Ability
  - Rig #2, Carburetor Icing
  - Rig #3, Dynamic Fuel System
  - Rig #4, Storage Stability
  - Rig #5, Cold Storage
  - Rig #6, Hot Surface

Phase 1 Data Evaluation

- Test Data Evaluated in 9 Performance Categories
  - Cold Fuel Performance
  - Hot Fuel Performance
  - Anti-Detonation Performance
  - Fuel Systems Compatibility
  - Engine Power and Performance
  - Engine Startibility
  - Environmental Risk Assessment
  - Fuel Property Lab Tests
  - Cost, Producibility, Infrastructure Impact

Phase 1 Results

- Conclusions
  - Use of available unleaded fuel (UL91/94) would have a high/costly impact on the high-performance segment of the fleet
  - Introduction of PAFI fuels should have less impact on a much wider segment of the fleet
  - Preliminary results indicate overall impacts of the PAFI unleaded fuel(s) should be less or comparable to UL91/94

- PAFI fuels Selected for further evaluation in Phase 2:
  - Shell UL100
    - Unleaded Aviation Gasoline Test Fuel
    - Based on ASTM Test Specification D7960
  - Swift UL102
    - High Aromatic Content Unleaded Hydrocarbon Aviation Gasoline
    - ASTM Specification D7719

FAA Technical Center Test Program

Phase II – Full Scale Engine & Aircraft Testing

Work Product – Data packages from full scale engine & aircraft testing which support ASTM & FAA Approval

- Fuels will be tested at the engine and aircraft level to evaluate their suitability across as much of the existing fleet as possible -multiple fuels in multiple engines and multiple aircraft
- Data collected from this testing will generate data that can be used to support the fleet wide authorization of aircraft and engines to operate on the replacement unleaded fuels
- Data from the Phase I and Phase II testing will support ASTM Production Specification

"Cloud" GA Recip Powered Fleet

PAFI Phase 2 Testing

Engine Test Articles:

- Engine Range, from Carbureted Four Cylinder to Turbocharged/Fuel Injected Six Cylinders
- Includes Representative Radial Engines

Engine Test Matrix:

- Detonation Testing
  - Naturally Aspirated and Turbocharged Engines
  - Includes Fuel Mixes, to Evaluate Phased Deployment
  - Altitude Simulation
- Durability Testing
  - Standard Part 33 Block Test
  - Mission Profile Test
- Performance Testing/Mapping
- Operations Testing, Propeller Test Stand
- Propeller/Crankshaft Vibration Testing, Propeller Test Stand

PAFI Phase 2 Testing

Aircraft Test Articles:

- Aircraft Range; Two Place Light Trainers to High Performance Twins and Rotorcraft
- Includes Breadth of Engine Test Articles

Aircraft Test Matrix:

- Hot Fuel/Weather
- Cooling Climb
- Inflight Restarts
- Engine Handling Characteristics
- Carburetor Icing/Deicing
- Continued Airworthiness/AFM Procedures
- Function and Reliability

Fleet Wide Authorization

- Fleet-wide authorization is the ***PRIMARY GOAL OF PAFI***
  - ✓ Approach will not result in classic engine/airframe specific approvals, as there will be no applicant, and no certificate issued
  - ✓ Plan to determine and publish eligibility lists of engines/aircraft that can utilize the new unleaded AVGAS formulation(s)
  - ✓ FAA and industry are currently working with Congress to expand or creating new statutory authorization for fleet wide transition
- Approach and implementation is fuel dependent
  - ✓ Fuel properties & composition
  - ✓ Impact on engine and aircraft models
- Plan to publish eligibility lists in the Federal Register

Key Takeaways

- FAA/Industry Piston Aviation Fuels Initiative (PAFI)
  - Purpose:
    - Facilitate transition to unleaded replacement Avgas with least impact on existing fleet
    - Primary objective is FAA fleetwide authorization of GA aircraft to operate on the PAFI unleaded fuels
  - Status & Milestones:
    - 5-Year Program Under Way and Funded by Congress and Industry In-Kind Contributions
    - July 2014: 17 candidate fuels from 6 offerors entered the program
    - Sept. 2014: 4 fuels from 3 offerors accepted into Phase 1
    - December 2014 - November 2015 – Phase 1 test program
    - March 2016: 2 fuels selected for Phase 2 evaluation
    - Dec. 2018: Fuel complete PAFI testing to support fleet-wide "approval"
- PAFI is a robust industry-government collaborative initiative
    - Crucial to establishing viable marketplace for unleaded fuel
- Program is on schedule and anticipated to stay that way

Next Few Years

- PAFI working an aggressive and ambitious timeline
- EPA timing regulatory actions in harmony with PAFI timelines
  - EPA Endangerment Finding – NPRM 2017, Final Rule 2018
- FAA must respond to EPA action if a positive finding of endangerment is determined
- Availability of leaded avgas remains stable and is projected to be so through the transition
  - Industry working closely with existing lead supplier and fuel industry to coordinate orderly transition from leaded to unleaded fuel
- AIR-20 continues to support applicants that approach the FAA directly for approvals of alternative fuels on specified models of engines and aircraft

Conclusion

"Ultimately it is everyone's goal that the piston aviation fleet moves efficiently and economically to a viable and safe unleaded future. The PAFI program provides a sound process to ensure that this goal is achieved with a minimum of disruption to the general aviation industry and with the greatest likelihood of marketplace success."

Reference PAFI Whitepaper Nov 2013

Piston Aviation Fuel Initiative Links

FAA PAFI Website

http://www.faa.gov/about/initiatives/avgas/

FAA Contracts SIR Link

https://faaco.faa.gov/index.cfm/announcement/view/15840

FAA Press Release, March 29, 2016

http://www.faa.gov/news/press_releases/news_story.cfm?newsId=20154

Questions?

Email regarding PSU lead measurements of 6-7-16:

Sarah [Armitage] and Hillsboro Citizen Scientists,

We made it through the first analyses of the filter samples. (Yay, sort of!) The results are up on the Google drive, if people wanted to take a peek. The attached is one cut on the data that one of my undergraduate students put together. It is a (nearly) all-site look at the atmospheric lead levels from the four seasons, with highest levels in the winter and fall (significantly different from spring ~ summer). I've asked him to look at whether the same is true for each of the sites individually. We will then try and look at the weather patterns to see if this makes sense from that perspective or whether we will need air traffic data to figure it out.

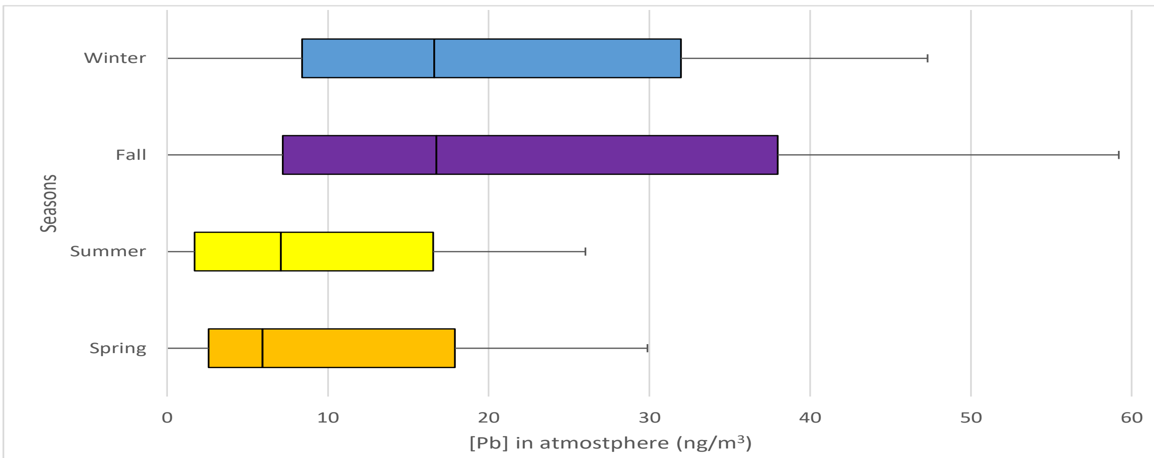
Unfortunately the data still isn't finalized per se. We are still trying to pin down the dates for the D site, but will probably get that done in the next week or so. We are also re running some of the analyses that looked problematic, so a number or two in the set will probably change.

But the general conclusions are probably solid. Not a clear spatial pattern (?). Annual average levels between 15 and 20 ng/m3 for all of the sites with individual values that range from 0 (quite a few at all sites) to around 90 (the ones above that are being looked at / rerun). Recall that the only applicable standard is the NAAQS of 150 ng/m3, which equals the DEQ/ATSAC benchmark, despite Jim's impressive efforts. This includes Jim's house, which is reasonably far out, so I really wish we had a solid year's worth of data from somewhere really far from a source. Maybe I'll put a sampler on my back porch in Dundee. Maybe Sarah from the DEQ (cc'ed on this) can recall whether those levels are higher than what we see at the Roselawn site?

It is still a work-in-progress, but we are starting to get a clearer picture.

Dean Atkinson
Associate Professor and Assistant Chair
Chemistry Department
Portland State University
503-725-8117

[See graph below]


Winter
Fall
Summer
Spring
Seasons
0
10
20
30
40
50
60
[Pb] in atmosphere (ng/m³)