Appendix B

An Economic Analysis of the California Energy Commission Staff's Fuel Delivery Temperature Study and the "Hot Fuel" Allegations

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California Energy Commission Staff's

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and

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An Economic Analysis of the CEC Staff's *Fuel Delivery Temperature Study* and the "Hot Fuel" Allegations[1]

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> Since competition and cost of doing business determine the price of [motor fuel] products in the marketplace, the pricing structure for retail sales reflects loss or gain of product [due to temperature variation].[3]
>
> If you tell [retailers] that they now have to sell on a net basis, you cannot assume that the price per gallon is going to remain the same.[4]

Introduction and summary

- The "hot fuel rip-off" is a myth, and to its credit, the *Fuel Delivery Temperature Study: Staff Report* (the *"CEC Staff Report"*) does not conclude otherwise. The "hot fuel" myth is based on the incorrect assumption that – in the absence of overt temperature compensation at the retail pump – retail prices are not adjusted for the effect of

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[1] This study presents the results of the author's independent economic analysis of proposals to require temperature compensation of retail sales of motor fuel in California, and more generally, of the national "hot fuel" controversy that gave rise to the California proposals. Preliminary versions of this study were presented informally to staff of the California Energy Commission on November 12, 2008, and to the Committee Workshop Regarding Staff Draft Report on Assembly Bill 868 Fuel Delivery Temperature Study on December 9, 2008. This study has been funded by a consortium of retail industry associations, including the National Association of Convenience Stores (NACS); NATSO, Inc.; the Petroleum Marketers Association of America (PMAA); and the Society of Independent Gasoline Marketers of America (SIGMA). However, the views expressed herein – as well as any errors – remain the responsibility of the author.

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[3] Presentation of Harold E. Harris, Engineering Coordinator, Exxon Company, "Temperature Correction of Petroleum Products at Retail", *Report of the 59th National Conference on Weights and Measures*, July 11, 1974 at p. 195.

[4] Remarks of Ross J. Andersen, Director of Weights and Measures, New York State Department of Agriculture and Markets, in the transcript of the CEC Staff Workshop re: AB 868 (Fuel Delivery Temperature Study), March 4, 2008, at p. 76.

temperature on the volume of fuel sold to consumers. Retail competition and repeat purchasing already adequately protect consumers from any "hot fuel" overcharges. Mandating an overt system of temperature compensation in California – whether the *ATC Retrofit*[5] or the imposition of a "new reference temperature"[6] – would add to costs that would have to show up in the retail price of gasoline and diesel fuel, without any offsetting benefit whatever.

- The "hot fuel" adherents erroneously assume that retail sales of gasoline and diesel fuel are not adjusted for temperature-induced expansion if temperature-compensation technology has not been explicitly incorporated into retail dispensers. They are wrong because they fail to realize that retail competition *already* leads dealers to take reductions in their target pump prices as fuel temperatures increase with warmer weather.

- The "hot fuel" allegations amount to nothing more than unsupported conjectures based on the physical properties of motor fuel. In any event, as a matter of economics, these alleged profits are fundamentally irreconcilable with both the "highly competitive business environment" within which retailers operate and the structure, conduct and profit performance of the U.S. retail motor fuel industry.

- These activists make no attempt to offer independent evidence that the "hot fuel rip-off" profits supposedly enjoyed by retailers in "warm" areas actually exist. To the contrary, the actual data on the profitability of U.S. retail stations completely refute the existence of the alleged "hot fuel profits" and effectively dispose of the "hot fuel" claims.

□ Despite its many misapprehensions and economics errors, the *CEC Staff Report* should be commended for not endorsing the "hot fuel rip-off" allegations, for recognizing that California retailers operate in a "highly competitive business environment", and generally for showing how difficult it is to make an economically credible cost-benefit case for the imposition of retail temperature compensation in California. But there are serious flaws in the *CEC Staff Report*, including:

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5 In this paper, *ATC Retrofit* refers to the option analyzed by the CEC staff to fit all existing California retail fuel dispensers with automatic temperature compensation technology. See *CEC Staff Report* at Chapter 4, pp. 59-81.

6 Similarly, the "new reference temperature option" refers to the alternative to the *ATC Retrofit* under which all retail pumps would be adjusted to dispense "gallons" that measured approximately 232.7 cubic inches (the volume occupied by a net gallon at 71.1°F.), rather than standard U.S. gallons measuring 231.0 cubic inches. See *CEC Staff Report* at Chapter 5, pp. 86-88.

- The claim that – at least in the short- and medium term – California consumers would enjoy "more fuel" worth $438 million annually following the proposed *ATC Retrofit*. This claim is wrong because the *CEC Staff Report* makes the same economics error that pervades the "hot fuel" allegations, namely that it would be possible to adjust the size of the quantity unit used to measure retail fuel transactions without causing any change in the retail price. In truth, California motorists would receive exactly the same amount of fuel at precisely the same total outlays after the *ATC Retrofit* as before.

- The claim that $438 million a year in consumer "savings" could be extracted from retailers' revenue, even though these "savings" likely are greater than dealers' *total pre-tax* profits. In truth, retailers would need to increase their retail prices immediately in proportion to the increased size of each "gallon" dispensed following the *ATC Retrofit*.

- The claim that only in "the long term" would California retailers succeed in "recapturing" the revenue lost as a result of the *ATC Retrofit*, and that in the interim, California motorists would benefit from "more fuel" at no increase in retail prices. In truth, this is economic nonsense; dealers would need to increase retail prices immediately or go out of business.

- The claim that the cost to dealers of the *ATC Retrofit* – including both the increased direct wholesale cost per unit of fuel as well as the indirect equipment and labor costs associated with the *ATC Retrofit* itself – could be absorbed out of retailers' profits or shifted to purchasers of the non-fuel items sold by convenience stores. In truth, this also is economic nonsense; the only way retailers could "absorb" such costs would be to increase their pump prices proportionately.

- The claim that California motorists would enjoy "increased price transparency benefits" worth $3.2 million a year as the result of the *ATC Retrofit*. The CEC staff's attempt to calculate these supposed benefits is based on an error-filled misapplication of the economic concept of *deadweight loss*. In truth, these "benefits" would be zero for California motorists as a group.

- The suggestion that Hawaii illustrates a successful early response by a state to the "hot fuel" issue. In truth, the switch to the larger "Hawaiian gallon" accomplished nothing; retail prices in Hawaii would have increased by the same percentage.

- The claim that the establishment of a "new reference temperature" in California also would save motorists $438 million a year, at least until retailers "recaptured" that revenue in "the long term". In truth, the choice of a particular "reference temperature" is completely arbitrary. More importantly, there is no need to adopt *any* “reference temperature” in connection with retail fuel sales. Consumers would pay identically the same dollar amount for identically the same quantity of motor fuel, no matter what “reference temperature” – or no reference temperature at all – was mandated in California.

- But the most glaring problem with both the “hot fuel rip-off” allegations and the *CEC Staff Report* is their common failure to recognize that retail competition already fully protects consumers from any “hot fuel” overcharges and that, as a result, the “overcharges” and “hidden dealer profits” that supposedly result from the “hot fuel rip-off” never existed in the first place.

  - Competition in retail fuel markets already adjusts pump prices to compensate for the seasonal effect of temperature on the volume of gasoline and diesel fuel.

  - Repeated purchases by consumers are sufficient to insulate them from any cross-sectional differences among dealers’ fuel temperatures in local competitive areas.

  - Independent data on the profitability of retail stations – and in particular, on their profitability by U.S. region – show conclusively that there simply are no “hot fuel” profits.

- In summary, the supposed benefits claimed by temperature-compensation proponents are illusory, and spring from the same faulty logic that has given rise to the “hot fuel” allegations themselves. The only thing that the proposed *ATC Retrofit* would accomplish would be higher retail prices for gasoline and diesel fuel, owing to the costs of that retrofit itself. Emphatically, consumers would *not* enjoy “more fuel” as a result. Because competition already adjusts retail prices to compensate for seasonal temperature variation, there simply is no need to require an expensive, elaborate and likely confusing and disruptive system of automatic temperature compensation at the retail level in California.

Alternative systems for measuring retail motor fuel transactions

Quantity and price units

Every retail motor fuel transaction has two components: the *quantity* of fuel being purchased (measured in some standardized unit of physical volume) and the *price per unit* of that fuel (expressed in monetary units – such as U.S. dollars – for each quantity unit).

In retail transactions, there generally are alternative systems of weights and measures available for measuring the quantities and expressing the prices involved. For goods sold by weight, for example, transactions can be denominated in tons (both long and short), hundredweights, pounds or ounces, as well as in metric measures such as metric tons, kilograms, and grams. For goods sold by liquid volume, there are gallons, quarts, pints, fluid ounces, cubic inches, British imperial gallons and quarts, and so forth, along with metric alternatives such as cubic centimeters, liters, kiloliters and cubic meters.

Conversion between alternative quantity units

Any volume expressed in terms of one unit of measure can be easily and exactly converted into the equivalent volume measured in terms of any other unit of volume measure. For example, it is simple to convert quantities measured in U.S. pounds into the equivalent number of kilograms and – relevant to the present matter – quantities measured in U.S. gallons can be easily and accurately restated in terms of the equivalent number of liters.

At the same time, if one knows the competitively-determined price in dollars per unit for one volume unit of measure, simple arithmetic yields the competitive price if the good or commodity is instead measured in some other unit of volume. As one example (shown in ***Figure 1***), if one knows the current retail price for a gallon of gasoline, it is straightforward to determine the equivalent price for a liter purchased at retail.

Figure 1.
Changing from gallons to liters affects only the price per unit, not total outlays.

Change from U.S. Gallons to Liters						
	Unit of measurement for quantity sold	Size of quantity unit (cubic inches)	Total quantity units available for sale	Dealer's target total sales revenue	Resulting dealer target street price per unit	Total cost of 100 US gallons (23,100 cubic inches)
Before	U.S. Gallon	231.00	8,000.0	$24,000	$3.000	$300.00
After	*Liter*	*61.02*	*30,285.2*		*$0.792*	*$300.00*
Change		*-73.58%*			*-73.58%*	*0.00%*

Since examples of this sort will be used repeatedly in this paper, it is useful to spend some time on how ***Figure 1*** was constructed. It starts with the assumption that the retailer has 8,000 U.S. gallons available for sale, for which he hopes to realize $24,000 in sales revenue.[7] This requires that he achieve a target street price of $3.000 per gallon. Now assume that his

[7] At this point, it does not matter whether the 8,000 gallons have been measured in *gross* units (i.e., not compensated for temperature variation) or *net* (i.e., temperature-compensated) units. Similarly, it does not matter at this point how the dealer arrived at his target revenue of $24,000. In later variations on this basic illustration, it will be specifically assumed that the retailer's wholesale cost per gallon is $2.875 (or $23,000 for 8,000 gallons) and that if his target margin per gallon is 12.5 cents, his target retail price per gallon should be $3.000. Selling 8,000 at $3.000 per gallon would generate $24,000 in sales revenue.

sales must henceforward be measured in liters (at 61.02 cubic inches per liter) instead of U.S. gallons (defined as 231.00 cubic inches). Simple arithmetic shows that the retailer would derive 30,285.2 liters from the 8,000 U.S. gallons. But at what retail price would he seek to sell each liter? The answer – $0.792 – is gotten by dividing the $24,000 in target sales revenue by the 30,285.2 liters available for sale.

There are several features of this example that should be noted. First, it is the retailer's motivation to keep constant his total sales revenue – combined with the fact that he operates in a competitive business environment – that drives the result. He cannot hope to repeatedly achieve more than $24,000 in sales revenue because competition from his rivals would make that impossible. At the same time, he cannot repeatedly settle for less than $24,000 in sales revenue because this would mean that his return over time would be insufficient to sustain him in business.

Second, as this example shows clearly, it is easy to translate between any two units of measure when each can separately be expressed in terms of a specific number of cubic inches per unit.

Third, and most importantly, a change in the unit of measure by a particular percentage would result in a change in the retail price per unit by the same percentage. In this example – going from U.S. gallons to liters – the volume of the unit of measurement declines by 73.58 percent (from 231 to 61.02 cubic inches). Therefore, it should not be surprising that the dealer's target street price per unit also falls by 73.58 percent (from $3.000 to $0.792).

Fourth, and last, this example makes clear that the change from U.S. gallons to liters did not give the consumer any "more" or "less" fuel than before. A retail customer who – prior to the change from gallons to liters – purchased 100 gallons (23,100 cubic inches) in a month for $300.00 now receives over 378 "units" for his $300.00. But it should be obvious that this does *not* mean that he got "more" fuel following the change from U.S. gallons to liters. If the retailer switched from liters back to U.S. gallons so that the consumer then received his 23,100 cubic inches in larger units of measure (namely, gallons), this also would not mean that he was getting "more" fuel after the switch.[8]

These four principles are again illustrated in ***Figure 2***, in which the assumed change is from U.S. gallons (231 cubic inches) to imperial gallons (277.40 cubic inches).

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8 However, this seems to be the "logic" implicit in the *CEC Staff Report*.

Figure 2.
Changing to imperial gallons affects only the price per unit, not total outlays.

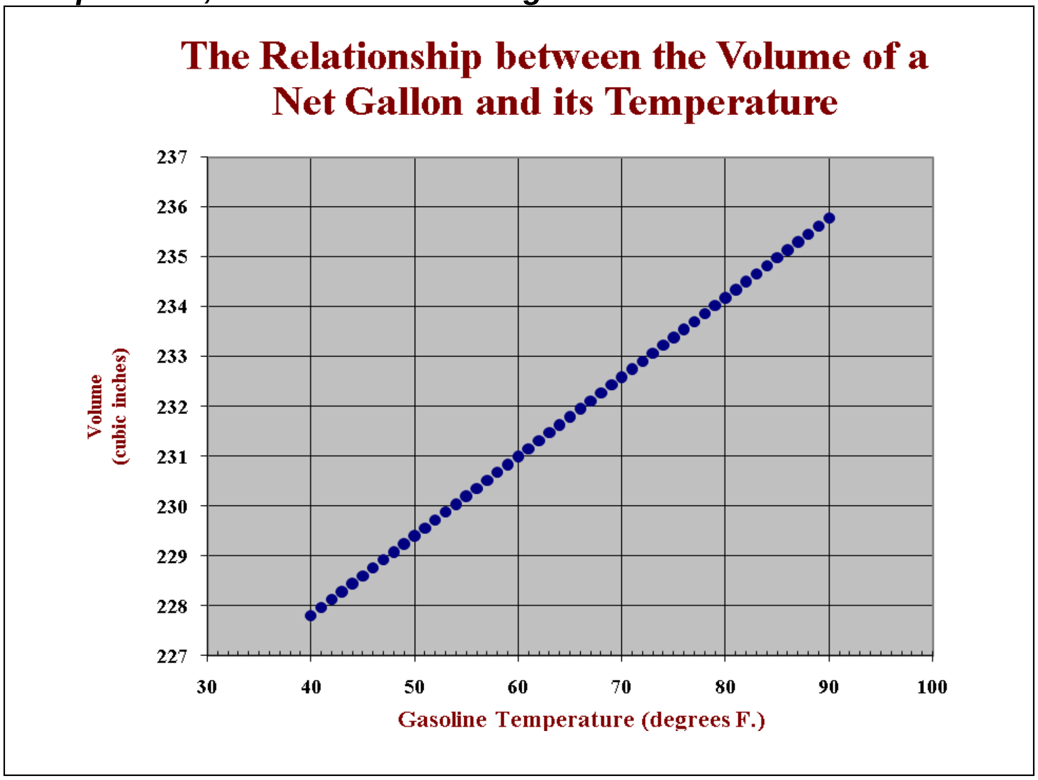
	Unit of measurement for quantity sold	Size of quantity unit (cubic inches)	Total quantity units available for sale	Dealer's target total sales revenue	Resulting dealer target street price per unit	Total cost of 100 US gallons (23,100 cubic inches)
Change from U.S. Gallons to Imperial Gallons						
Before	U.S. Gallon	231.00	8,000.0	$24,000	$3.000	$300.00
After	*Imperial Gallon*	*277.40*	*6,661.8*		*$3.603*	*$300.00*
Change		*20.09%*			*20.09%*	*0.00%*

Quantity units defined by temperature

Next, I extend these examples to deal with changes in fuel volume induced by changes in temperature. As is well-known to anyone familiar with the "hot fuel" allegations, the variation in the volumes occupied by gasoline and diesel fuel due to temperature variation has motivated the so-called *net* gallon, which (in the case of gasoline) occupies 231 cubic inches only at 60°F. At temperatures in excess of 60°F., a net gallon occupies more than 231 cubic inches, while at temperatures below 60°F., a net gallon is smaller than 231 cubic inches. So, in contrast to a *gross* gallon – which always is 231 cubic inches, regardless of the fuel's temperature – the volume (in cubic inches) of a *net* gallon of fuel varies directly with temperature.

But the key insight is that any "gallon" defined in terms of a reference temperature – such as the *net* gallon defined at 60°F. – corresponds to a *known* number of cubic inches at any other temperature, owing to the linear relationship between the temperature of a net gallon of motor fuel and its volume in cubic inches. This is illustrated in ***Figure 3***, which shows the number of cubic inches occupied by a net gallon at temperatures from 30° to 100°F. Because of this simple linear relationship, at any particular temperature there is one – and only one – "size" of a net gallon of gasoline or diesel fuel, and knowing the temperature of the fuel is the same as knowing the size in cubic inches of a net gallon of that fuel.

Figure 3.
At each temperature, the volume of a net gallon is a known constant.



This means that fuel units defined in terms of temperature are no different than any other fuel units that are defined in terms of cubic inches, notwithstanding the *CEC Staff Report's* mistaken assertion to the contrary.[9] The fact that the number of cubic inches varies as the temperature varies is a red herring. The important point is that *at any particular temperature* the number of cubic inches is a *known constant*, and retail competition can and will lead to the appropriate adjustment in the price per unit.

Next, consider a change in the quantity unit of measure from U.S. gallons to a hypothetical "75°F. reference temperature gallon"[10] as shown in ***Figure 4***, which is similar to ***Figures 1 and 2*** already discussed. It should not be surprising that the retailer's resulting target street price of $3.031 per "gallon" is 1.035 percent greater than the original $3.000 per gallon, because – at 233.39 cubic inches – the volume of this 75° F. reference temperature gallon is 1.035 percent greater than a 231-cubic inch U.S. gallon.

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9 The *CEC Staff Report* incorrectly claims at p. 6 that "A change from gross to net gallons at retail stations in California would not be similar to a conversion to the metric system…because the cubic inches dispensed to retail motorists would *vary* according to temperature. The number of cubic inches dispensed to retail motorists if stations converted to liters would be *fixed* under varying temperature (emphasis in original)."

10 Defined as the volume – 233.39 cubic inches – occupied by a net gallon at 75°F.

Figure 4.
Changing to "75° gallons" affects only the price per unit, not total outlays.

Change from U.S. Gallons to "75° F. Reference Standard Gallons"						
	Unit of measurement for quantity sold	Size of quantity unit (cubic inches)	Total quantity units available for sale	Dealer's target total sales revenue	Resulting dealer target street price per unit	Total cost of 100 US gallons (23,100 cubic inches)
Before	U.S. Gallon	231.00	8,000.0	$24,000	$3.000	$300.00
After	*75° Gallon*	*233.39*	*7,918.0*		*$3.031*	*$300.00*
Change		*1.04%*			*1.04%*	*0.00%*

Taken together, ***Figures 1, 2 and 4*** illustrate an important principle: If retail sales of gasoline and diesel take place in a competitive market, that retail competition insures that any change in the size of the unit used to measure quantity would necessarily be accompanied by an equal change in the competitive price per "unit". A consumer would never receive "more" or "less" fuel, and she would not pay "more" or "less" for that fuel. Her total dollar outlays for a specific quantum of fuel – such as 23,100 cubic inches or 100 U.S. gallons – would remain the same, regardless of which system of quantity units is used and regardless of the differences in the size of the particular units of measure.

"Net" and "gross" systems of measurement

Because volumes of motor fuel can be measured using any of several quantity units – such as U.S. gallons, liters, net gallons, "reference temperature gallons", and the like – it is necessary to insure that the physical unit used to measure quantity and the retail price per unit are based on the *same* unit of measurement.

The "hot fuel" controversy arises from the fact that quantities of fuel sold in the U.S. can be measured using either of two alternative systems, *gross* gallons or *net* gallons.[11] As a result, the price of fuel can be denominated in dollars per *gross* gallon or in dollars per *net* gallon.

This is summarized in ***Figure 5***, a simple diagram that illustrates four possible scenarios for measuring retail sales of motor fuel generated by forming the possible combinations of the two systems for measuring quantities with the two systems for measuring price per unit:

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11 A *net gallon* of fuel is defined as the quantity of fuel (measured by weight) that would occupy 231.0 cubic inches at 60°F. A *gross gallon* – alternatively, a U.S. gallon – of fuel occupies 231.0 cubic inches regardless of temperature.

Figure 5.
Four possible scenarios for measuring retail fuel transactions.

		How the QUANTITY of fuel is measured at retail	
		In GROSS gallons (no adjustment for temperature)	In NET gallons (temperature-compensated)
How the PRICE of fuel is expressed at retail	In $ per GROSS gallon (no adjustment for temperature)	I	II
	In $ per NET gallon (temperature-compensated)	III	IV

Scenario I Retail sales are measured in *gross* gallons and priced in dollars per *gross* gallon.

Scenario II Retail sales are measured in *net* gallons but sold at the price per "unit" that would prevail if sales were measured in *gross* gallons.

Scenario III Retail gasoline sales are measured in *gross* gallons but priced at the same dollars per unit that would prevail if retail quantities were measured in *net* gallons.

Scenario IV Retail gasoline sales are measured in *net* gallons and priced in dollars per *net* gallon.

Consumers' interests are protected as long as retail fuel sales take place in a highly competitive market and the *same* system – it does not matter whether *gross* or *net* – is used when measuring both quantities and prices. In terms of ***Figure 5***, if the assumptions of ***Scenario I*** are met (in other words, in the absence of temperature compensation at the retail pump, the price is determined in a competitive retail market and denominated in terms of dollars per *gross* gallon), then consumers' interests are as fully protected as they would be under ***Scenario IV***, but without the costs generated by the implementation of automatic temperature compensation. It is the core assumption of this paper that no dispute or problem arises as long as retail fuel sales are conducted according to *either* ***Scenario I*** *or* ***Scenario IV***. This is because, under either of these two scenarios, there is no conflict between the system for measuring quantities and the system for measuring prices.

But ***Scenarios II and III*** *would* be problematic, because each is predicated on a fundamental inconsistency between the system for measuring quantity and the system for measuring prices.[12] In any transaction, quantity and price must be measured in terms of units that are logically consistent with each other, or the result would be nonsensical. For example, no one would seriously maintain that the total amount of a retail gasoline sale should be calculated by measuring the quantity in liters and then multiplying that quantity by the price per unit that would emerge if quantities were measured in gallons. Therefore, it is reasonable to expect that the retail prices of gasoline and diesel fuel should be expressed in terms of the same physical unit that is used to measure the quantity of motor fuel being sold at retail.

Net vs. gross systems in the "hot fuel" allegations

The only way to make logical sense of the claims of "hot fuel" activists is that they must think that fuel sales in California – and in the U.S. generally – currently take place according to ***Scenario III***, in which it is assumed that retail prices are stated in dollars per *net* gallon without there being any adjustment for temperature-induced expansion when measuring *quantities*.[13] This is illustrated by ***Figure 6***. Only by making such an assumption could these activists expect (as they do) that current retail prices per "unit" would remain the same even if the quantity unit was changed from gross gallons to net gallons. While temperature-compensation activists might believe they are pushing for ***Scenario IV***, they would be wrong if retail prices actually are denominated in dollars per gross gallon. Put differently, this means that – as depicted in ***Figure 7*** – these "hot fuel" activists really are demanding that retail sales be governed by ***Scenario II***, which improperly mixes net quantity units with prices stated in terms of gross units.

[12] Whether retail transactions are based on the same system of measure as is used in connection with so-called "upstream" transactions is irrelevant. But there would be a problem if a *mixed* system (i.e., a combination of gross and net measures) were used at retail. Specifically, if *net* quantity units were required solely on the ground that net units also were employed in "upstream" transactions, while retail prices somehow continued to be expressed in dollars per *gross* gallon, the result would be economic chaos.

[13] For what else could these activists mean when they insist that consumers "aren't getting what they paid for"? If this is not their assumption, then retail sales would be taking place under ***Scenario I*** currently, effectively mooting the entire "hot fuel" controversy.

Figure 6.
The status quo as seen by the "hot fuel" activists.

		How the QUANTITY of fuel is measured at retail	
		In GROSS gallons (no adjustment for temperature)	In NET gallons (temperature-compensated)
How the PRICE of fuel is expressed at retail	In $ per GROSS gallon (no adjustment for temperature)	I	II
	In $ per NET gallon (temperature-compensated)	III	IV

Figure 7.
The scenario actually demanded by the "hot fuel" activists.

		How the QUANTITY of fuel is measured at retail	
		In GROSS gallons (no adjustment for temperature)	In NET gallons (temperature-compensated)
How the PRICE of fuel is expressed at retail	In $ per GROSS gallon (no adjustment for temperature)	I	II
	In $ per NET gallon (temperature-compensated)	III	IV

Net vs. gross systems in the <u>CEC Staff Report</u>

The *CEC Staff Report* appears to be predicated on different assumptions than those made by the "hot fuel" activists (***Figures 6 and 7***). Instead of assuming that retail fuel sales currently are measured in gross gallons but priced in terms of net gallons (***Figure 6***), the *CEC Staff Report* offers no explicit assumption at all. But the CEC staff appears to accept that retailers' sales and prices are both measured in gross gallons (i.e., ***Scenario I*** as shown in ***Figure 5***).[14]

But by claiming that – at least in the short- and medium term following the *ATC Retrofit* – retailers could be expected to dispense temperature-compensated net gallons at their unchanged former prices for U.S. (or gross) gallons, the *CEC Staff Report* assumes that retail sales would follow ***Scenario II*** in ***Figure 8*** during that interval.

Figure 8.
The <u>CEC Staff Report's</u> "short- and medium-term" scenario.

		How the QUANTITY of fuel is measured at retail	
		In GROSS gallons (no adjustment for temperature)	In NET gallons (temperature-compensated)
How the PRICE of fuel is expressed at retail	In $ per GROSS gallon (no adjustment for temperature)	I	II
	In $ per NET gallon (temperature-compensated)	III	IV

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[14] It should be pointed out, however, that the *CEC Staff Report* makes a contradictory assumption in connection with its attempt to analyze the "information asymmetry" supposedly inherent in current retail fuel sales in California. There the CEC staff explicitly assumes that "Retailers price fuel on a net gallon basis and then sell the fuel on a gross gallon basis." See *CEC Staff Report* at *Appendix R*, p. 149. In its body, the *CEC Staff Report* cannot be making this assumption (that retail prices currently are priced on a net gallon basis). If it did, the anticipated revenue "recapture" by retailers would lift pump prices to supracompetitive levels, something that is economically incompatible with the "highly competitive business environment" within which retailers are deemed to operate.

Only in the long term does the *CEC Staff Report* concede that retailers would manage to recapture their previous revenue levels by achieving pump prices that are consistent with the temperature-compensated, net gallons they would be dispensing. This is illustrated by ***Scenario IV*** in ***Figure 9***.

Figure 9.
The <u>CEC Staff Report's</u> "long-term" scenario.

		How the QUANTITY of fuel is measured at retail	
		In GROSS gallons (no adjustment for temperature)	***In NET gallons (temperature-compensated)***
How the PRICE of fuel is expressed at retail	In $ per GROSS gallon (no adjustment for temperature)	I	II
	In $ per NET gallon (temperature-compensated)	III	**IV**

"Net" and "gross" systems are equally valid alternatives

The *net* and *gross* systems of measurement provide alternative depictions of the same objective facts, as is illustrated by ***Figure 10***. So long as each is used independently and consistently, either system of measurement can be used in retail operations and transactions, because they are two different ways of measuring the *same* objective reality. As should be clear from the examples shown in ***Figures 1, 2 and 4***, no objective aspect of that reality changes depending on which measurement system is employed. In particular, the total dollar cost to a motorist for a given quantum of fuel would be identical under either ***Scenario I*** or ***Scenario IV***. A problem would arise only if one fails to use a particular system *consistently* by, for example, mixing quantity units from one system with price units from the other.

Figure 10.
Net and gross systems are equally valid alternatives for the same objective reality.

In "Cold" Climate (gasoline at 45° F.)							
	Total "gallons" delivered	Size of "gallon" (in cubic inches)	Dealer's cost of delivered fuel	Dealer's Implicit cost per "gallon"	Dealer's target gross margin	Dealer's target sales revenue	Dealer's target street price per "gallon"
Measured in NET Gallons*	8,082.8	228.61	$23,000	$2.846	$1,000	$24,000	$2.969
Measured in GROSS Gallons	8,000.0	231.00		$2.875			$3.000

In "Hot" Climate (gasoline at 75° F.)							
	Total "gallons" delivered	Size of "gallon" (in cubic inches)	Dealer's cost of delivered fuel	Dealer's Implicit cost per "gallon"	Dealer's target gross margin	Dealer's target sales revenue	Dealer's target street price per "gallon"
Measured in NET Gallons*	7,917.2	233.39	$23,000	$2.905	$1,000	$24,000	$3.031
Measured in GROSS Gallons	8,000.0	231.00		$2.875			$3.000

* "Net Gallons" are used in this and subsequent exhibits for illustrative purposes. In actuality, retailers receive only "Gross Gallons" but may be billed for "Net Gallon" equivalents.

Figure 10 illustrates how a dealer's receipt and sale of the same physical quantity of gasoline can be accounted for using either of two systems: ***Scenario I*** (with prices and physical units expressed in *gross* gallons) or ***Scenario IV*** (with prices and physical units denominated in *net* gallons). The essential equivalence of these two alternative systems is the result of the competitive discipline that leads a retailer to seek to generate the same $24,000 in total revenue from an assumed wholesale delivery of gasoline, no matter whether he conducts his trade in gross units or in net units.

Figure 10 also illustrates the impact of temperature variation on these two alternative systems for measuring retail transactions in motor fuel. Obviously, temperature differences have no impact when both prices and quantities are measured using net units. But gross measurement systems are equally capable of adjusting for temperature variation, even though this can result in different numbers of gross gallons available for sale from the same physical quantum of gasoline as its temperature changes. Retail competition compensates for the varying number of available gallons by inducing the dealer to set target street prices that vary by the exact amount needed to insure that selling that fuel will generate the target $24,000, regardless of the temperature of the fuel at the time.

That a consumer would fare equally well under consistently-applied gross and net systems of measurement is demonstrated in ***Figure 11***. In a "cold" climate, the dealer's target sales revenue of $24,000 would lead him to seek a retail price of $2.969 per net gallon or $3.000 per gross gallon. But the key point of ***Figure 11*** is that it would cost a consumer $297 for 100 net gallons of gasoline, no matter whether the retailer's pump prices were stated in terms of net gallons or gross gallons.[15] Similarly, in a "warm" climate, the motorist's cost for 100 net gallons of gasoline would be identically the same at $303, no matter whether the retailer dispensed fuel in net gallons or gross gallons.

Figure 11.
A consumer's total outlay is identical using either the net or gross system.

In "Cold" Climate (gasoline at 45° F.)					
	Total "gallons" available for resale	**Size of "gallon" (in cubic inches)**	**Dealer's Implicit cost per "gallon"**	**Dealer's target street price per "gallon"**	**Total retail cost of 100 net gallons**
Measured in **NET** Gallons*	*8,082.8*	*228.61*	*$2.846*	*$2.969*	*$297*
Measured in **GROSS** Gallons	*8,000.0*	*231.00*	*$2.875*	*$3.000*	*$297*
In "Hot" Climate (gasoline at 75° F.)					
	Total "gallons" available for resale	**Size of "gallon" (in cubic inches)**	**Dealer's Implicit cost per "gallon"**	**Dealer's target street price per "gallon"**	**Total retail cost of 100 net gallons**
Measured in **NET** Gallons*	*7,917.2*	*233.39*	*$2.905*	*$3.031*	*$303*
Measured in **GROSS** Gallons	*8,000.0*	*231.00*	*$2.875*	*$3.000*	*$303*

The careful reader will notice that – for the purposes of ***Figures 10 and 11*** – it was assumed that the dealer's wholesale price was $2.875 per *gross* gallon and that he sought to

15 This paper makes occasional reference to a particular "quantum of fuel", meaning a fixed number of net gallons. The fact that the number of net gallons is invariant with respect to temperature is used only for convenience of exposition, and such usage should *not* be taken to mean that measuring retail transactions using net units is inherently superior to using gross gallons.

achieve a retail margin of $0.125 per *gross* gallon. However, nothing of substance would change if it were assumed instead that the dealer paid a wholesale price of $2.875 per *net* gallon and sought a margin of $0.125 per *net* gallon, a fact demonstrated in ***Figures 12 and 13***. In this alternative, a consumer would pay the identical amount – $300 – for the fixed quantum of gasoline (i.e., 100 net gallons), regardless whether the retail transaction itself were denominated in terms of gross gallons or net gallons.

Figure 12.
Nothing changes if the dealer's targets are denominated in net gallons.

In "Cold" Climate (gasoline at 45° F.)							
	Total "gallons" delivered	Size of "gallon" (in cubic inches)	Dealer's cost of delivered fuel	Dealer's Implicit cost per "gallon"	Dealer's target gross margin	Dealer's target sales revenue	Dealer's target street price per "gallon"
Measured in NET Gallons*	*8,082.8*	*228.61*	$23,238	*$2.875*	$1,010	$24,248	*$3.000*
Measured in GROSS Gallons	*8,000.0*	*231.00*		*$2.905*			*$3.031*

In "Hot" Climate (gasoline at 75° F.)							
	Total "gallons" delivered	Size of "gallon" (in cubic inches)	Dealer's cost of delivered fuel	Dealer's Implicit cost per "gallon"	Dealer's target gross margin	Dealer's target sales revenue	Dealer's target street price per "gallon"
Measured in NET Gallons*	*7,917.2*	*233.39*	$22,762	*$2.875*	$990	$23,752	*$3.000*
Measured in GROSS Gallons	*8,000.0*	*231.00*		*$2.845*			*$2.969*

Figure 13.
A consumer's total outlays are the same under net and gross systems.

	Total "gallons" available for resale	Size of "gallon" (in cubic inches)	Dealer's Implicit cost per "gallon"	Dealer's target street price per "gallon"	Total retail cost of 100 net gallons
In "Cold" Climate (gasoline at 45° F.)					
Measured in **NET** Gallons*	*8,082.8*	*228.61*	*$2.875*	*$3.000*	*$300*
Measured in **GROSS** Gallons	*8,000.0*	*231.00*	*$2.905*	*$3.031*	*$300*
In "Hot" Climate (gasoline at 75° F.)					
Measured in **NET** Gallons*	*7,917.2*	*233.39*	*$2.875*	*$3.000*	*$300*
Measured in **GROSS** Gallons	*8,000.0*	*231.00*	*$2.845*	*$2.969*	*$300*

The inconsistency of the "hot fuel" activists

The "hot fuel" activists have what can only be described as a schizophrenic approach to the measurement issues presented by variations in fuel temperature, a fact illustrated in ***Figure 14***. These activists prefer to overlook entirely the retail fuel transactions that occur in "cold" climates. This no doubt is due to the fact that – were they to apply the same "logic" they employ when analyzing transactions in "hot" climates – they would have to conclude that it is the *consumers* who are "ripping off" the retailers in these colder states.

Figure 14.
"Hot fuel" activists prefer to ignore retail transactions in "cold" climates.

In "Cold" Climate (gasoline at 45° F.)

Ignore Transactions in "Cold" Climates			Dealer's cost of delivered fuel	Dealer's Implicit cost per "gallon"	Dealer's target gross margin	Dealer's target sales revenue	Dealer's target street price per "gallon"
Measured in **NET** Gallons*	*8,082.8*	*228.61*	$23,238	*$2.875*	$1,010	$24,248	*$3.000*
Measured in **GROSS** Gallons	*8,000.0*	*231.00*		*$2.905*			*$3.031*

In "Hot" Climate (gasoline at 75° F.)

	Total "gallons" delivered	Size of "gallon" (in cubic inches)	Dealer's cost of delivered fuel	Dealer's Implicit cost per "gallon"	Dealer's target gross margin	Dealer's target sales revenue	Dealer's target street price per "gallon"
Measured in **NET** Gallons*	*7,917.2*	*233.39*	**$22,762**	*$2.875*	**$990**	**$23,752**	*$3.000*
Measured in **GROSS** Gallons	*8,000.0*	*231.00*		*$2.845*			*$2.969*

But there is another telling inconsistency even within their analysis of retail fuel transactions in "hot" climates. As was illustrated in ***Figure 7***, temperature-compensation activists effectively are demanding that retail sales of "hot" fuel be measured using a *mixed* system of measurement units – namely ***Scenario II*** – with quantities measured in *net* gallons but sold at *unadjusted gross* prices per unit.

Figure 15 shows the consequences that would result if a retailer actually attempted to conduct his business in the way demanded by the "hot fuel" activists (assuming a fuel temperature of 75°F.). Because these activists would expect the dealer to dispense larger (i.e., 233.39-cubic-inch) *net* gallons at this temperature – but at the same $3.000 target retail price the dealer previously sought on each *gross* gallon sold – this would result in an immediate and significant reduction in the dealer's sales revenue and profitability. In the illustration in ***Figure 15***, the dealer's gross margin would decline by nearly 25 percent. Since the dealer's other costs of doing business also must be covered by that gross margin and since his net profit is only a small fraction of the total gross margin, such a 25-percent reduction likely would erase his entire profit, and over time, would jeopardize the very existence of the retailer's business.

Figure 15.
The effect of the "hot fuel" activists' demands on a retailer's gross margin.

In "Hot" Climate (gasoline at 75° F.)							
	Size of "gallon" (in cubic inches)	**Total "gallons" available for resale**	**Dealer's target sales revenue**	**Dealer's target street price per "gallon"**	**Actual sales revenue**	**Resulting dealer gross margin**	**Change in dealer's gross margin**
What the CEC Staff Report advocates…	***233.39***	7,917.2	$24,000.00	***$3.000***	$23,751.60	***$751.60***	***-$248.40***
				↑			
…compared to current transactions using GROSS quantities and prices	***231.00***	8,000.0	$24,000.00	***$3.000***	$24,000.00	***$1,000.00***	

The "hot fuel rip-off" controversy

The allegations themselves

Starting – and ending – with a few propositions, its adherents claim that the "hot fuel rip-off" is a proven scientific fact:

- Since the 1920s, most U.S. motor fuel transactions have been conducted on a "net" basis[16] at all levels of distribution *except* retail sales to consumers.

- The volumetric expansion and contraction of gasoline and diesel fuel due to variations in temperature are well-established scientific facts.

- Consequently, a 231-cubic-inch gallon of fuel at 60° F. contains more energy than does a 231-cubic-inch gallon measured at a warmer temperature.

- Most U.S. retail sales of motor fuel take place at temperatures that – on average – exceed 60 ° F.[17]

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16 That is, denominated in gallons that are temperature-compensated to 60 ° F.

17 Taken over the entire U.S. and all seasons of the year, the temperature of gasoline sold at retail supposedly averages about 64.7° F. But this estimate is based on figures collected by an unnamed manufacturer of storage tank monitoring equipment, the sampling properties of which are unknown. (Testimony of Richard Suiter, National Institute of Standards and Technology, before the Domestic Policy Subcommittee of the Oversight and Government Reform Committee, June 8, 2007 at p. 4.) The

On the basis of these propositions – and nothing more – the "hot fuel" activists assert that motorists are not getting the fuel that they paid for because U.S. retailers sell fuel in volumetrically-measured, 231-cubic-inch gallons with no adjustment or compensation in price or volume to correct for differences in temperature or in energy content. By selling this "hot fuel", gasoline retailers supposedly have been shorting consumers by about 800 million gallons of fuel annually and overcharging them by billions of dollars each year.[18] The "hot fuel" activists also charge that retailers collect approximately $350 million each year in state and federal fuel taxes on the so-called "phantom gallons" created by temperatures in excess of 60°F. that they keep for themselves rather than remitting to the government.

The most recent "hot fuel" controversy was sparked by a series of articles that appeared in late 2006 and in 2007 in the *Kansas City Star* under the byline of Steve Everly that purported to document the supposedly decades-long practice by which U.S. retailers of gasoline and diesel fuel had been systematically shortchanging their customers.[19] Using fuel storage tank temperature data, the impact of state-by-state average temperatures on fuel volume, and state-by-state motor fuel consumption data, the *Star* and Everly calculated that retail sales of "hot fuel" cost consumers approximately $2.3 billion annually.[20]

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estimate supplied by this manufacturer for California (74.7°F.) has been shown by the *California Fuel Temperature Survey* – which yielded an average statewide temperature of 71.1° F. – to be not just "slightly" but significantly overstated. (*CEC Staff Report* at p. 25)

18 Statement of Joan Claybrook, President, *Public Citizen*, "Hot Fuel Means Big Rip-Off at Gasoline Pumps," December 14, 2006 ("[in] a practice common in the gasoline retail industry…retailers have been ripping off consumers to the tune of an estimated 2 billion dollars a year.")

19 The "hot fuel" charges were initially laid out in two 2006 front-page articles by Steve Everly: "It's Hot Fuel for You, Cold Cash for Big Oil," *Kansas City Star*, August 27, 2006 at p. A1; and "Technology, New Rules Can Fix Hot-Fuel Issues," *Kansas City Star*, August 28, 2006 at p. A1. These were followed by more than a half dozen additional articles written by Mr. Everly and published by the *Star* in 2006, 2007 and 2008.

20 Everly's and the *Star's* methodology was sketched as follows:

> The fuel temperature data was gathered by the National Institute of Standards and Technology from storage tanks at 1,000 gas stations and truck stops in 48 states and the District of Columbia during a period from 2002 to 2004.
>
> The NIST data revealed that the average temperature of fuel across the country and year-round was 64.7 degrees Fahrenheit – almost 5 degrees higher than the government standard of 60 degrees.
>
> …
>
> The Star estimated how much fuel sales were affected in each state based on the state's average fuel temperature and how much fuel volume would expand or contract under those conditions. In most states, consumers got less energy per gallon than they were paying for because fuel temperatures were hotter than the standard. That translates into lower gas mileage – and more fill-ups down the road. In some cold-weather states,

The charges in the *Kansas City Star* series were taken up, repeated and amplified by a number of advocates[21] and journalists at other newspapers.[22] In 2007, the "hot fuel" allegations resulted in congressional hearings[23] and formed the basis for a number of lawsuits brought on behalf of classes of retail customers that have named various motor fuel retailers as defendants.[24]

There are three important subtexts to the "hot fuel rip-off" allegations.

The first is that it is "Big Oil" – seeking to preserve its "hot fuel" profits by systematically shortchanging its retail customers – that has prevented the implementation of automatic temperature compensation at retail, while protecting its own interests by insisting on temperature compensation at all higher stages in the distribution chain from refinery to the corner gas station. In truth, not all "upstream" transactions are conducted on a temperature-compensated basis – a fact acknowledged by the *CEC Staff Report* – and there are economically reasonable explanations for its actual occurrences that having nothing to do with avoiding "hot fuel rip-offs". Further, "Big Oil" owns and operates fewer than 10 percent of gasoline retail facilities, therefore its influence over retail fuel pricing decisions throughout the nation is significantly limited.

The second is that "Big Oil's" hypocrisy is demonstrated by its "rush" in the 1990s to adopt temperature compensation on retail sales in Canada, supposedly because the industry was losing money when it sold fuel to motorists at temperatures below 15° C.[25] Again, there is an

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drivers actually got a bit more energy per gallon because their gas was cooler than the standard.

The resulting state-by-state consumption change figures were then multiplied by the prevailing gas price in each state as reported during the last week of July by AAA. Those state-by-state gas figures were then combined with national figures for diesel consumption and price to arrive at the $2.3 billion nationwide estimate.

21 These include Joan Claybrook of *Public Citizen*, John Siebert of the *Owner-Operator Independent Drivers Association* (*OOIDA*), and Jamie Court and Judy Dugan of *OilWatchdog* (a project of *Consumer Watchdog.org,* formerly known as *The Foundation for Taxpayer and Consumer Rights* (FTCR).

22 Including Elizabeth Douglass and Ronald D. White, *Los Angeles Times*, and David R. Baker, *San Francisco Chronicle*.

23 Hearings on Hot Fuels, Subcommittee on Domestic Policy of the Committee on Oversight and Government Reform, Rep. Dennis Kucinich, Chairman, June 8 and July 25, 2007.

24 These individual actions have been consolidated into the multi-district action captioned *In re: Motor Fuel Temperature Sales Practices Litigation (MDL 1840)* that has been assigned to the U.S. District Court for the District of Kansas.

25 The Canadian reference temperature for motor fuel transactions that is roughly equivalent to 60° F.

economically rational explanation for the process by which temperature compensation was initially introduced in Canada and then spread to include the majority of retailers.

The third is that the state of Hawaii and George Mattimoe, its then Deputy Director of Weights and Measures, have shown that individual states can effectively end the "hot fuel rip-off" by requiring retailers to dispense larger "gallons" that – on average – compensate motorists for temperature-induced expansion. As is discussed at greater length below, the entire "Hawaii-Mattimoe" legend also is a myth. In particular, the introduction of the slightly larger "Hawaii gallon" did not "save" motorists anything. Because retail prices increased by the percentage given by the ratio of the volume of the "Hawaii gallon" to the U.S. statutory gallon, Hawaiian consumers' outlays for a given quantum of motor fuel were unchanged.

Not surprisingly, "hot fuel" advocates prefer to focus attention on just those states – like California – in which the average temperature of dispensed fuel exceeds 60° F. and, therefore, the "hot fuel" overcharges supposedly are greatest. These activists appear to have little to say about the significant number of "colder" states in which – by their logic – it is the retailers who have been "ripped off" by consumers.

The "hot fuel" allegations are unproven conjectures

But the ATC proponents' conclusions are pure conjectures that have never been verified by independent data. The "hot fuel" adherents appear to take as given their assumption that actual retail prices reflect the true market price for *temperature-compensated net* gallons. That is, they assume that actual retail prices have not been adjusted in any way to account for the volumetric expansion that occurs when fuel is greater than 60° F. The "hot fuel" adherents maintain that – in the absence of direct evidence that each retailer consciously calculates the adjustment to his retail price required by the actual temperature of the fuel in his tanks – no such "adjustment" ever occurs.

Put it in terms of scientific analysis and hypothesis-testing, all that these activists offer is a *hypothesis* about retail profits that they derive from the fact of temperature expansion, measurement of retail sales in 231-cubic-inch gallons regardless of temperature, and the average retail price per gallon at which those sales were made. But this in no way *proves* that retailers have actually extracted and pocketed any "hot fuel" profits. A hypothesis may have been formulated, but it has not been subjected to confirmation using independent data.

In other words, these claims by temperature-compensation activists – like any conjectures – must be shown to be consistent with *all* the relevant facts before they should be accepted as true. To the extent there is any validity to these claims, it means that it is the *retailers* who are reaping these "hot fuel" profits, not upstream refiners and wholesale marketers (because, say the "hot fuel" activists, ATC governs transactions at these higher levels in the distribution chain).

So it needs to be demonstrated that independent, direct measurements of actual retail store profitability confirm the existence of the supposed "hot fuel" profits. Similarly, it must be shown that the trends in the number and profitability of retail gasoline stores are consistent with the alleged decades-long existence of the supposedly massive "hot fuel" profits. If the actual data are inconsistent with these implications of the "hot fuel" allegations, then there ought to be considerable skepticism about the "hot fuel" claims.

Similarly, if it can be demonstrated that the retail prices posted for gasoline actually are the result of the competitive interactions of retailers and consumers, and that these prices *do* reflect the effect of temperature on volume, then the entire edifice erected by the temperature-compensation proponents simply collapses.

The economic flaw in the "hot fuel" activists' argument is their assumption that prices currently charged at retail stations have not been adjusted for the effect of temperature because these activists see no evidence that each retailer makes the overt adjustments to his or her pump prices that would be required. In the absence of such explicit, overt adjustments by retailers, they argue that the street prices posted by retailers must be for the same temperature-compensated "net" gallons that they purchased at wholesale. Since retailers currently pump gross (or uncompensated) gallons, the "hot fuel" activists insist that motorists fail to receive "what they paid for."

The "hot fuel" activists also insist that the "rip-off" exposed by the *Kansas City Star* has since been "proven" by the Kucinich hearings[26] as well as by the *CEC Staff Report* itself.[27]

But nothing of the sort has occurred. The activists' conclusions regarding the size and dollar value of the supposed "rip-off" really are nothing more than conjectures, based only on the physics of motor fuels subjected to temperature variation. The "hot fuel rip-off" allegations "predict" the accumulation of billions of dollars in ill-gotten "hot fuel" profits by retailers, but its adherents have done nothing to actually go out and directly measure these profits to see if they even exist and that their magnitude and geographic distribution are even consistent with the "hot fuel" rip-off hypothesis.

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26 David Tanner, "BREAKING NEWS: U.S. House report validates "hot fuel" rip-off," *Land Line: The Business Magazine for Professional Truckers*, June 7, 2007 (emphasis added) http://www.landlinemag.com/Special_Reports/2007/Jun07/060707_hotfuel.htm

27 Judy Dugan, "CEC Deep Freeze On Hot Fuel," *OilWatchdog*, December 4, 2008 (emphases added) http://www.oilwatchdog.org/articles/?storyId=24060&topicId=8072

> "A California Energy Commission (CEC) draft report on the "hot fuel" ripoff *proves beyond doubt* that consumers are unfairly treated at the pump…
> "The CEC draft…*fully acknowledges* that consumers suffer annual loss in the hundreds of millions of dollars statewide (emphases added)."

The <u>CEC Staff Report</u> and the "hot fuel" allegations

Pursuant to AB 868[28] directing the California Energy Commission "to conduct a cost-benefit analysis and make recommendations relative to the implementation of automatic temperature compensation devices at retail service stations," the staff of the California Energy Commission conducted a nearly year-long series of workshops that culminated in late November with publication of the *Fuel Delivery Temperature Study: Staff Report*.[29]

Yet even though the "hot fuel" allegations led directly to the *CEC Staff Report*, there is an unmistakable tension between the two. At no point does the *CEC Staff Report* discuss the "hot fuel" allegations, much less endorse them.

While the *CEC Staff Report* does not even refer to the "hot fuel" controversy, its derivation of the potential consumer benefits from the *ATC Retrofit* are similar in methodology and amount to the "hot fuel profits" calculated for California by the *Kansas City Star*.[30] Unlike the implicit charge of the "hot fuel activists", the *CEC Staff Report* does not claim that retailers' pump prices are denominated in dollars per net gallon while they sell temperature-expanded gross gallons to motorists. But the *CEC Staff Report* does insist that

> [F]uel sold at retail in California has not been volume-adjusted to compensate for variations in temperature, leading to concerns over potential inequities for retail motorists.[31]

At the same time, the *CEC Staff Report* concedes that retailers operate in a "highly competitive business environment."[32] The CEC Staff does not realize that, as a matter of economics, this concession is sufficient to establish that retail competition *must adjust retail prices* to compensate for temperature variations. Otherwise, retailers would be earning *supracompetitive (i.e., "hot fuel") profits*, which are economically incompatible with a "highly

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28 Davis, Chapter 398, Statutes of 2007.

29 CEC-600-2008-012-SF, Gordon Schremp, Principal Author, November 2008 (hereinafter referred to as the *CEC Staff Report*).

30 Everly and the *Kansas City Star* calculated that retail purchasers of gasoline in California were being "ripped off" by approximately $509 million per year, while the *CEC Staff Report* estimates that the annual benefit of the *ATC Retrofit* to California purchasers of retail gasoline would have amounted to $376 million during the April 2007 - March 2008 study period. The approximately $133 million annual difference is explained by the fact that the *Kansas City Star* assumed the average annual temperature of gasoline sold at retail in California was 74.7° F., while the *CEC Staff Report* concludes that the correct figure was at 71.1° F., or 3.6° F cooler.

31 *CEC Staff Report* at p. 5.

32 *CEC Staff Report* at p. 72.

competitive" market. It seems not to have occurred to the authors of the *CEC Staff Report* that competition might cause the *price* of the gross gallons dispensed by retailers to vary inversely with the temperature of that fuel. Nor does the *CEC Staff Report* explain how the thousands of California retailers – who operate in a highly competitive business environment – would be able to restore and sustain the supracompetitive prices that would be needed to "recapture" their previous revenue levels.

As a result, the *CEC Staff Report* appears to view the proposed *ATC Retrofit* in a vacuum – as something that California *could* mandate – with the only important question being whether it would succeed in transferring the $438 million annually from retailers to motorists in the long term. The *CEC Staff Report* is interested only in whether that "consumer benefit" would be economically achievable and sustainable, and not in whether it is needed to correct the *status quo*. In short, the *CEC Staff Report* treats the *ATC Retrofit* as something akin to a "no fault" remedy for a nonexistent problem.

Consumers would not enjoy "more fuel" after the ATC Retrofit

The CEC staff appears to seriously believe that mandating the *ATC Retrofit* would result in "more fuel" for California motorists. How else can one interpret such statements as:

> If Automatic Temperature Compensation (ATC) was required in California, [the] benefits would include *more fuel* for consumers (emphasis added).[33]

or the following:

> **Potential Consumer Benefits Resulting From ATC Retrofit**
> This section of the report details the staff efforts to properly characterize and quantify [the] potential benefits. It should first be noted that "consumer benefits" have been denoted as the monetary value of *the additional transportation fuel* that California motorists would have received if ATC devices had been in place during the study period of April 2007 through March 2008. *The additional fuel* would be in terms of slightly larger size gallons as measured in cubic inches that would occur under circumstances in which retail fuel temperatures are warmer than 60 degrees Fahrenheit.[34]

Not content to leave it at that, the *CEC Staff Report* continues:

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33 CEC Staff PowerPoint presentation at its June 5, 2008 workshop, Slide 6.

34 *CEC Staff Report* at p. 75 (emphases added).

> It is understood that retail transactions transitioning from gross to net gallons *will not alter the total demand for fuel* consumed over the study period, but rather result in variable size gallons depending on temperature. The main question to address is whether consumers would retain *the additional cubic inches* dispensed from ATC fuel dispensers during warmer period [sic] of the year without any attempt by retail station owners to recapture this revenue by raising prices of fuel and non-fuel goods.[35]

One hardly knows where to begin. What "additional fuel" or "additional cubic inches" is the *CEC Staff Report* talking about, especially when any changes "will not alter the total demand for fuel"?[36]

All that would be accomplished by either the *ATC Retrofit* or the adoption of a "new reference temperature" would be to change the size (in cubic inches) of the "gallon" used to measure retail fuel transactions. Under the *ATC Retrofit*, the size of that "gallon" would vary throughout the calendar year as a function of the seasonal variation in fuel temperature. Under the "new reference temperature" option, the size of that "new" gallon would be fixed at 232.77 cubic inches.

Because the size of a "gallon" at each possible alternative temperature is fixed and known – owing to the linear relationship shown in ***Figure 3*** – the changes following the *ATC Retrofit* or the "new reference temperature" would be no different in principle than the hypothetical change from U.S. gallons to British imperial gallons that has already been shown in ***Figure 2***. In that example, competition resulted in dealers' target retail prices increasing from $3.000 to $3.603, or by the same percentage that a 231-cubic-inch volume must be increased in order to occupy 277.4 cubic inches. Also in that example, if a consumer had been purchasing 23,100 cubic inches (or 100 U.S. gallons) at $300 before the change, she would receive the same 23,100 cubic inches for the same $300 following the change. She definitely would not receive "more fuel" after the switch.

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35 *Id.*

36 Assume that a consumer buys 20 gallons of gasoline at $3.00 per gallon, for a total outlay of $60.00. The "logic" implicit in the *CEC Staff Report* is best illustrated by a scam in which a confidence man promises to quadruple the amount of gasoline received by that consumer while at the same time reducing by half his cost per unit. Whereupon the scam artist switches from gallons to quarts to measure the quantity of fuel purchased while reducing the retail price "per unit" from $3.00 to $1.50. By the "logic" implicit in the *CEC Staff Report*, the consumer would be getting "more" fuel at a "lower" price per unit, but he would now have to pay $6.00 – or twice as much – for each gallon as was previously necessary.

As already shown in ***Figure 4***, the adoption of any particular "reference temperature" – such at 75°F – has no effect on the total quantum of fuel received by a consumer or the total amount he pays at retail for it.

But as will be demonstrated in a later section of this paper, the same logic applies to "gallons" of fuel that vary in size (measured in cubic inches) due to seasonal changes in fuel temperature. At each possible temperature over the annual seasonal cycle, the volume occupied by a specific quantum of fuel (e.g., a specific number of net gallons) is fixed and known. More to the point, the number of gross gallons available to a retailer for sale to consumers also is fixed and known by him. In a competitive retail market, the retailer will aim for a target pump price that compensates him for the wholesale cost of that fuel while also allowing him to cover his other expenses and to earn a competitive return.

In other words, resorting to automatic temperature compensation to adjust for seasonal variations in temperature is, in principle, no different than mandating a sequence of changes in the applicable "reference temperature" throughout the calendar year. While each "gallon" may contain more (or fewer) cubic inches, this would not mean that motorists received "more" (or "less") fuel. After all, the whole point of automatic temperature compensation is that it is supposed to ensure that consumers receive the *same* number of net gallons for a given outlay in dollars.

Because motorists do *not* receive "more fuel" following a change from U.S. gallons to gallons defined by a "reference temperature" greater than 60°F., they similarly would not get "more fuel" following the proposed *ATC Retrofit*. Rather, they would continue to receive the *same* total number of net gallons at the *same* total cost.

Put succinctly, the *CEC Staff Report* tries to quantify the "potential consumer benefits resulting from the *ATC Retrofit*" by adding up the "additional cubic inches of fuel" that consumers would "receive" with each "gallon" purchased and then valuing these additional cubic inches at unchanged retail prices. But consumers would be equally well off if the price they must pay per U.S. gallon is reduced to account for temperature-induced expansion. This is exactly what is achieved currently by retail competition without the expense and disruption that would be occasioned by the *ATC Retrofit*.

The choice for retailers: increase price immediately or go out of business

The *CEC Staff Report* appears to be based on the assumption that only the costs of the *ATC Retrofit* itself might eventually lead retailers to successfully increase their street prices, but even here it expects that any such increases would be only partially successful and, in any event, would succeed only "in the long term". The *CEC Staff Report* appears to liken retailers' raising their pump prices in order to "recapture" their erstwhile revenue streams as an attempt to "get even" for the *ATC Retrofit*, rather than as critically necessary for them to remain economically viable.

Gasoline retailing is competitive, as economists – and, one hopes, the CEC staff – use that term. This means that industry participants enjoy on average only normal competitive profits and that, at the margin, participants earn a return that is just sufficient to induce them to remain in business. Were retailers somehow required to pay for the costs of implementing temperature compensation at their stations out of their competitively-determined and -limited profits, this could reduce their profitability to a level below the minimum necessary to induce them to continue in operation.

The *CEC Staff Report* fails to recognize that – as a matter of elementary economics – the *ATC Retrofit* would necessarily result in an immediate increase in retail prices that exactly offsets the "benefits" it imagines consumers would enjoy as they received "more fuel" at unchanged retail prices.

Since retail competition already adjusts pump prices in response to temperature variation – thus insuring that the retail price of fuel remains constant when expressed in terms of net gallons – and dealers currently operate in a highly competitive environment, these dealers do not have any "hot fuel" profits out of which to absorb the increase in their wholesale cost per "gallon" that would be induced by either the *ATC Retrofit* or a new "reference temperature" for California. Instead, the gross margins out of which they must pay their other expenses and earn a competitive profit would be immediately and substantially reduced.

The amount of this reduction would entirely eliminate retailers' profits and leave them unable to fully cover their other costs of doing business. According to the *CEC Staff Report*, the *ATC Retrofit* would extract $438 million per year in revenue from fuel retailers, at least in the short- and medium term.[37] According to the most recent "station count" published by *NPN News*, there are approximately 9,700 such retailers in California. Simple arithmetic indicates that the average California motor fuel retailer would lose $45,155 in sales revenue each year following the *ATC Retrofit*. This greatly exceeds the $33,000 in annual *pre-tax* profits that the *CEC Staff Report* gives as the total profit earned by the average fuel-dispensing convenience store over the period from 1998 through 2007.[38] The *CEC Staff Report* does not indicate how California dealers could absorb such a revenue loss and remain in business.

Instead, the *CEC Staff Report* opines that retail competition would make it difficult for dealers to increase their pump prices to compensate for the larger "gallons" they would dispense under either the *ATC Retrofit* or the switch to the "California reference temperature option". This is exactly backwards, because it is that very competition that would *force* retailers to increase their pump prices *immediately* upon implementation of either option, or quickly go out of business.

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37 *CEC Staff Report* at p. 76.

38 *CEC Staff Report* at p. 83.

In terms of economics, requiring retailers to dispense larger temperature-compensated gallons would be effectively the same as increasing their wholesale cost *per "gallon"*. Again in terms of elementary economics, this would amount to an increase in each retailer's *direct* (or *marginal*) cost per unit sold. In a competitive market, if all firms are confronted with an identical increase in their direct cost per unit sold, the market-equilibrium price per "gallon" must go up by the amount of that increase in the cost per "gallon". Competitors who fail to achieve this higher price would eventually go out of business.

In acknowledging that retailers operate in a highly competitive business environment, the *CEC Staff Report* takes this to mean that this "can, at times, create temporary difficulties and challenges with regard to recovering increased expenses" that depends on the "spheres of competition" within which each retailer operates.

But these "increased expenses" that the CEC staff has in mind appear to involve only the cost of the proposed *ATC Retrofit* itself. It is true that – for the most part – these would be one-time fixed expenses that would not vary directly with the number of gallons sold. Economists term these "indirect" or "fixed" expenses, and distinguish them from direct (or marginal) costs that do vary directly with the quantity of the product produced or sold. In general, it is true that competition does not guarantee that an individual seller or producer will be able to recover increases that he alone experiences in his indirect or fixed expenses by increasing his prices.

However, when *all* sellers incur the *same* expense – and consumers have no alternative sources for the product they sell – then there is little to restrain an attempt by individual sellers to increase retail prices in order to compensate for that increased expense.[39]

The *CEC Staff Report* is wrong as a matter of economics when it suggests that retailers would respond to an immediate increase in their direct (marginal) cost per unit of gasoline only in the long term. The speed and extent by which increases in dealers' marginal costs are transmitted to pump prices has been extensively studied by economists who generally have

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39 In principle, pump prices – on a cost per gallon basis – could increase by *more* than is needed to compensate for the *average* retailer's cost to implement the *ATC Retrofit*. In a competitive market comprised of sellers with differing cost structures, the impact on the *market* equilibrium price of a cost increase incurred by all sellers is a function of its impact on the cost structure of the *marginal* (or least efficient) seller. In the present context, this is the "low monthly volume" retailer. Assuming that this retailer must expend the same total dollar amount to retrofit his pumps as a "high volume" retailer, he would sell fewer gallons per month over which he could hope to distribute these retrofit costs. This would require that – in order to successfully shift the cost of his *ATC Retrofit* to his customers – he would have to achieve a greater increase in his per-gallon pump prices than would be necessary for his "high volume" rivals. Because of this, these rivals might be content to see retail prices per gallon increase by enough to allow their "low volume" competitor to recover his *ATC Retrofit* costs, even though such an increase would be more than enough to cover their own such costs. The result could be that retail prices increase by *more* than the aggregate cost of the *ATC Retrofit*, allowing the higher-volume dealers to "over-recover" their own costs.

found that increases in retailers' wholesale cost for fuel are substantially passed through to retail pump prices within about a week or two and in their entirety within at most a few weeks.[40]

The illusion of "increased prices on non-fuel items"

As a matter of economics, it is even more difficult to understand how the *CEC Staff Report* concludes that retailers would or could defray the cost of the *ATC Retrofit* or their increased wholesale cost per "gallon" by raising prices on the non-fuel items they sell.[41, 42]

First of all, such a shift – even assuming it were feasible – would in no way reduce the total cost ultimately born by consumers for the *ATC Retrofit*. It would merely shift some of that total cost to other items also purchased by motorists who patronize motor fuel retailers with convenience stores. Even if such a shift were feasible, it would be nonsensical as a matter of economics to pretend that the cost to Californians of the ATC retrofit is limited to just that portion that results in higher pump prices.

But to the extent that motor fuel retailers – especially convenience stores – sell such items, they do so in competition with supermarkets, fast food outlets, non-fuel convenience stores, auto stores, drug and sundries stores, and the like. Therefore, to suggest that motor fuel retailers could profitably raise their prices on non-fuel items can mean only that – at present – such retailers must be failing to maximize their profits. If station owners *could* simply increase prices on their non-fuel items to pay for the costs of the *ATC Retrofit* without harming their ability to compete with non-fuel retailers, then it would have been economically rational for them to have done so already. In other words, because of the competitive environment in which they operate, it must be assumed that the prices at convenience stores for non-fuel items have been established at levels that maximize retailer profits, and that a further increase in these prices

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40 See (among other examples): Severin Borenstein, Colin Cameron and Richard Gilbert, "Do Gasoline Prices Respond Asymmetrically to Crude Oil Price Changes?", *Quarterly Journal of Economics*, 112 (February 1997); Energy Information Administration, "Price changes in the Gasoline Market," February 1999; and Michael Burdette and John Zyren, *Gasoline Price Pass-through*, Energy Information Administration Petroleum Marketing Annual, 2003 at http://www.eia.doe.gov/pub/oil_gas/petroleum/feature_articles/2003/gasolinepass/gasolinepass.htm.

41 *CEC Staff Report* at p. 68. ("[CEC] Staff assumes that retail station owners will attempt to recover these [*ATC Retrofit*] costs by raising prices on products that are sold at retail stations, both fuel and non-fuel commodities.")

42 *CEC Staff Report* at p. 73. ("For example, retail stations that sell fuel and non-fuel commodities (such as convenience stores) have increased flexibility to attempt incremental expense recovery by increasing prices for multiple goods (gasoline and foodstuffs) and/or services (car washes). But a retail station that only sells transportation fuels has less flexibility and can only attempt to pass along increased expenses by raising the price of fuel they sell. These types of retail stations are estimated to account for less than 20 percent of the gasoline and diesel fuel sales.")

would only decrease those profits. It is not clear how the CEC staff has obtained the expertise to render such a judgment and to perceive an unexploited opportunity for increased profitability that apparently has eluded the owners and operators of the more than 100,000 fuel-selling convenience stores in the U.S.

It should be obvious that the other sellers of the non-fuel items that are also available at retail stations would incur no increased costs in connection with the *ATC Retrofit* because they have no fuel dispensers. But the *CEC Staff Report* does not explain how motor fuel retailers could successfully shift the increased capital costs of the *ATC Retrofit* itself and their higher per-“gallon” wholesale fuel costs to the non-fuel items available in their convenience stores when none of the non-fuel retailers with whom they compete would have experienced similar cost increases.

Since motor fuel retailers have no latitude to shift the costs of the ATC retrofit and higher per-“gallon” wholesale costs to their sales of non-fuel items, this means that these costs must be shifted in their entirety to retail fuel prices. In particular, an increase in the per-“gallon” wholesale price – an increase in the retailer’s marginal cost – will necessarily be passed through in its entirety to pump prices.

But so too would be the cost of the *ATC Retrofit* itself, which cannot be shifted to non-fuel items because the competing non-fuel sellers of such items would not have to undertake any *ATC Retrofit* and incur similar fixed or indirect cost increases. And because *all* motor fuel retailers would face the *same* increased costs – and because consumers seeking to purchase gasoline or diesel fuel would have no alternative sources – it also is likely that retailers would be able to pass such costs through to their pump prices in their entirety.[43]

The <u>CEC Staff Report’s</u> “increased price transparency benefit”

Because the *CEC Staff Report* ultimately concludes that neither the *ATC Retrofit* nor the “new reference temperature option” would yield measurable benefits in the form of “more fuel” for California consumers in the long term, the *only* positive contribution to the “benefits” side of the cost-benefit analysis that the CEC staff has managed to identify comes from the so-called

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43 A credible argument can be made that, in the new equilibrium, *more* than 100 percent of the *ATC Retrofit* costs could be passed through to retail customers. Here is how that might happen: In a competitive equilibrium, the market clearing price is determined by the costs of the least efficient producer. The indirect cost of the *ATC Retrofit* would loom larger for those retailers who sell relatively smaller fuel volumes per month. This is because they have fewer gallons of retail sales over which to distribute (or amortize) the fixed costs of the *ATC Retrofit*. If these low-volume retailers seek street prices that allow them to fully recapture their *ATC Retrofit* costs, and if it is their street prices that determine the market price, then all of the higher-volume, more efficient retailers would be content to match the pump prices of their less-efficient rivals, thus enabling them to “over-recover” their own *ATC Retrofit* costs.

"increased price transparency benefit" of $3.2 million per year that supposedly would result from the *ATC Retrofit*.[44]

The "logic" of *CEC Staff Report's* Information Asymmetry Model is this: In the absence of the *ATC Retrofit*, consumers buy "more" gasoline at "higher" prices than they would if they had full information regarding the temperature of the fuel in a retailer's tanks.[45] But in order to "find" and "monetize" this putative benefit, the CEC staff has resorted to a misguided attempt to force the "hot fuel" controversy and the proposed *ATC Retrofit* into the economic frameworks of *deadweight loss* and *consumer surplus*. As is shown below, this attempt fails as a matter of economics.

The main justification offered by the *CEC Staff Report* for the proposed *ATC Retrofit* is that it would enable consumers to enjoy "more fuel". But in the context of the Information Asymmetry Model, motorists are better off if they buy "less fuel"; "more fuel" supposedly is the *harm* that arises in the *absence* of automatic temperature compensation.

Moreover – as demonstrated later in this paper – competition already leads to adjustments in retail prices in response to seasonal changes in the prevailing average fuel temperature in each local area, and each consumer's repeated purchases are sufficient to protect against the possibility that the average temperature of a motorist's fuel purchases might significantly exceed the prevailing average fuel temperature in the local area.

So what additional "increased price transparency benefit" potentially remains that can be realized only by implementing the *ATC Retrofit*? According to the *CEC Staff Report*, this supposed benefit comes from ending the danger that a consumer might "overpay" for fuel purchased from a particular retailer because the consumer does not realize how "warm" that retailer's fuel is. In other words, this consumer would buy "too many" gross gallons because he does not realize that each such "gross" gallon contains marginally less energy. But following the *ATC Retrofit*, the consumer would be assured that he is getting "identical" net gallons, no matter which station he patronizes.

This argument has a surface plausibility, except that it overlooks all those consumers who currently "underpay" for fuel because they do not realize how "cool" that fuel is relative to the prevailing average temperature. These consumers would be roughly equal in number to the

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[44] *CEC Staff Report* at pp. 76-78. Even if the *CEC Staff Report's* analysis were otherwise unassailable – which it emphatically is not – it still would be the case that consumers would enjoy only *half* of that $3.2 million per year. As a matter of elementary economics, half of the benefit attributed by CEC staff to ending the supposed "deadweight loss" would be retained by retailers; consumers' gain would be limited to the remaining half. See, for example, Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics* (5th ed.), (Prentice Hall, 2001) at pp. 288-293.

[45] *CEC Staff Report* at p. 149 ("The inefficiency occurs from consumers consuming more gallons than they would have if they had full information on the fuel temperature.").

consumers who "overpay" because of the same "information asymmetry". So for all motorists in the aggregate, the "increased price transparency benefits" would be zero, because the positive benefits conferred on motorists who would otherwise "overpay" for "warmer-than-average" fuel are cancelled out by the negative benefits of those motorists who would otherwise "underpay" for "cooler-than-average" fuel.

According to the *CEC Staff Report*, the value of the supposed "increased price transparency benefit" is measured by the difference between the "larger" number of "higher-priced gallons" that consumers unwittingly buy (because they are unaware of actual fuel temperatures and cannot work out the "true" price per net gallon) and the "smaller" number of "lower-priced gallons" they would purchase after the *ATC Retrofit*. In the diagram that accompanies *Appendix R*, the "increased price transparency benefit" is gained by ending the total "deadweight loss" that arises because there are non-zero differences between the pre- and post-*ATC Retrofit* prices and quantities.

But the *CEC Staff Report's* attempt to use the diagram in *Appendix R* to analyze the problem supposedly raised by the sale of "warmer than average" fuel to an unsuspecting consumer is problematic. In that scenario, *either* the dispensed quantum of fuel is too small *or* the price per unit of fuel is too high, *but not both simultaneously*.[46] The reason this is important is that the "deadweight loss" triangle in that diagram has nonzero area *only* if P_{none} (the price per unit paid by consumers in the absence of ATC) is greater than P_{full} (the price per unit that would prevail under ATC) *and at the same time* Q_{none} (the quantity of fuel purchased by consumers in the absence of ATC) exceeds Q_{full} (the quantity of fuel they would buy if they enjoyed the "price transparency" promised by ATC). Otherwise that triangle has zero area and there would be no deadweight loss.[47]

The only way that $Q_{none} > Q_{full}$ can be satisfied is if the analysis is limited to transactions measured in gross gallons involving just those consumers purchasing at retailers whose fuel temperature exceeds the local cross-sectional average. Similarly, the only way that $P_{none} > P_{full}$ can be satisfied is if the analysis focuses on just those motorists who buy at stations whose fuel temperature exceeds the prevailing cross-sectional average.

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46 In other words, it cannot be the case that *both* the quantum of fuel is too small *and at the same time* the price charged for that quantum of fuel is too high.

47 There is another way to see that the diagram in Appendix R is wrong. In that diagram, $P_{none} > P_{full}$ *and* $Q_{none} > Q_{full}$ only because *CEC Staff Report* assumes an *inward* shift (i.e., toward origin) in the demand curve from $D_{no\ info}$ to $D_{full\ info}$, meaning that the consumer purchases less fuel at every possible price per unit. But how can this be, if consumers are supposed to be getting *more* fuel following the *ATC Retrofit*?

In other words, the only way that the *CEC Staff Report* can achieve its desired result is if it ignores those consumers who purchase at retailers with fuel temperatures that fall below the prevailing local average.

But measured over *all* California purchasers of motor fuel at retail, the putative "increased price transparency benefit" has got to be zero. Following the *ATC Retrofit*, all that would change is that market transactions – originally measured in gross gallons and proceeding at prices denominated in dollars per gross gallon – henceforward would be conducted using net gallons to measure quantity and priced in dollars per net gallon. But nothing real would change, only the units used to measure the transactions (and these have changed in compensatory ways, leaving total market quantities and dollar outlays absolutely unchanged).

But since California motorists in the aggregate would receive the same total quantity of fuel (measured in net gallons) for the same total dollar outlay following the *ATC Retrofit* as they did before, there would be no difference between P_{none} and P_{full} and no difference between Q_{none} and Q_{full}, the area shown in *Appendix R* as the total "deadweight loss" would disappear, and the "increased price transparency benefit" would be zero.

This means that the fact that the *ATC Retrofit* would enable *some* motorists to avoid "overpaying" for warmer-than-average fuel in particular transactions would be exactly offset by the negative "benefits" of those motorists who would lose the opportunity to "underpay" for cooler-than-average fuel.

Hawaii and the "New Reference Temperature Option" for California

The <u>CEC Staff Report's</u> "new reference temperature option"

The possible adoption of a "new reference temperature option" is the fallback option favored by "hot fuel" activists in the event that full automatic temperature compensation is not mandated.[48] The *CEC Staff Report* also considered this option – with 71.1° F. selected as the reference temperature – as an alternative to the *ATC Retrofit*.

The *CEC Staff Report* refers to the "new reference temperature option" as the "Hawaii example"[49] because it would result in the use of a larger "California gallon" to measure retail

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48 See, for example, Letter of Judy Dugan of *Consumer Watchdog* to the California Energy Commission, December 3, 2008 ("If the CEC recommends a legislative prohibition [of any voluntary fuel temperature compensation]…it must recommend adoption of a cost-free but less accurate solution – a statewide reference temperature of 71 degrees [even though this] would offer less benefit to consumers in warmer parts of the state, and be a greater cost burden on retailers in colder parts of the state.").

49 *CEC Staff Report* at p. 14.

fuel quantities similar to the "Hawaii gallon" adopted by the State of Hawaii at the urging of George Mattimoe.[50] Advocates of the "reference temperature" option believe that the judicious choice of a particular reference temperature would save consumers money because retail sales would henceforward be measured using "larger gallons" that more nearly approximate the volume of a net gallon at prevailing local fuel temperatures. However, these same advocates are also fearful that some "inequities" would remain, because actual fuel temperatures could still vary from the adopted "reference temperature". For example, these consumers become concerned if they think that the chosen reference temperature is not identically equal to the local average fuel temperature, or if the seasonal variation in fuel temperatures around that particular reference temperature is "too large".

These beliefs – and concerns – are misplaced. No matter what specific reference temperature is selected, its imposition in a competitive market for retail motor fuel sales would have absolutely no effect whatever on the prices paid by consumers for a specified quantity of fuel. But worse, the adoption of a reference temperature conveys the erroneous impression to consumers that there is some significance to the particular reference temperature chosen, and that a different reference temperature would yield different results at the pump.

The *CEC Staff Report* succumbed to this mistaken view:

> Energy Commission staff believes that a reference temperature is a more viable option in Hawaii because there is very little seasonal volatility in climate temperatures throughout the year, as well as very small geographic difference in temperature in areas dispensing gasoline on any given day. California, on the other hand, has many climate zones that have large variations in seasonal temperatures throughout the year. The existence of the diversity and range of temperatures at any given time in California would also make the reference temperature option not as preferable as it is in Hawaii.[51]

The particular reference temperature selected makes no difference

This finding shows that the CEC staff does not understand that – in a competitive market – redefining the "size" of the quantity unit used to measure retail sales of motor fuel would have no effect whatever on consumer outlays for fuel. Moreover, it simply would not matter whether that chosen reference temperature was exactly equal to the average temperature of fuel in the relevant geographic area, or indeed, whether it was even within the annual range of such temperatures. By extending ***Figure 4***, these conclusions are demonstrated in ***Figures 16, 17 and 18***.

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50 The CEC staff interviewed Mr. Mattimoe in connection with its report. (*CEC Staff Report* at p. 13)

51 *CEC Staff Report* at p. 107.

Figure 16 is the same as ***Figure 4*** except that it assumes that 50°F. (rather than 75°) is the "reference temperature".[52] Since – at 229.41 cubic inches – this "50°F. reference temperature gallon" is 0.69 percent smaller than a U.S. gallon, it should not be surprising that the resulting target street price of $2.979 (obtained by dividing the target sales revenue of $24,000 by the 8,055.6 available "50° gallons") is 0.69 percent less than the target retail price of $3.000 for a U.S. gallon.

Figure 16.
Changing to "50° gallons" affects only the price per unit, not total outlays.

Change from U.S. Gallons to "50° F. Reference Standard Gallons"						
	Unit of measurement for quantity sold	**Size of quantity unit (cubic inches)**	**Total quantity units available for sale**	**Dealer's target total sales revenue**	**Resulting dealer target street price per unit**	**Total cost of 100 US gallons (23,100 cubic inches)**
Before	**U.S. Gallon**	**231.00**	**8,000.0**	**$24,000**	**$3.000**	**$300.00**
After	***50° Gallon***	***229.41***	***8,055.6***		***$2.979***	***$300.00***
Change		***-0.69%***			***-0.69%***	***0.00%***

Next, consider ***Figure 17***, which assumes that the "reference temperature" is 90° F. Because – at 235.78 cubic inches – this "90° gallon" is 2.07 percent larger than a 231-cubic inch U.S. gallon, the resulting target retail price per "gallon" is 2.07 percent greater than the target retail price of $3.000 per gross gallon, or $3.062.

52 By design, this is more than 20° cooler than California's actual average fuel temperature.

Figure 17.
Changing to "90° gallons" affects only the price per unit, not total outlays.

Change from U.S. Gallons to "90° F. Reference Standard Gallons"						
	Unit of measurement for quantity sold	**Size of quantity unit (cubic inches)**	**Total quantity units available for sale**	**Dealer's target total sales revenue**	**Resulting dealer target street price per unit**	**Total cost of 100 US gallons (23,100 cubic inches)**
Before	**U.S. Gallon**	**231.00**	**8,000.0**	**$24,000**	**$3.000**	**$300.00**
After	***90° Gallon***	***235.78***	***7,837.8***		***$3.062***	***$300.00***
Change		***2.07%***			***2.07%***	***0.00%***

Finally, ***Figure 18*** analyzes the change in the target retailer price per unit under the assumption that 71.1°F. is adopted as the "California reference temperature". The resulting target street price of $3.023 is 0.77 percent greater than $3.000, which is to be expected since at 232.77 cubic inches, the "California gallon" is 0.77 percent bigger than the 231 cubic inches occupied by a gross gallon.

Figure 18.
Changing to "71.1° gallons" affects only the price per unit, not total outlays.

Change from U.S. Gallons to "71.1° F. California Reference Temperature Gallons"						
	Unit of measurement for quantity sold	**Size of quantity unit (cubic inches)**	**Total quantity units available for sale**	**Dealer's target total sales revenue**	**Resulting dealer target street price per unit**	**Total cost of 100 US gallons (23,100 cubic inches)**
Before	**U.S. Gallon**	**231.00**	**8,000.0**	**$24,000**	**$3.000**	**$300.00**
After	***71.1° Gallon***	***232.77***	***7,939.2***		***$3.023***	***$300.00***
Change		***0.77%***			***0.77%***	***0.00%***

Each of ***Figures 4 and 16 through 18*** analyzes the effect on a retailer's target price per unit assuming a switch from gross gallons as the unit of measure to each of four alternative "reference temperature gallons" where each "reference temperature gallon" is defined as the number of cubic inches occupied by a net gallon at the indicated temperature (respectively, 75°, 50°, 90° or 71.1°F.). The key is that each of these "reference temperature gallons" actually is defined in terms of a specific number of cubic inches. In other words, in the case of each reference temperature, the number of cubic inches is constant and independent of the actual fuel temperature at the time of the transaction for which a particular "reference temperature gallon" is used as the quantity unit. For example, a "71.1°F. California gallon" will occupy identically 232.77 cubic inches *at every possible temperature* from, say, 30°F. all the way up to 100°F. In other words, its volume in cubic inches does *not* vary as the fuel temperature varies.

But *at any particular actual fuel temperature*, a consumer would pay the same amount for a given quantum of fuel – measured in a fixed number of cubic inches – no matter which of these four "reference temperature gallons" actually is used. Suppose the actual fuel temperature is 82°F. and that competition has established $3.000 per U.S. gallon as the target retail price, meaning that it would cost a consumer $300 to purchase 100 U.S. gallons (or 23,100 cubic inches). As already demonstrated in ***Figures 4 and 16 through 18***, it would cost the same $300 to purchase 23,100 cubic inches of gasoline no matter which of the four "reference temperature gallons" had been adopted at the time and no matter the actual temperature – whether 30°F. or 100°F. or anywhere in between – of the fuel itself.

The "Hawaii example" and the "hot fuel" activists

It should not be surprising that Hawaii's well-known switch to a "80°F. Hawaiian reference standard gallon" likely had absolutely no effect on retail consumers' outlays for a given quantum of gasoline. As summarized in ***Figure 19***, the 234.19 cubic inch "Hawaiian gallon" would have been about 1.38 percent larger than a U.S. gallon. Maintaining the current hypothetical (rather than the retail prices that prevailed at the time of the actual imposition of the "Hawaiian gallon"), and continuing to assume that retailers sought to generate the same target sales revenue of $24,000, Hawaiian dealers would have had to raise their target pump prices by the same 1.38 percent to $3.041 per "gallon".

Figure 19.
A change to 80° "Hawaii gallons" affects the price per unit, not total outlays.

Change today from U.S. Gallons to 80° F. "Hawaii Gallons"						
	Unit of measurement for quantity sold	Size of quantity unit (cubic inches)	Total quantity units available for sale	Dealer's target total sales revenue	Resulting dealer target street price per unit	Total cost of 100 US gallons (23,100 cubic inches)
Before	U.S. Gallon	231.00	8,000.0	$24,000	$3.000	$300.00
After	*80° Gallon*	*234.19*	*7,891.1*		*$3.041*	*$300.00*
Change		*1.38%*			*1.38%*	*0.00%*

Nevertheless, the so-called "Hawaii example" remains a favorite of the "hot fuel" activists, having been prominently mentioned in the *Kansas City Star* series in late 2006[53] and taken up subsequently by other "hot fuel" activists.[54, 55] The *CEC Staff Report* cites the State of

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[53] Steve Everly, "Technology, New Rules Can Fix Hot-Fuel Issues," *Kansas City Star*, August 28, 2006, p. A1:

> OAHU, Hawaii | Idyllic weather, pounding surf and a warm, welcoming culture help make Hawaii unique in this nation.
> So does its gallon of gas.
> The Hawaiian gallon contains nearly 234 cubic inches of fuel – about three cubic inches more than is dispensed in the rest of the United States. The extra volume, required by state law, helps offset the hotter temperature in this tropical climate, which causes the gasoline to expand. If the gallon wasn't temperature-adjusted, Hawaiians would receive less energy per gallon than called for under the government standard. That's because for nearly a century, gasoline and diesel have been dispensed across America at a more-condensed 231 cubic inches – based on the assumption of a fuel temperature of 60 degrees.
> The larger Hawaiian gallon saves consumers in the state millions of dollars a year. But across the rest of America, consumers will lose an estimated $2.3 billion this year because of "hot" fuel. No other state adjusts for temperature fluctuations when dispensing fuel, including warm-weather states such as California, Texas and Florida, where drivers lose hundreds of millions of dollars a year.
> In fact, few consumers even realize that they're not getting what they pay for when they fill up at the pump. That's because no national law requires retail station owners to sell fuel at the government standard of 60 degrees, or use pumps that adjust to reflect the hotter fuel.
> That omission might seem odd, especially considering soaring gas prices and record oil industry profits. As Hawaii proved, states can take action to address the hot-fuel problem.

[54] Judy Dugan, "Californians Say Aloha (in the Bye-Bye Sense) to Their Savings – State Gasoline Price Tops Hawaii," *OilWatchdog*, March 17, 2008: http://www.oilwatchdog.org/articles/?storyId=19150

> Hawaii's retail gallon of gasoline is larger than in the rest of the U.S. because of the state's "hot fuel" law. Hawaii is warm year-round, and so is gasoline sold in the state, averaging over 80 degrees. Gasoline expands and loses energy as it heats up. Hawaii requires a gallon slightly more than 1% larger than the U.S. standard, a hypothetical "60-degree" gallon.
> "In reality, Hawaii's gasoline is more than a nickel cheaper than California's, because drivers are already getting four cents extra worth of gasoline in each gallon," said Dugan. "No wonder oil companies and marketers are so opposed to giving motorists in California and other warm states a fair measure of fuel by compensating for fuel temperature on retail sales."

Hawaii and George Mattimoe – its then Deputy Director of the Division of Weights and Measures – as early pioneers in the campaign to end the "hot fuel rip-off." This acclaim results from the belief that Hawaii and Mattimoe purportedly saved that state's motorists "millions of dollars"[56] by resetting retail pumps to dispense larger, "Hawaii gallons" of approximately 234 cubic inches of gasoline rather than statutory U.S. gallons of 231 cubic inches.[57]

The *CEC Staff Report* appears to accept these claims regarding Hawaii:

> Hawaii is the only state in the nation that has adopted a form of temperature compensation at retail outlets. This occurred when the state increase the size of their gallon from the U.S. standard of 231 cubic inches to a larger Hawaiian gallon of about 233 cubic inches.[58]

In implicit acknowledgment of the "Hawaii example", AB 868 directed the CEC to conduct a cost-benefit analysis of the possible establishment of a "different statewide reference temperature" for use in California. Pursuant to that direction, CEC staff apparently interviewed Mr. Mattimoe in connection with its consideration of the option of establishing a "California reference temperature" to be used as the basis retail sales in the state.[59]

The *CEC Staff Report* acknowledges the "input and support in the production of this report" provided by Mr. Mattimoe and the Hawaii Department of Weights and Measures,[60] and credits him for having spear-headed the campaign to have a standardized unit of measure adopted in Hawaii,[61] and for reducing the cost of fuel to Hawaiian consumers.[62]

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55 Statement of Joan Claybrook, President, *Public Citizen*, "Hot Fuel Means Big Rip-Off at Gasoline Pumps", December 14, 2006. http://www.citizen.org/pressroom/print_release.cfm?ID=2337 ("Since the 1970s, Hawaii has adjusted the standard volume of a gallon of gasoline to account for its warmer temperatures.…Ultimately, Congress needs to step in to protect consumers nationwide against hot fuel overcharges.")

56 Janos Gereben, "Technical Wizard Here Helps Us Save on Gas," *Honolulu Star-Bulletin*, November 18, 1975, p. A1.

57 The size of this "Hawaii gallon" was determined to be the volume of a net gallon at the average year-round temperature in Hawaii, 80°F.

58 *CEC Staff Report* at p. 1.

59 *CEC Staff Report* at pp. 11, 13-14.

60 *CEC Staff Report* at pp. i-ii.

61 *CEC Staff Report* at p. 13.

But the discussion in the *CEC Staff Report* also shows that the CEC staff failed to conduct an independent analysis of the historical record and data to verify the claims made by Mattimoe[63] and the "hot fuel" activists regarding the practical effect of imposing the "Hawaii gallon". Had it done so, the CEC staff would have discovered that the adoption of that unit of measure had no effect whatever on the retail cost of fuel to Hawaiian consumers.

What actually happened in Hawaii

The first thing that the CEC staff would have learned is that – rather than instituting the practice in 1974 as claimed by Mattimoe and others, "Hawaii has been making allowance for the expansion of gasoline in gasoline pumps since 1969,"[64] a time when retail gasoline prices likely were less than about 43.9 cents per gallon.[65, 66]

Figure 20 suggests that the adoption of the "Hawaii gallon" would have meant an increase of substantially less than one cent per gallon in 1969, given the prevailing retail price levels at the time. ***Figure 20*** incorporates the approximate retail price level that prevailed in Hawaii in 1969, and shows that the resulting impact on retail prices of the 1969 imposition of the "Hawaii gallon" would have amounted to about six-tenths of one cent per gallon when retailers' incorporated their higher wholesale cost per "gallon" into their pump prices.[67]

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62 *CEC Staff Report* at p. 14 ("Despite improving the situation and reportedly saving consumers money by having a higher reference temperature…")

63 Presentation of George E. Mattimoe, "Temperature Correction of Petroleum Products at Retail," *Report of the 59th National Conference on Weights and Measures 1974* (July 7-12, 1974) at pp. 166-181.

64 Janos Gereben, "Technical Wizard Here Helps Us Save on Gas," *Honolulu Star-Bulletin*, November 18, 1975, p. A1. Apparently, the 1969 change was implemented at the county (island) level by action of county commissioners. The effect of the 1974 action by the State of Hawaii was to codify the counties' practice into state law.

65 *Honolulu Star-Bulletin*, "Local Gasoline Prices Vary," May 19, 1968, p. D7.

66 *Honolulu Star-Bulletin*, "Third Firm Raises Price of Gasoline, April 23, 1970, p. A14.

67 While no specific reference to the impact of the 1969 adoption of the "Hawaii gallon" on retail prices can be located, it is reasonable to conclude that retailers did adjust their street prices to account for it. This inference is supported by the fact that retailers did raise their prices in response to other cost increases during the relevant period. See *Honolulu Star-Bulletin*, May 19, 1968 at p. D7 ("Local Gasoline Prices Vary"); April 1, 1970 at p. A5 ("Standard Hikes Price of Gasoline in Isles"); April 23,1970 at p. A14 ("Third Firm Raises Price of Gasoline"); and November 23, 1970 at p. B3 ("Standard Oil Stations Boost Gasoline 1 Cent").

Figure 20.
Adoption of the "Hawaii gallon" in 1969 increased target retail prices by 0.6¢.

Change in 1969 from U.S. Gallons to 80° F. "Hawaii Gallons"						
	Unit of measurement for quantity sold	**Size of quantity unit (cubic inches)**	**Total quantity units available for sale**	**Dealer's target total sales revenue**	**Resulting dealer target street price per unit**	**Total cost of 100 US gallons (23,100 cubic inches)**
Before	**U.S. Gallon**	**231.00**	**8,000.0**	**$3,500**	***$0.438***	**$43.75**
After	***80° Gallon***	***234.19***	***7,891.1***		***$0.444***	***$43.75***
Change		***1.38%***			***1.38%***	***0.00%***

A reasonable inference is that the adoption of the "Hawaii gallon" *did* lead to an increase in contemporaneous retail prices, but because the amount of the implied increase was so small and because it came at a time when Hawaiian retailers were increasing their pump prices in response to other cost increases, consumers did not take particular notice.[68]

Ironically, the best summary of the impact of adopting a new "reference temperature" is from Measurement Canada:

> Why was 15°C chosen as the reference temperature for ATC?
> The reference temperature of 15°C is a long-standing international standard used in most countries for the purchase and sale of petroleum products…
>
> Would using a different reference temperature save me money?
> ***No. The actual reference temperature used does not matter.*** In the sale of temperature compensated petroleum products, the volume is based on 15°C. This means that the consumer is paying for a 15°C litre at a 15°C price, no matter what the temperature of the product. If a different

68 In an interesting side note, while Mattimoe went to some lengths to redefine the unit of measure for use in retail fuel sales, no similar change was imposed on wholesale transactions in Hawaii. This is significant because at the time, such transactions were *not* compensated for temperature in any way. Consequently, Hawaiian retailers publicly complained that they were being unfairly treated following Mattimoe's initiative, because the gasoline they purchased at wholesale was not measured in "Hawaii gallons" or corrected in any way for expansion due to temperature, while at the same time they were required to dispense such gallons to their customers. See *Honolulu Star-Bulletin*, "Is Temperature Meter Necessary? Buying Gasoline a Heated Issue," August 5, 1981 at p. A3.

> reference temperature were chosen, the purchaser would still receive consistent amounts of product. ***However, a different price per litre would possibly be charged if a different reference temperature were used.***[69]

The adoption of automatic temperature compensation by Canadian retailers

As the *CEC Staff Report* appears to acknowledge,[70] the adoption in the mid-1990s of automatic temperature compensation by most Canadian retailers resulted from the particular circumstances in Canada at the time, and does not amount to "proof" of the "hypocrisy" of U.S. retailers.[71] Canadian consumers did not save – or lose – any money on their purchases of gasoline and diesel fuel following that change. But the Canadian adoption of automatic temperature compensation did generate considerable confusion and complaints that should serve as a cautionary warning to proponents of the *ATC Retrofit* in California.

The permissive legal framework and the specter of underground leaks

In the early and mid-1990s, Canadian retailers became particularly concerned about their liability for underground leaks from their storage tanks because their stations were not equipped with automatic tank monitoring systems that would enable them to track their inventories and to detect any leakage. A spate of negative coverage had appeared in the Canadian press at the time.[72] This created an opportunity for automatic temperature compensation because that technology would – as a byproduct – enable retailers to better track their underground inventory and to detect leaks.

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69 Measurement Canada, *Information Bulletin - Automatic Temperature Compensation and the Retail Sale of Gasoline and Diesel Fuel*, updated 2008-02-21 (emphases added). http://www.ic.gc.ca/epic/site/mc-mc.nsf/en/lm01094e.html.

70 *CEC Staff Report* at pp. 14-15.

71 See John Siebert, *OOIDA*, "Temperature Compensation at the Retail Pump," presentation before the Interim Meeting of the National Conference on Weights and Measures, January 22, 2007 ("I have two words for those who oppose temperature compensation at the retail pump: Canada… and CANADA!!!")

72 *Winnipeg Free Press*, "Buried fuel tanks raise alarm," July 12, 1993, A1; "Gas leaks [at Winnipeg service stations] spark merchants' anger," March 29, 1993, A1; "Gas stations clean contaminated soil," March 29, 1993, B1. See also *Halifax Chronicle Herald*, "Leaking gas tanks retailers' nightmare," April 6, 1993, pp. B1-2; *Calgary Herald*, "Gasoline leaks contaminating well water," April 22, 1994, A14; *Daily Commercial News*, "Buried gas tanks create quandary," September 7, 1994, pp. 1, 3; *Calgary Herald*, "Court orders Shell to pay $430,000 penalty; fines, damages assessed after water contaminated at service station," November 4, 1995, A3.

At the same time, Canadian law had been changed – at the urging of a would-be supplier of the necessary equipment – to allow individual retailers to voluntarily implement automatic temperature compensation in their dispensers.[73]

The temporary "first mover advantage" enjoyed by early adopters

More importantly, Canada's colder temperatures gave a "first mover advantage" to early adopters of ATC technology. This is illustrated by ***Figure 21***, which demonstrates that a retailer with ATC would have a significant tactical advantage over rivals who had not adopted ATC. The "early adopter" either could gain additional sales revenue by posting the same apparent price per liter as his rivals, or he could appear to post a lower price per liter while keeping his total sales revenue unchanged.

Figure 21.
"First mover" advantage for early adopter of ATC in "cold" climate.

Fuel temperature at 45° F.	***"First Mover"*** *(Installs ATC equipment)*				**Local Rival** (Does not install ATC)			
	Size of "gallon" (in cubic inches)	**Total "gallons" available for sale**	**Target retail price per "gallon"**	**Resulting total sales revenue**	**Size of "gallon" (in cubic inches)**	**Total "gallons" available for sale**	**Target retail price per "gallon"**	**Resulting total sales revenue**
Without ATC equipment	231.00	8,000.0	$3.000	$24,000	231.00	8,000.0	$3.000	$24,000
With ATC equipment ***Option 1*** (pump price "same" as Local Rival)	***228.61***	***8,083.7***	***$3.000***	***$24,251***				
or ***Option 2*** (pump price "below" Local Rival)	***228.61***	***8,083.7***	***$2.969***	***$24,000***				

That Canadian manufacturer of ATC equipment – Kraus Technology[74] – seized the opportunity created by the "first mover" advantage and the prospect of improved leak detection to actively pitch its ATC products to Canadian retailers as a way to boost profits.[75] Because of

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73 *CEC Staff Report* at p. 14.

74 Ironically, this is the same Kraus Technology on which the CEC staff relies for its estimates of the cost of the equipment needed to accomplish the *ATC Retrofit*.

75 Steve Everly, "Hot fuel for you means cold cash for big oil, retailers," *Kansas City Star*, August 27, 2006 at p. A1.

> Hans Kraus, who owned a company in Canada that supplied equipment to the petroleum industry, helped push the change [in Canadian law to permit voluntary adoption of automatic temperature compensation].. Kraus had produced a retrofit kit allowing temperature compensation at existing pumps, and he needed to market his

the competitive advantage gained by the first retailer to adopt ATC in a particular local area, rivals would be forced to follow suit or suffer competitively. When Kraus induced Texaco to implement it at all their stores, other retailers had no alternative but to follow suit.[76]

The resulting confusion and complaints among the Canadian public

As was explained and demonstrated earlier in this report, the adoption of automatic temperature compensation did not "save" Canadian consumers anything. But significantly, it actually generated a torrent of complaints and negative press accounts because the 15°C reference standard was warmer than the actual average Canadian temperature of 6°C, and in particular because motorists felt they were being "shorted" in cold weather.[77]

> gizmo. So he prepared a study showing that temperature compensation would make the industry money in Canada. The industry bought his pitch and pushed for a change in Canadian law.
> Today, sales material used by Kraus Global Products in Canada asserts that using fuel dispensers that don't adjust for temperature is an "inherently inaccurate" way to sell fuel. In one example, the sales material claims an Edmonton, Alberta, gas station could save $23,000 for every $1 million in fuel it sold.

[76] Written statement of Hugh Cooley, Shell Oil Company, before the Subcommittee on Domestic Policy of the House Committee on Oversight and Government Reform, July 25, 2007 at p. 3:

> My understanding is that the government of Canada approved temperature adjustment for retail gasoline fifteen years ago at the urging of the manufacturer of a temperature adjustment device. A few years later, some retailers began to temperature adjust, presumably to obtain a competitive advantage over other retailers as a result of their lowered unit cost. Once the trend became apparent, other retailers followed to avoid a competitive disadvantage.

[77] *Montreal Globe*, "Drivers will pay for unpumped gasoline," September 15, 1994, D3; *Toronto Star*, "Drivers face new squeeze at pump; new meters means less in your tank in winter but more in summer," September 15, 1994 at p. B1:

> Drivers will be paying millions at the pump for gasoline they're not getting. Service stations are installing sophisticated meters that apply a basic law of physics to your bill. Like all liquids and gases, gasoline expands when it's hot and contracts when it's cold. The new meters charge you as if the gasoline was at 15C, an international standard used for crude oil tanker loads. "That might be okay for South Carolina, but the average temperature here should be 5 degrees or less," said Ron Chalmers, who has spent $200,000 installing meters on the tanker trucks he uses to deliver fuel to Imperial Oil Ltd. outlets.

See also *The (Kitchener, Ontario) Record*, "The federal government aids and abets oil cartel," June 16, 1998, at p. A11:

> The oil industry's most eye-catching piece of robbery is the adjustment of gasoline pumps to take into account the fact that the volume of gasoline contracts as the temperature goes down. Unfortunately for consumers, the pumps are set to a temperature

Once the other retailers in an area were forced to follow suit by acquiring automatic temperature compensation equipment themselves, the first mover's competitive advantage would disappear. In the long run, the principal beneficiaries of the widespread adoption of ATC equipment were its manufacturers.

No savings by Canadian motorists after the adoption of ATC

Canadian motorists paid the same amount for a given quantity of fuel following the widespread adoption of automatic temperature compensation as they did prior to it, owing to the competitive market for retail fuel sales in Canada.

> of 15 C, although the average temperature in Canada is only 6 C. The effect is that most of the year, drivers are actually getting less gas than the pump indicates.

See also: *CBC Marketplace*, "Are we getting hosed at the pumps?" February 16, 1999. http://www.cbc.ca/consumers/market/files/cars/gasprice/index.html:

> At pumps across Canada, the price isn't always right.
>
> Most of us don't pay much attention when we're filling up. We may check the pump to verify the price and the number of litre we're paying for, but that's about it. But the next time you fill up, look for a little black sticker that says "this register has been volume corrected to 15 degrees Celsius."
>
> What does that mean?
>
> Well, the bottom line is, if it's colder than 15 degrees, you're getting less gas than you paid for.
>
> ...
>
> Critics say there's a problem with that method in Canada, because the temperature of gas is closer to the mean air temperature of our country, which is 6 degrees. And because of that, they say for most of the year, you're paying for gas you're not getting."
>
> "I think it's been a bit of a sneaky price increase by the major oil companies that's been inflicted on consumers," says Dave Collins of Wilsons Fuels, an independent retailer in Halifax, which operates 54 service stations Nova Scotia and New Brunswick. All but two of them sell gas which is *not* temperature compensated.
>
> "As a consumer you don't know that it's temperature compensating," Collins says. "The vast majority of Canadians can't make an informed choice. They believe that a litre is a litre is a litre."
>
> Mike Budded, with the Independent Retail Gasoline Marketers Association of Canada, in Toronto, agrees, and adds that "the problem as we see it is that an inappropriate temperature has been picked for compensation."

The <u>CEC Staff Report's</u> underestimate of the true cost of the proposed ATC Retrofit

It is highly likely that the estimates of the total costs associated with retrofitting each California retailer's dispensers to incorporate automatic temperature compensation are too low by a significant margin.

First, the *CEC Staff Report* has uncritically adopted cost estimates from Kraus Global, an obviously biased source with an apparent history of inducing governments to institute policy changes for which it turns out to be the principal beneficiary. Moreover, it does not appear that the Kraus estimates have been adjusted to reflect the price increases that likely would result if all California retailers tried to purchase and install retrofit kits simultaneously.

Nor is it obvious that individual retailers would be able to borrow the necessary capital at all, much less at the rates assumed by the *CEC Staff Report.*

As a matter of economics, it is unlikely that any retailers would want to "beat the rush" by implementing ATC ahead of any mandatory deadline. This is because – unlike the case in Canada with its colder temperatures – a California retailer who elected to be an "early adopter" of automatic temperature compensation would suffer a "first mover *disadvantage*", as shown in ***Figure 22***. This competitive disadvantage arises not just from the dealer's need to pay for the *ATC Retrofit* equipment. The more important cost – and competitive disadvantage – would be caused by the fact that he would be dispensing "larger" gallons than those pumped by his competitors following the retrofit. Thus he would face a choice between posting higher apparent retail prices per "gallon" than his local rivals (in order to maintain his target retail sales revenue) or sacrificing revenue by posting per-"gallon" prices that matched his competitors'.

Figure 22.
"First mover" <u>disadvantage</u> for early adopter of ATC in "warm" climate.

Fuel temperature at 75° F.	***"First Mover"*** *(Installs ATC equipment)*				**Local Rival** (Does not install ATC)			
	Size of "gallon" (in cubic inches)	**Total "gallons" available for sale**	**Target retail price per "gallon"**	**Resulting total sales revenue**	**Size of "gallon" (in cubic inches)**	**Total "gallons" available for sale**	**Target retail price per "gallon"**	**Resulting total sales revenue**
Without ATC equipment	231.00	8,000.0	$3.000	$24,000	231.00	8,000.0	$3.000	$24,000
With ATC equipment								
Option 1 (pump price "same" as Local Rival)	***233.39***	***7,918.0***	***$3.000***	***$23,754***				
or								
Option 2 (pump price "above" Local Rival)	***233.39***	***7,918.0***	***$3.031***	***???***				

Though it was available to the CEC staff, the *CEC Staff Report* takes no notice of the much higher estimate of the cost to implement automatic temperature compensation that was prepared by the State of Missouri.[78] If one scales the Missouri estimate of $341 million upward to reflect the ratio between the number of retail stores in California compared to Missouri, the result suggests that it would cost over $700 million – rather than the $102 to $123 million figure arrived at by the CEC staff[79] – to accomplish the *ATC Retrofit*.

Nor does the *CEC Staff Report* recognize two additional respects in which it likely has overlooked the true financial cost of its proposed *ATC Retrofit*:

First, as discussed earlier in this paper, it is reasonable as a matter of economics to expect that retail prices could increase by *more* than average retailer's costs associated with the *ATC Retrofit*, owing to the greater proportionate burden that such costs would represent for the smaller-volume retailers who would be the marginal retail suppliers following that retrofit.

Second, the *CEC Staff Report* underestimates the effect that the ATC Retrofit would have on retail prices if some retailers were forced to withdraw from the market rather than incur the expense needed to remain in business. The CEC staff appears to believe that such withdrawals would be of concern only if they occurred in "isolated communities". As a matter of economics, this is incorrect; economists have documented the fact that reductions in the density of retail stores lead to increased retail prices, all else constant, no matter where they occur.

How competition adjusts retail prices to account for seasonal temperature variation.

Like the "hot fuel" allegations themselves, the consumer benefits anticipated by the *CEC Staff Report* upon implementation of the *ATC Retrofit* evaporate if it should be the case that retail competition *already* adjusts retail prices for seasonal variations in fuel temperature. As demonstrated in this section, the discipline imposed on retailers by the need to be able to pay for their wholesale deliveries of fuel, to cover their other costs of doing business and to earn a competitive return – combined with unrelenting competition from rival retailers – forces price adjustments that compensate for the average temperature-induced expansion of motor fuel volumes in local competitive areas.

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[78] That 2006 estimate – $341 million – was reported by the U.S. Government Accountability Office in its September 2008 report *Stakeholder Views on Compensating for the Effects of Gasoline Temperature in Volume at the Pump* (GAO-08-1114) at p. 18. The State of Missouri has not offered any details about how that estimate was constructed.

[79] *CEC Staff Report* at p. 4.

In short, the absence of overt temperature-compensation technology at the retail level does *not* mean that retail prices are not adjusted for the temperature-induced expansion (and contraction) in fuel volume. The fact that it is *market competition* from other retailers that forces the appropriate adjustment – and that dealers themselves do not consciously and explicitly change their pump prices to achieve this result – does not change the essential fact that retail pump prices already *are* adjusted for seasonal temperature variation.

Where the *ATC Retrofit* would compensate for the temperature-induced expansion in fuel volumes by, in effect, varying the *size* of each dispensed "gallon" as fuel temperatures vary, retail competition achieves equivalent compensation by adjusting the *price* of each 231-cubic-inch gross gallon dispensed by retail pumps.[80] The practical result is that a consumer's total outlay for a specific quantum of fuel (measured, say, in net gallons) would be identical using either method. The important difference is that adjustment for temperature variation through retail competition is already in place and effective at zero incremental cost, compared to the hundreds of millions of dollars that would be required to accomplish the *ATC Retrofit*. Because of this, the imposition of the *ATC Retrofit* on California retailers would not generate any additional benefits for California motorists, even though it inevitably would saddle them with higher prices for gasoline and diesel fuel.

Because it is market competition, rather than explicit deliberation and calculation by each dealer that forces the necessary adjustments, anyone looking for the specific notes and calculations by which individual retailers determined the appropriate changes in their pump prices will do so in vain. This is because the mechanism at work is a practical illustration of Adam Smith's "invisible hand".[81]

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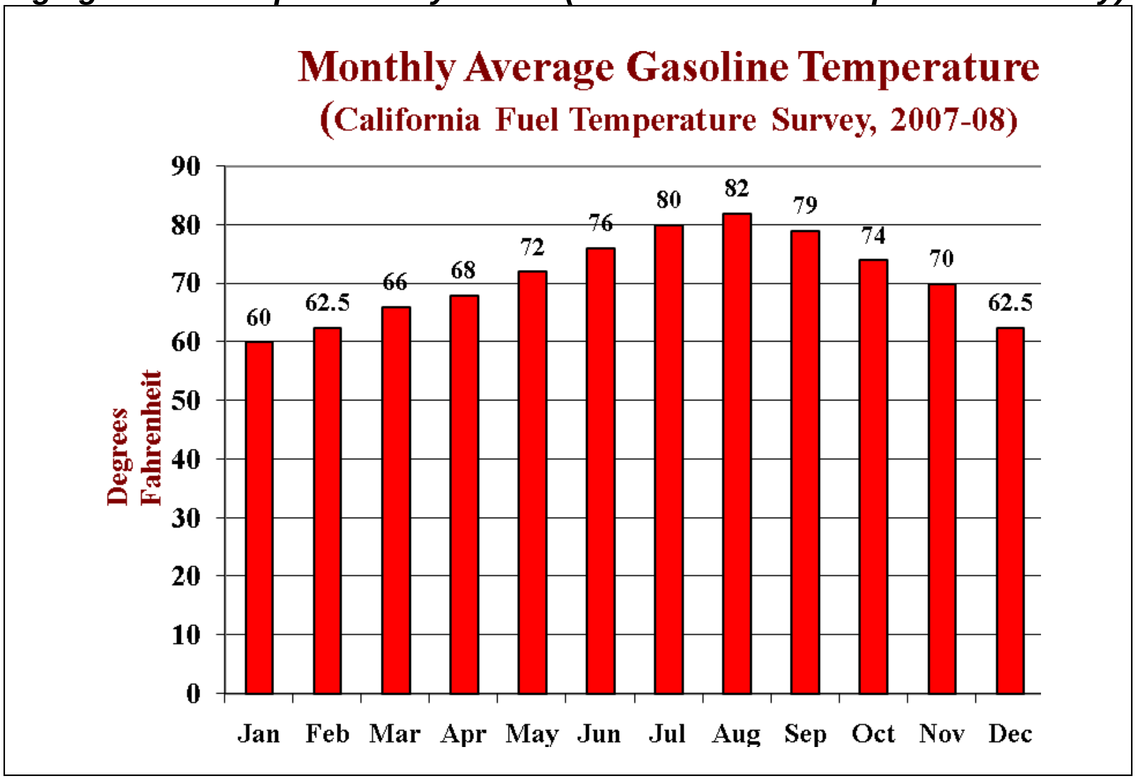
80 Automatic temperature compensation explicitly varies the *volume* of each dispensed "gallon" in proportion to the expansion induced by temperature changes, while keeping constant the posted price per *net* gallon. Retail competition, on the other hand, keeps constant the volume of each *gross* gallon dispensed (at 231 cubic inches) but induces dealers to adjust their pump prices as average fuel temperatures vary with the seasons.

81 Adam Smith, *The Wealth of Nations*, Volume IV Chapter II, Modern Library edition, pp. 484-485 (emphases added):

> As every individual…endeavors as much he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of greatest value; every individual necessarily labors to render the annual revenue of the society as great as he can. He generally…neither intends to promote the public interest, nor knows how much he is promoting it.…[B]y directing that industry in such a manner as its produce may be of the greatest value, he intends only own gain, and *he is in this, as in many other cases, led by an **invisible hand** to promote an end which was no part of his intention*. Nor is it always the worse for the society that it was not part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it. I have never known much good done by those who affected to trade for the public good. It is an

So how does retail competition induce – indeed, *force* – retailers to adjust their pump prices to compensate for temperature-induced changes in fuel volume? The explanation – which requires only that the retailer operate in a competitive market[82] with knowledge of how much sales revenue he needs to generate and how many (gross) gallons he has available to sell[83] in order to try to achieve that target revenue – is illustrated in the following series of figures that are based on the monthly California-wide average retail gasoline temperatures shown in ***Figure 23*** derived from the *California Fuel Temperature Survey*[84] and on the assumption that the hypothetical retailer receives and sells a single load of 8,000 gallons of gasoline each month.

Figure 23.
Average gasoline temperature by month (California Fuel Temperature Survey).



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affectation…not very common among merchants, and very few words need to be employed in dissuading them from it.

82 *CEC Staff Report* at p. 72.

83 Dealers have access to this information through their tank monitoring systems. See *California Fuel Temperature Survey*, Presentation by Ken Lake, California Division of Measurement Standards, CEC Staff Workshop, March 4, 2008 at slides 3-4.

84 *CEC Staff Report*, Figure 10 at p. 37.

Month-by-month illustration of how competition makes the adjustment

Start with ***Figure 24*** that assumes that the retailer takes wholesale delivery of 8,000 gallons of gasoline in January and that the temperature of that gasoline is 60°F. As a result, the delivery measures an identical 8,000 gallons, regardless of whether it is measured in net or gross terms. Assume that the dealer paid $2.875 per net gallon, so that the total wholesale cost of the delivered fuel is $23,000. Assume further that the dealer's target retail margin – from which he must pay the other expenses associated with his business and generate a profit sufficient to justify remaining in business – is $1,000 (or 12.5 cents per gross gallon). So in order to pay for the wholesale delivery of gasoline and achieve his target margin, he must try to generate total retail revenue of $24,000. Using simple arithmetic, it follows that he must try to achieve a (target) pump price of $3.000 per gallon (both net and gross).

Figure 24.
How retail competition adjusts for the effect of temperature on fuel volume—JANUARY.

Month	Total GROSS gallons received	Fuel temp (F.)	Total NET gallons availabl e for resale	Wholesale price per NET gallon	Cost to retailer of delivered fuel	Wholesale price per GROSS gallon	Target dealer margin	Target sales revenue	Target retail price per NET gallon	Target retail price per GROSS gallon	Differenc e in target GROSS price relative to January
January	*8,000.0*	***60.0***	***8,000.0***	$2.875	$23,000	$2.875	$1,000	***$24,000***	$3.000	***$3.000***	
February											
March											
April											
May											
June											
July											
August											
September											
October											
November											
December											

Next, consider the retailer's situation in February upon receipt of another delivery of 8,000 gross gallons of gasoline, shown in ***Figure 25***. Since the temperature of this fuel is a somewhat warmer 62.5°F., that delivery yields only 7986.2 net gallons. At an unchanged wholesale price of $2.875 per net gallon, the wholesale cost of this delivery is $22,960.33. Add to that the dealer's target margin of $1,000 (8,000 gross gallons x $0.125), and one determines that the dealer's sales revenue target is $23,960. When the dealer divides this target sales revenue figure by the number of gross gallons he has in inventory and available for sale, he realizes that he can achieve his target revenue with a pump price of $2.995 per gallon, *a decrease of half a cent per gallon from his target price in January*. In other words, market competition has led the dealer to decrease his target retail price by 0.17 percent (or $.005) because temperature-induced fuel expansion caused the volume occupied by net gallon to increase by the same 0.17 percent (or 0.398 cubic inches).

Figure 25.
How retail competition adjusts for the effect of temperature on fuel volume—FEBRUARY.

Month	Total GROSS gallons received	Fuel temp (F.)	Total NET gallons available for resale	Wholesale price per NET gallon	Cost to retailer of delivered fuel	Wholesale price per GROSS gallon	Target dealer margin	Target sales revenue	Target retail price per NET gallon	Target retail price per GROSS gallon	Difference in target GROSS price relative to January
January	*8,000.0*	***60.0***	***8,000.0***	$2.875	$23,000	$2.875	$1,000	***$24,000***	$3.000	***$3.000***	
February	*8,000.0*	***62.5***	***7,986.2***	$2.875	$22,960	$2.870	$1,000	***$23,960***	$3.000	***$2.995***	***– 0.5¢***
March											
April											
May											
June											
July											
August											
September											
October											
November											
December											

But notice that the dealer's target retail price per *net* gallon did *not* change. In January, the target retail revenue of $24,000 was distributed over 8,000 net gallons, yielding a target retail price of $3.000 per net gallon. In February, the dealer's target revenue of $23,958.60 was distributed over 7,986.2 net gallons, again resulting in a target pump price of $3.000 per net gallon.

Next (shown in ***Figure 26***) comes March, with a still warmer fuel temperature of 66.0°F. Now the delivery of 8,000 gross gallons corresponds to just 7,966.9 net gallons, which – at an unchanged wholesale price of $2.875 per net gallon – costs the dealer $22,905 in total. When his target margin of $1,000 is added to the wholesale cost of the fuel itself, the dealer's sales revenue target becomes $23,905. Dividing that figure by the 8,000 gross gallons available for sale from his inventory, the dealer determines that his target retail price per gross gallon needs to be $2.988, or *1.2 cents less per gallon* than was his target in January.[85]

[85] As a net gallon has expanded by 0.41 percent since January, the dealer's target street price per *gross* gallon has fallen by 0.41 percent. However, his target retail price per *net* gallon remains constant at $3.000.

Figure 26.
How retail competition adjusts for the effect of temperature on fuel volume—MARCH.

Month	Total GROSS gallons received	Fuel temp (F.)	Total NET gallons available for resale	Wholesale price per NET gallon	Cost to retailer of delivered fuel	Wholesale price per GROSS gallon	Target dealer margin	Target sales revenue	Target retail price per NET gallon	Target retail price per GROSS gallon	Difference in target GROSS price relative to January
January	8,000.0	60.0	8,000.0	$2.875	$23,000	$2.875	$1,000	$24,000	$3.000	$3.000	
February	8,000.0	62.5	7,986.2	$2.875	$22,960	$2.870	$1,000	$23,960	$3.000	$2.995	– 0.5¢
March	8,000.0	66.0	7,966.9	$2.875	$22,905	$2.863	$1,000	$23,905	$3.000	$2.988	– 1.2¢
April											
May											
June											
July											
August											
September											
October											
November											
December											

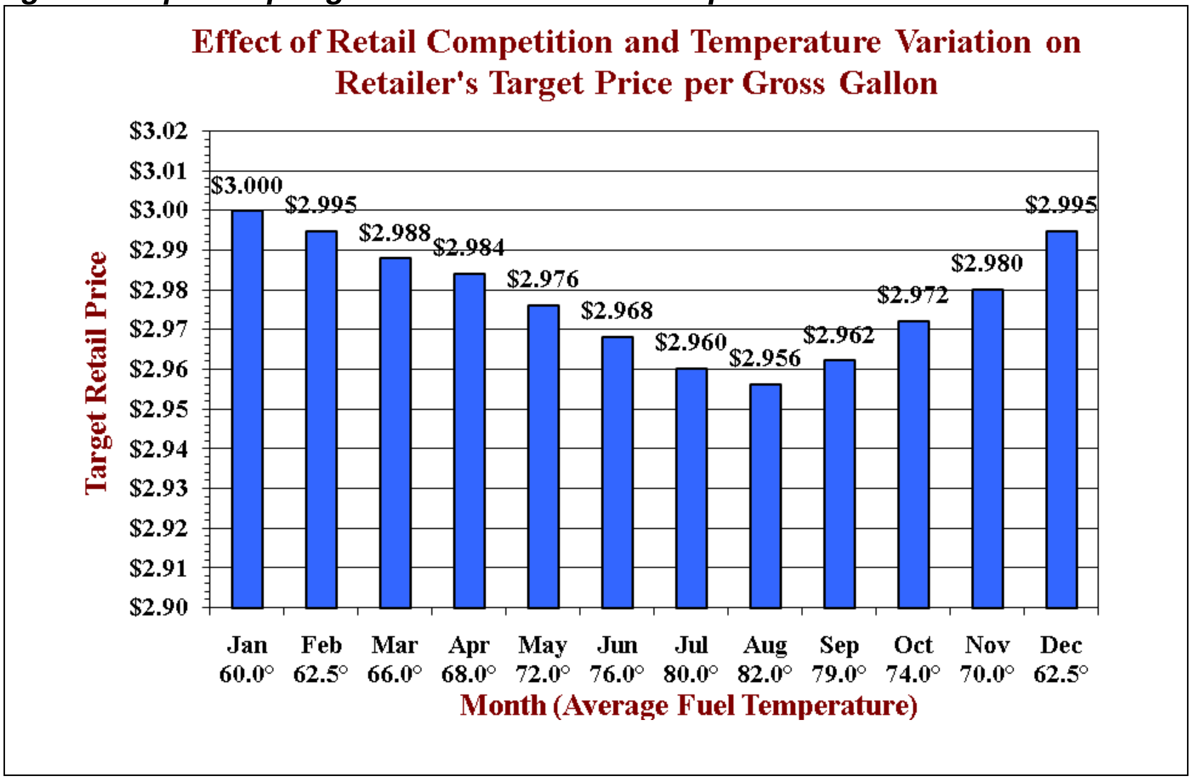
Repeating this process for each of the remaining nine calendar months, as depicted in ***Figure 27***, shows that as the fuel temperature continues to rise in the months from April through August, the dealer's target retail price per gross gallon declines, reaching $2.956 in August when the fuel temperature reaches its maximum value of 82°F. This is a 4.4 cent per gallon reduction from the January target retail price of $3.000 per gross gallon. Thereafter, as fuel temperatures ebb with the cooling weather, the dealer's target retail price per gallon increases, reaching $2.995 per gross gallon in December. The month-by-month target retail prices that result from this process are shown in ***Figure 28***.

Figure 27.
How retail competition adjusts for the effect of temperature on fuel volume—ENTIRE YEAR.

Month	Total GROSS gallons received	Fuel temp (F.)	Total NET gallons available for resale	Wholesale price per NET gallon	Cost to retailer of delivered fuel	Wholesale price per GROSS gallon	Target dealer margin	Target sales revenue	Target retail price per NET gallon	Target retail price per GROSS gallon	Difference in target GROSS price relative to January
January	8,000.0	60.0	8,000.0	$2.875	$23,000	$2.875	$1,000	$24,000	$3.000	$3.000	
February	8,000.0	62.5	7,986.2	$2.875	$22,960	$2.870	$1,000	$23,960	$3.000	$2.995	– 0.5¢
March	8,000.0	66.0	7,966.9	$2.875	$22,905	$2.863	$1,000	$23,905	$3.000	$2.988	– 1.2¢
April	8,000.0	68.0	7,955.8	$2.875	$22,873	$2.859	$1,000	$23,873	$3.000	$2.984	– 1.6¢
May	8,000.0	72.0	7,933.8	$2.875	$22,810	$2.851	$1,000	$23,810	$3.000	$2.976	– 2.4¢
June	8,000.0	76.0	7,911.7	$2.875	$22,746	$2.843	$1,000	$23,746	$3.000	$2.968	– 3.2¢
July	8,000.0	80.0	7,889.6	$2.875	$22,683	$2.835	$1,000	$23,683	$3.000	$2.960	– 4.0¢
August	8,000.0	82.0	7,878.6	$2.875	$22,651	$2.831	$1,000	$23,651	$3.000	$2.956	– 4.4¢
September	8,000.0	79.0	7,895.1	$2.875	$22,698	$2.837	$1,000	$23,698	$3.000	$2.962	– 3.8¢
October	8,000.0	74.0	7,922.7	$2.875	$22,778	$2.847	$1,000	$23,778	$3.000	$2.972	– 2.8¢
November	8,000.0	70.0	7,944.8	$2.875	$22,841	$2.855	$1,000	$23,841	$3.000	$2.980	– 2.0¢
December	8,000.0	62.5	7,986.2	$2.875	$22,960	$2.870	$1,000	$23,960	$3.000	$2.995	– 0.5¢

The key result is this: Viewed over an entire year, in which monthly fuel temperatures vary as shown in ***Figure 23***, retail competition leads to adjustments in dealers' target pump prices per gross gallon (summarized in ***Figure 28***) that exactly offset the temperature-induced expansion in fuel volume.

Figure 28.
Target retail prices per gallon fall as the fuel temperature increases.



Consequently, it makes no difference whether these transactions are conducted in terms of *net* gallons or *gross* gallons, insofar as a motorist's total annual outlay for gasoline (measured in net gallons) is concerned. This is shown in ***Figure 29***, which starts by assuming that a consumer purchases the equivalent of 100 net gallons each month, for an annual total of 1,200 net gallons. At a retail price of $3.000 per net gallon, the consumer's total annual outlay is $3,600. But as shown in ***Figure 29***, as the fuel temperature and volume increase, it requires a greater number of gross gallons to deliver the same 100 net gallons each month. But ***Figure 29*** also demonstrates that the consumer's total outlay will *not* increase, because retail competition induces an exactly offsetting decrease in a retailer's target pump price per gross gallon.

Figure 29.
A consumer's outlay is the same no matter whether net or gross units are used.

Month	Fuel temp (F.)	Total NET gallons purchased	Dealer's target retail price per NET gallon	Total cost of 100 NET gallons to consumer	GROSS equivalent of 100 NET gallons	Dealer's target retail price per GROSS gallon	Total cost of GROSS equivalent of 100 NET gallons
January	*60.0*	*100.00*	*$3.00*	*$300*	*100.00*	*$3.000*	*$300*
February	*62.5*	*100.00*	*$3.00*	*$300*	*100.17*	*$2.995*	*$300*
March	*66.0*	*100.00*	*$3.00*	*$300*	*100.41*	*$2.988*	*$300*
April	*68.0*	*100.00*	*$3.00*	*$300*	*100.55*	*$2.984*	*$300*
May	*72.0*	*100.00*	*$3.00*	*$300*	*100.83*	*$2.976*	*$300*
June	*76.0*	*100.00*	*$3.00*	*$300*	*101.10*	*$2.968*	*$300*
July	*80.0*	*100.00*	*$3.00*	*$300*	*101.38*	*$2.960*	*$300*
August	*82.0*	*100.00*	*$3.00*	*$300*	*101.52*	*$2.956*	*$300*
September	*79.0*	*100.00*	*$3.00*	*$300*	*101.31*	*$2.962*	*$300*
October	*74.0*	*100.00*	*$3.00*	*$300*	*100.97*	*$2.972*	*$300*
November	*70.0*	*100.00*	*$3.00*	*$300*	*100.69*	*$2.980*	*$300*
December	*62.5*	*100.00*	*$3.00*	*$300*	*100.17*	*$2.995*	*$300*
TOTAL		*1,200.00*		*$3,600*	*1209.11*		*$3,600*

The preceding illustrations are based on the assumption that the retailer takes delivery of 8,000 *gross* gallons each month. However, as shown in ***Figure 30***, nothing of substance would change if it were assumed instead that these wholesale deliveries consist of 8,000 *net* gallons at $2.875 per *net* gallon and that the dealer's target margin is $0.125 per *net* gallon. The dealer's target retail price per *gross* gallon would still vary inversely with the average fuel temperature.

Figure 30.
Nothing changes if it is assumed that wholesale deliveries and dealer margins are in net gallons.

Month	Total GROSS gallons received	Fuel temp (F.)	Total NET gallons available for resale	Wholesale price per NET gallon	Cost to retailer of delivered fuel	Wholesale price per GROSS gallon	Target dealer margin per NET gallon	Target sales revenue	Target retail price per NET gallon	Target retail price per GROSS gallon	Difference in target GROSS price relative to January
January	8,000.0	60.0	8,000	$2.875	$23,000	$2.875	$1,000	$24,000	$3.000	$3.000	
February	8,013.8	62.5	8,000	$2.875	$23,000	$2.870	$1,000	$24,000	$3.000	$2.995	– 0.5¢
March	8,033.1	66.0	8,000	$2.875	$23,000	$2.863	$1,000	$24,000	$3.000	$2.988	– 1.2¢
April	8,044.2	68.0	8,000	$2.875	$23,000	$2.859	$1,000	$24,000	$3.000	$2.984	– 1.6¢
May	8,066.2	72.0	8,000	$2.875	$23,000	$2.851	$1,000	$24,000	$3.000	$2.975	– 2.5¢
June	8,088.3	76.0	8,000	$2.875	$23,000	$2.844	$1,000	$24,000	$3.000	$2.967	– 3.3¢
July	8,110.4	80.0	8,000	$2.875	$23,000	$2.836	$1,000	$24,000	$3.000	$2.959	– 4.1¢
August	8,121.4	82.0	8,000	$2.875	$23,000	$2.832	$1,000	$24,000	$3.000	$2.955	– 4.5¢
September	8,104.9	79.0	8,000	$2.875	$23,000	$2.838	$1,000	$24,000	$3.000	$2.961	– 3.9¢
October	8,077.3	74.0	8,000	$2.875	$23,000	$2.847	$1,000	$24,000	$3.000	$2.971	– 2.9¢
November	8,055.2	70.0	8,000	$2.875	$23,000	$2.855	$1,000	$24,000	$3.000	$2.979	– 2.1¢
December	8,013.8	62.5	8,000	$2.875	$23,000	$2.870	$1,000	$24,000	$3.000	$2.995	– 0.5¢

It also is important to notice what was *not* required in these illustrations. In particular, it was not required that a retailer start with a target pump price per net gallon (presumably, some markup over his wholesale price per net gallon), then measure the actual temperature of the fuel in his inventory, next perform the calculations to determine the increased volume of his net gallons beyond 231 cubic inches, and finally make the appropriate arithmetic adjustment to his preliminary target street price per net gallon, all in order to arrive at the actual price per gross gallon to be posted on his pumps. All the retailer actually needed to know was how many gross gallons he had in inventory, how much he paid for that inventory, and what gross margin he needed to seek in order to cover his other costs of doing business and to earn a competitive profit. Retail competition then led the retailer to make the appropriate adjustments to his target street price.

No "excess federal and state motor fuel taxes" are collected

Using this same analytical approach, it is straightforward to dispose of the charge by "hot fuel" activists that dealers "generate hidden profits" by overcharging their retail customers for federal and state motor vehicle fuel taxes.[86] The activists' argument goes like this: Retailers purchase wholesale inventory – and pay applicable federal and state motor vehicle fuel taxes – on the basis of the net gallons delivered by the supplier. However, when these same retailers sell that fuel to their retail customers at higher temperatures, they sell more gallons than they

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86 *Kansas City Star*, "Loophole enhances 'hot fuel' profits," November 12, 2006 http://www.kansascity.com/128/v-print/story/38819.html; "Second Consolidated Amended Complaint, *In re: Motor Fuel Temperature Sales Practices Litigation*, filed December 1, 2008 in U.S. District Court for the District of Kansas at pp. 4, 19-22, 32-33; and *Public Citizen*, "Fact Sheet on Hot Fuel", December 14, 2006.
http://www.citizen.org/cmep/energy_enviro_nuclear/electricity/Oil_and_Gas/articles.cfm?ID=16025

purchased at wholesale and on which their own federal and state fuel tax liabilities were calculated. Yet retailers require consumers to pay motor vehicle fuel taxes on these extra gallons, even though this results in more tax revenue than the retailers had to pay at the time of their wholesale purchases. The difference is undeserved profit to these retailers.

Figure 31.
Competition also adjusts the fuel taxes collected per gross gallon as the temperature changes.

Month	Total GROSS gallons received	Fuel temp (F.)	Total NET gallons purchased by retailer	Motor fuel taxes paid per NET gallon by dealer	Wholesale price per NET gallon less fuel taxes	Cost to retailer of delivered fuel	Target sales revenue	Target retail price per GROSS gallon (total)	Target retail price per GROSS gallon (net of fuel taxes)	Target fuel taxes per GROSS gallon	Differenc e in fuel taxes per GROSS gallon relative to January
January	*8,000.0*	***60.0***	***8,000.0***	***$0.378***	$2.497	$23,000	***$24,000***	***$3.000***	***$2.622***	***$0.378***	
February	*8,000.0*	***62.5***	***7,986.2***	***$0.378***	$2.497	$22,960	***$23,960***	***$2.995***	***$2.618***	***$0.377***	***– 0.1¢***
March	*8,000.0*	***66.0***	***7,966.9***	***$0.378***	$2.497	$22,905	***$23,905***	***$2.988***	***$2.612***	***$0.376***	***– 0.2¢***
April	*8,000.0*	***68.0***	***7,955.8***	***$0.378***	$2.497	$22,873	***$23,873***	***$2.984***	***$2.608***	***$0.376***	***– 0.2¢***
May	*8,000.0*	***72.0***	***7,933.8***	***$0.378***	$2.497	$22,810	***$23,810***	***$2.976***	***$2.601***	***$0.375***	***– 0.3¢***
June	*8,000.0*	***76.0***	***7,911.7***	***$0.378***	$2.497	$22,746	***$23,746***	***$2.968***	***$2.594***	***$0.374***	***– 0.4¢***
July	*8,000.0*	***80.0***	***7,889.6***	***$0.378***	$2.497	$22,683	***$23,683***	***$2.960***	***$2.588***	***$0.373***	***– 0.5¢***
August	*8,000.0*	***82.0***	***7,878.6***	***$0.378***	$2.497	$22,651	***$23,651***	***$2.956***	***$2.584***	***$0.372***	***– 0.6¢***
September	*8,000.0*	***79.0***	***7,895.1***	***$0.378***	$2.497	$22,698	***$23,698***	***$2.962***	***$2.589***	***$0.373***	***– 0.5¢***
October	*8,000.0*	***74.0***	***7,922.7***	***$0.378***	$2.497	$22,778	***$23,778***	***$2.972***	***$2.598***	***$0.374***	***– 0.4¢***
November	*8,000.0*	***70.0***	***7,944.8***	***$0.378***	$2.497	$22,841	***$23,841***	***$2.980***	***$2.605***	***$0.375***	***– 0.3¢***
December	*8,000.0*	***62.5***	***7,986.2***	***$0.378***	$2.497	$22,960	***$23,960***	***$2.995***	***$2.618***	***$0.377***	***– 0.1¢***

Figure 31 is the same as earlier ***Figure 27***, except that it explicitly breaks out the $0.378 in motor fuel taxes per net gallon[87] that were included in the $2.875 per net gallon collected by the wholesale supplier. The key results are in the three rightmost columns: Just as before, the dealer's target retail price per gross gallon decreases as the fuel temperature increases. But ***Figure 31*** also shows that the dollar amount of the U.S. and California fuel taxes per gross gallon also declines as the fuel warms. In January – with the fuel temperature at 60°F. – the retailer's target pump price of $3.000 per gross gallon includes 37.8 cents in taxes. But in each succeeding month, as the fuel temperature increases, the amount of fuel taxes collected with each gross gallon sold decreases, falling to 37.2 cents per gallon in August when the fuel temperature peaks at 82.0°F. If one assumes that a consumer purchases the equivalent of 100 net gallons per month, the adjustments to the dollar amount of fuel taxes collected per gross gallon that are summarized in ***Figure 31*** insure that the consumer pays no more and no less than $37.80 each month in federal and state fuel taxes, regardless of the fuel temperature. This is shown in
Figure 32.

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87 The sum of $0.180 federal, $0.183 California and $0.015 underground storage tank taxes per gallon.

Figure 32.
Fuel taxes paid by consumer per net gallon remain constant.

Month	Fuel temperature (F.)	Total NET gallons purchased	Fuel taxes paid by consumer per NET gallon	Total fuel taxes paid by consumer per 100 NET gallons	GROSS equivalent of 100 NET gallons	Dealer's target fuel taxes per GROSS gallon	Total taxes collected per GROSS equivalent of 100 NET gallons
January	*60.0*	*100.00*	*$0.378*	*$37.80*	*100.00*	*$0.378*	*$37.80*
February	*62.5*	*100.00*	*$0.378*	*$37.80*	*100.17*	*$0.377*	*$37.80*
March	*66.0*	*100.00*	*$0.378*	*$37.80*	*100.41*	*$0.376*	*$37.80*
April	*68.0*	*100.00*	*$0.378*	*$37.80*	*100.55*	*$0.376*	*$37.80*
May	*72.0*	*100.00*	*$0.378*	*$37.80*	*100.83*	*$0.375*	*$37.80*
June	*76.0*	*100.00*	*$0.378*	*$37.80*	*101.10*	*$0.374*	*$37.80*
July	*80.0*	*100.00*	*$0.378*	*$37.80*	*101.38*	*$0.373*	*$37.80*
August	*82.0*	*100.00*	*$0.378*	*$37.80*	*101.52*	*$0.372*	*$37.80*
September	*79.0*	*100.00*	*$0.378*	*$37.80*	*101.31*	*$0.373*	*$37.80*
October	*74.0*	*100.00*	*$0.378*	*$37.80*	*100.97*	*$0.374*	*$37.80*
November	*70.0*	*100.00*	*$0.378*	*$37.80*	*100.69*	*$0.375*	*$37.80*
December	*62.5*	*100.00*	*$0.378*	*$37.80*	*100.17*	*$0.377*	*$37.80*
TOTAL		*1,200.00*		*$453.60*	*1209.11*		*$453.60*

Monte Carlo simulation of repeated retail purchases in the context of cross-sectional temperature variations.

The preceding section showed how retail competition adjusts pump prices for the expansion in fuel volumes induced by seasonal changes in average fuel temperatures. But "hot fuel" activists are also alarmed by temperature differences in the fuel being sold at the same point in time from different retailers in the same local area.[88]

88 Letter to the California Energy Commission from Judy Dugan, The Foundation for Taxpayer and Consumer Rights (FTCR) and oilwatchdog.org, February 8, 2008 ("The presentation by Henry Opperman at the open meeting Jan. 28 showed that, even in a small sample, stations within blocks of one another had gasoline temperature variations of up to 10 degrees F."); "Consumer's View of Mr. Ross Anderson's 'Comments on Fuel Deliver and [sic] Temperature Study," comments submitted to the California Energy Commission by John Siebert, Owner Operator independent Drivers Association, February 29, 2008 ("[T]he issue facing consumers is between buying only gross gallons in a market where fuel temperatures can vary 15 to 20 degrees within a five block area. Henry Opperman shared a fuel temperature map of Topeka, Kansas, at the NCWM interim meeting which illustrates this well.")

In this section, I will show how a motorist's repeated purchases – over, say, a calendar year – are sufficient to protect against what is termed *cross-sectional variation* in fuel temperature in that motorist's local area.

Data on cross-sectional temperature variations.

Because of limitations in its design and execution, the *California Fuel Temperature Survey* did not gather the sort of data that would be needed to analyze this phenomenon in California. Consequently, the demonstration that follows is based on cross-sectional observations drawn from retailers located within approximately five miles of the center of Topeka, Kansas.[89] These data, consisting of 48 observations gathered on four separate occasions in 2007 and presented to the National Conference on Weights and Measures in 2008,[90] are summarized in ***Figure 33***.[91] For each observation, the statistic of interest is its deviation from the prevailing average (or mean) fuel temperature, because the possibility of such deviations are the basis for the concerns expressed by activists. When each actual observation is replaced by its deviation from the mean, it becomes feasible to aggregate all 48 observations into a single "meta-sample" of deviations from the mean of Topeka-area fuel temperatures.[92, 93]

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[89] Not "within *blocks* of one another" or "within a five *block* area", as claimed by Ms. Dugan and Mr. Siebert respectively.

[90] Henry Oppermann, "Temperature Data from Weights and Measures Programs," Presentation at the NCWM Interim Meeting, January 28, 2008, slides 12-15.

[91] Nineteen measurements with a mean temperature of 50.6°F. were obtained during the January 8-12, 2007 period, followed by six observations each on April 16 and April 23, 2007 (with mean temperatures of 54.4° and 59.0°, respectively), and with seventeen more readings gathered during the December 4-8, 2007 interval (with a mean of 50.6°F.). One apparently anomalous observation taken in December 2007 (with a reported fuel temperature of 32.7°F.) was omitted from my analysis because it was nearly 10 degrees colder than the next coldest measurement. This omission had no material effect on the results reported in this paper.

[92] It should be noted that the *range* in fuel temperatures at one point in time (calculated as the arithmetic difference between the warmest and coldest measurements) is of less interest. A hypothetical consumer would not face a choice between only the warmest and coldest fuel in the area; she could also randomly select from among any of the intermediate fuel temperatures available at the time.

[93] Since it is the *deviations* from the prevailing average fuel temperature – and not the temperatures themselves – that are of interest, it makes no particular difference that these 48 observations were recorded during relatively "cold" months.

Figure 33.
Fuel temperatures in the vicinity of Topeka, KS reported by Henry Oppermann.

January 8-12, 2007 (Mean = 50.6° F.)			April 16, 2007 (Mean = 54.4° F.)			April 23, 2007 (Mean = 59.0° F.)			December 4-8, 2007 (Mean = 50.6° F.)		
Obs no	*Temp*	***Devn***	*Obs no*	*Temp*	***Devn***	*Obs no*	*Temp*	*Dev*	*Obs no*	*Temp*	***Devn***
1	58.8	***8.2***	20	59.5	***5.1***	26	66.0	***7.0***	32	55.9	***5.3***
2	55.4	***4.8***	21	58.8	***4.4***	27	61.2	***2.2***	33	54.9	***4.3***
3	54.7	***4.1***	22	54.5	***0.1***	28	59.9	***0.9***	34	54.9	***4.3***
4	54.1	***3.5***	23	53.6	***-0.8***	29	56.3	***-2.7***	35	54.9	***4.3***
5	53.2	***2.6***	24	52.2	***-2.2***	30	55.6	***-3.4***	36	54.1	***3.5***
6	53.1	***2.5***	25	48.0	***-6.4***	31	55.2	***-3.8***	37	53.8	***3.2***
7	52.3	***1.7***							38	52.5	***1.9***
8	52.0	***1.4***							39	51.6	***1.0***
9	51.3	***0.7***							40	51.4	***0.8***
10	51.1	***0.5***							41	50.5	***-0.1***
11	50.7	***0.1***							42	50.4	***-0.2***
12	50.2	***-0.4***							43	49.3	***-1.3***
13	48.7	***-1.9***							44	49.3	***-1.3***
14	46.8	***-3.8***							45	47.7	***-2.9***
15	46.6	***-4.0***							46	44.4	***-6.2***
16	46.4	***-4.2***							47	42.3	***-8.3***
17	46.4	***-4.2***							48	42.3	***-8.3***
18	45.9	***-4.7***									
19	43.3	***-7.3***									

This derived "meta-sample" can be interpreted in either of two ways: It can be thought of as the possible departures from the average fuel temperature in a local competitive area that a consumer might encounter as she chooses randomly among all of the stations available in that area in order to fuel her vehicle. Or it can be interpreted as the possible departures from the average fuel temperature prevailing in the local area that a motorist might encounter if she made all her purchases at the *same* station but at random amounts of time since the dealer received his most recent wholesale delivery.[94]

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[94] This interpretation is based on the fact that retail stores in a particular local area tend to be supplied from the same wholesale terminal. As a result, any cross-sectional differences in fuel temperature among these stores would mostly be due to differences in the amount of time that has elapsed since they received a wholesale delivery. See the Testimony of R. Timothy Columbus before the Subcommittee on Domestic Policy of the House Committee on Oversight and Government Reform, June 8, 2007 at p. 3 ("[F]or the most part, all retailers in a particular market acquire product at a terminal facility which contains the co-mingled products of many manufacturers. The only "product differentiation" between products takes place as sellers inject different additives into the product as it is delivered from the terminal into a transport truck. In most metropolitan markets all retailers obtain their products from terminals supplied by the same common carrier pipeline, located in sufficiently close physical proximity as to experience the same ambient temperature, deliver them by trucks driving through

The question of interest is this: What is the probability that a consumer – who either randomly chooses among all of the available dealers in the local area or chooses to purchase from a specific retailer at random times since its most recent delivery – might as a matter of chance (or bad luck) end up with aggregate annual fuel purchases whose average temperature significantly exceeded the prevailing average fuel temperature in that area?

Monte Carlo simulation

This question can be addressed using a standard statistical technique known as *Monte Carlo simulation*, in which a computer is instructed to generate a large number of independent random "samples" by drawing from the same specified "population". Here the "population" consists of the 48 deviations summarized in ***Figure 33***, and the computer was instructed to make 52 "purchases" of 20 gallons each at temperatures drawn randomly from the "population" in ***Figure 33*** in order to simulate a consumer making weekly gasoline purchases totaling 1,040 gallons over an entire year. Following this random sampling, the computer was instructed to calculate the average temperature deviation for these 52 weekly purchases and 1,040 gallons, in order to determine how much temperature-induced expansion (or contraction) had been encountered by the consumer. Finally, the computer was instructed to repeat this entire process 10,000 times, in order to build up the database needed to determine how likely it was that a consumer might randomly wind up with annual fuel purchases whose average temperature significantly exceeded the prevailing average fuel temperature in the local area.

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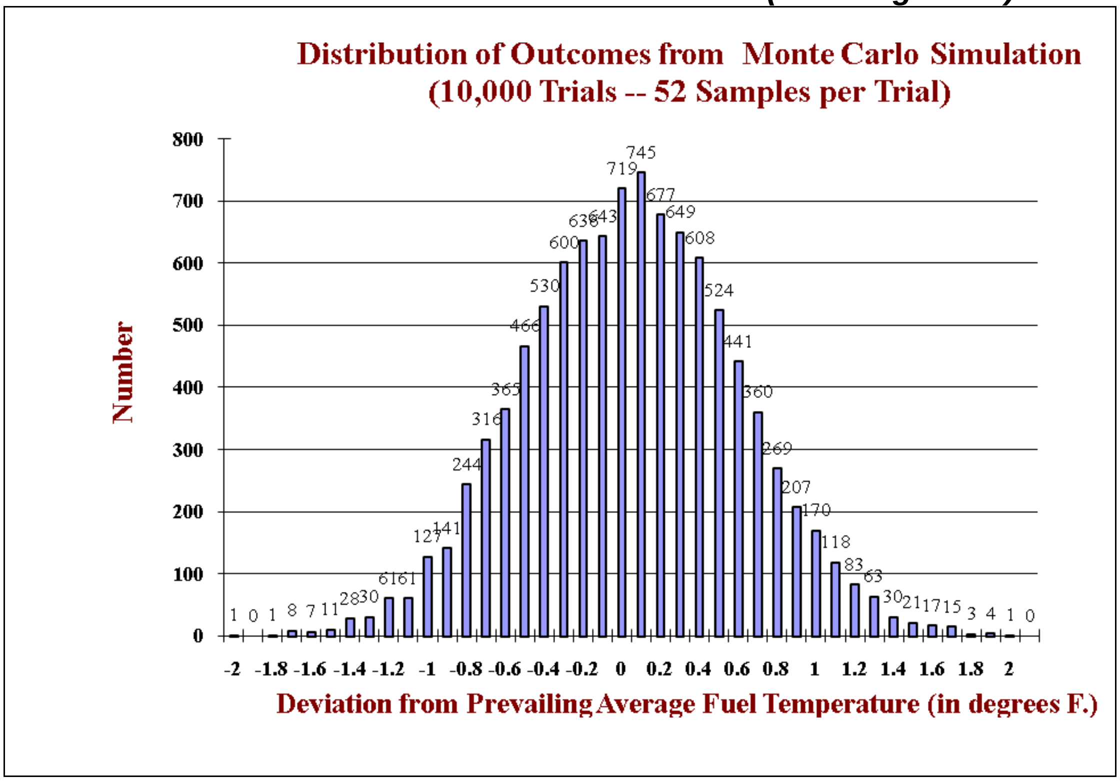
the same ambient air temperature, and deliver this product into storage tanks surrounded by ground of the same ambient ground temperature.").

Resulting evidence on the effect of cross-sectional temperature variation.

Figure 34.
Distribution of outcomes from Monte Carlo simulation (52 x 20 gallons)



The results of the 10,000 Monte Carlo simulation trials are summarized in the histogram shown in ***Figure 34***. The results are striking. In only *one* of the 10,000 trials – or one one-hundredth of one percent – was the average temperature of the consumer's purchased fuel even 2.0°F. warmer than the prevailing average temperature. This means, for example, that a consumer who purchased 1,040 gallons at $3.00 per gallon over a year would face only one chance in 10,000 of "overpaying" by as much as $4.31 in total over that year,[95] and no chance at all of paying more than that amount. Or, to select a different reference point, the probability is greater than 0.96 that the consumer's total annual purchases are no more than 1° warmer or $2.15 more expensive[96] than would be the case if all his purchases were made precisely at the prevailing average fuel temperature. ***Figure 35*** summarizes the probabilities that the average temperature of a consumer's annual fuel purchases exceeds the average for the local area by particular deviations, measured in degrees, along with the additional costs these deviations would imply at various assumed gasoline prices.

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95 $4.31 = (.00069) x (2°) x 1,040 x $3.00.

96 Again, assuming a retail price of $3.00 per gallon.

Figure 35.
Results of Monte Carlo simulation assuming 52 20-gallon purchases in a year.

Cost of "Hot Fuel" Overcharges Due to Cross-Sectional Temperature Differences *Assuming Total Annual Purchases of 1,040 Gallons (52 x 20 gallons)*							
Degrees above local average	**Number of Outcomes**	**Probability**	**Maximum gallons "lost"**	**Assumed Retail Price per Gallon**			
				$2.00	**$3.00**	**$4.00**	**$5.00**
0.0 to 0.5	3,398	33.98%	0.18	$0.36	$0.54	$0.72	$0.90
0.5 to 1.0	1,801	18.01%	0.36	$0.72	$1.08	$1.44	$1.79
1.0 to 1.5	464	4.64%	0.54	$1.08	$1.61	$2.15	$2.69
1.5 to 2.0	60	0.60%	0.72	$1.44	$2.15	$2.87	$3.59
2.0 to 2.5	1	0.01%	0.90	$1.79	$2.69	$3.59	$4.49
2.5 to 3.0	0	0.00%	1.08	$2.15	$3.23	$4.31	$5.38
3.0 +	0	0.00%	1.26	$2.51	$3.77	$5.02	$6.28

The results are substantially the same if one were to posit either a consumer who makes only 26 biweekly purchases of 20 gallons in fuel (or 540 gallons in total) in a year (***Figures 36***) or a consumer who makes 104 (or twice-weekly) purchases (for 2,080 gallons) in a year (***Figures 37***).

Figure 36.
Results of Monte Carlo simulation assuming 26 20-gallon purchases in a year.

Cost of "Hot Fuel" Overcharges Due to Cross-Sectional Temperature Differences *Assuming Total Annual Purchases of 520 Gallons (26 x 20 gallons)*							
Degrees above local average	**Number of Outcomes**	**Probability**	**Maximum gallons "lost"**	**Assumed Retail Price per Gallon**			
				$2.00	**$3.00**	**$4.00**	**$5.00**
0.0 to 0.5	2,506	25.06%	0.18	$0.36	$0.54	$0.72	$0.90
0.5 to 1.0	1,828	18.28%	0.36	$0.72	$1.08	$1.44	$1.79
1.0 to 1.5	934	9.34%	0.54	$1.08	$1.61	$2.15	$2.69
1.5 to 2.0	267	2.67%	0.72	$1.44	$2.15	$2.87	$3.59
2.0 to 2.5	55	0.55%	0.90	$1.79	$2.69	$3.59	$4.49
2.5 to 3.0	12	0.12%	1.08	$2.15	$3.23	$4.31	$5.38
3.0 +	0	0.00%	1.26	$2.51	$3.77	$5.02	$6.28

Figure 37.
Results of Monte Carlo simulation assuming 104 20-gallon purchases in a year.

Cost of "Hot Fuel" Overcharges Due to Cross-Sectional Temperature Differences ***Assuming Total Annual Purchases of 2,080 Gallons (104 x 20 gallons)***							
Degrees above local average	**Number of Outcomes**	**Probability**	**Maximum gallons "lost"**	**Assumed Retail Price per Gallon**			
				$2.00	**$3.00**	**$4.00**	**$5.00**
0.0 to 0.5	*4,422*	*44.22%*	*0.18*	$0.36	$0.54	$0.72	$0.90
0.5 to 1.0	*1,429*	*14.29%*	*0.36*	$0.72	$1.08	$1.44	$1.79
1.0 to 1.5	*116*	*1.16%*	*0.54*	$1.08	$1.61	$2.15	$2.69
1.5 to 2.0	*2*	*0.02%*	*0.72*	$1.44	$2.15	$2.87	$3.59
2.0 to 2.5	*0*	*0.00%*	*0.90*	$1.79	$2.69	$3.59	$4.49
2.5 to 3.0	*0*	*0.00%*	*1.08*	$2.15	$3.23	$4.31	$5.38
3.0 +	*0*	*0.00%*	*1.26*	$2.51	$3.77	$5.02	$6.28

The conclusion supported by these Monte Carlo simulations is that – because motorists make repeated fuel purchases over, say, a year – any cross-sectional variation in fuel temperature within a local competitive area that poses no significant issue.

Where are the supposed "hot fuel rip-off" profits?

The activists are unanimous in their assertions that U.S. retailers have been pocketing billions of dollars each year in hidden "hot fuel" profits, and that each year consumers are cheated of the same amounts.

This paper has shown how retail competition is sufficient to adjust dealer's pump prices to compensate for the temperature-induced expansion of their fuel inventories. In the preceding section, this paper also has shown why consumers are not being "ripped off" by possible cross-sectional differences among fuel temperatures in local areas.

In view of these two showings, it is highly unlikely that the supposed "hot fuel rip-off" profits even exist. More to the point, the "hot fuel" activists have never attempted to prove independently the actual existence of these supposed hidden profits.

If it turns out that the predicted "hot fuel rip-off" profits themselves do not actually exist, then this should be taken as dispositive proof that the entire "hot fuel" controversy is a sham.

Equivalence of the "hot fuel" allegations and tacit collusion

Before proceeding with an analysis of the profitability of U.S. retailers of motor fuel and of the state-by-state implications of the supposed "hot fuel rip-off", it is important to realize that those allegations are tantamount to a claim that U.S. retailers of motor fuel have tacitly colluded with each other for eighty years to maintain their pump prices above competitive levels and to secretly retain the resulting "hot fuel" profits. As a matter of economics – both industrial organization and antitrust economics – the achievement and maintenance of such a collusive scheme is extraordinarily unlikely, because it would constitute the largest and longest-lived anticompetitive agreement ever achieved in the U.S. While it is not the purpose of this paper to offer a formal analysis and refutation of the collusive agreement implicit in the "hot fuel" allegations, there are several reasons to be highly skeptical that such an anticompetitive arrangement ever existed:[97, 98]

- *Number and heterogeneity of the supposed participants.* In 2007, there were approximately 164,300 retail sellers of motor fuel in the U.S.[99] As one example, at least tens of thousands of these dealers would have been the principal direct beneficiaries of the "hot fuel rip-off", while the remainder would have had to participate in its cover-up, even though there are serious conflicts of interest among all these retailers. Dealers in "cold" parts of the U.S. supposedly have their profits "ripped off" by consumers as the result of the same physical properties of motor fuel that underpin the "hot fuel" allegations. Why would these "cold state" retailers keep silent about the "hot fuel rip-off", when it is *costing* each of them thousands of dollars every year? There also is a diversity of interest between retailers who are employees of the integrated refiner-marketers, on the one hand, and independent dealers, on the other. The employers of the former are motivated to minimize the profitability of the retail level, while independent dealers naturally would like to see that level be as profitable as possible.

- *Frequent entry, exit and turnover among the supposed participants*. No collusive agreement can simply be put on "autopilot" to continue indefinitely; for such an agreement to persist requires the active involvement of its participants to recruit and indoctrinate newcomers to the industry. The ownership and management of retail stores is in constant flux, with frequent entry, departures and turnover. The proponents of the

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97 The reader is referred to any of the several standard works on industrial organization and antitrust economics for a fuller discussion of these arguments and for citations to the primary literature. For example, see the following works and the citations: Dennis W. Carlton and Jeffrey M. Perloff, *Modern Industrial Organization* (3rd ed.), (Addison-Wesley, 2000) at pp. 121-150; W. Kip Viscusi, John M. Vernon and Joseph E. Harrington, Jr., *Economics of Regulation and Antitrust* (3rd ed.), (The MIT Press, 2001) at pp. 112-135; and Herbert Hovenkamp, *Economics and Federal Antitrust Law*, (West Publishing Co., 1985) at pp. 83-110.

98 Arthur G. Fraas and Douglas F. Greer, "Market Structure and Price Collusion: An Empirical Analysis," *26 Journal of Industrial Economics* (1977) at pp. 21-44; George A. Hay and Daniel Kelley, "An Empirical Survey of Price-Fixing Conspiracies," *17 Journal of Law and Economics* (1974) at pp. 13-38; Peter Asch. and J. J. Seneca, "Is Collusion Profitable?," *68 Review of Economics and Statistics* (1976) at pp. 1-12; and Valerie Y. Suslow, "Cartel contract duration: empirical evidence from inter-war international cartels," *Industrial and Corporate Change*, 2005.

99 National Petroleum News, *NPN Market facts 2008*. <http://www.npnweb.com>

"hot fuel" allegations never explain how the tacit collusion among retailers that is a necessary condition for the "success" of the "hot fuel rip-off" is maintained in the face of such turnover.

- *The withdrawal of major refiner-marketers from the retail end of the distribution chain.* The "hot fuel" activists are among the most vocal critics of so-called "Big Oil" and the latter's supposed determination to squeeze the greatest possible profits out of consumers. At the same time, these activists claim that billions each year in "hot fuel" profits are being "ripped off" from motorists at the retail level. If this is the case, why would major refiner-marketers voluntarily seek to exit the retail end of the industry?[100, 101]

But there are other bodies of evidence that strongly suggest that retailers have been incapable of maintaining pump prices above the competitive levels at which they earn only normal, competitive profit. Chief among these are retail "price wars" among dealers, and the manifest inability of retailers to maintain high pump prices when their wholesale prices recede following "spikes".

The frequency of localized "price wars" among retailers is strong evidence against the existence of "hot fuel" profits. Such "price wars" erupt because rival retailers are unable to maintain and stabilize their respective prices at levels that are acceptable to them. Price wars devastate the profitability of participants. If rival retailers in a local competitive area cannot manage to prevent such frequent and costly "misunderstandings", how is it that they nevertheless have been able to sequester and preserve their supposed "hot fuel" profits – and to avoid dissipating these profits through price wars – for decades? If retailers have succeeded in forming and maintaining their collusive "hot fuel" agreement, why do these same retailers engage in price wars with each other? Their inability to prevent price wars speaks volumes about the likelihood that these same retailers have formed and successfully maintained an agreement to extract "hot fuel" profits from their customers.

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[100] Steve Everly, "There's little gain in selling gas", *Kansas City Star*, December 26, 2008: Gas retailing has long filled an awkward niche in the oil business. Federal lawyers compiling an antitrust case against Big Oil in the 1970s – a case that was eventually dropped by President Ronald Reagan – were prepared to argue that the oil industry's retail stations weren't viewed as profit centers in themselves. Instead, they were needed to dispose of huge amounts of profitable Mideast oil that the companies owned before those supplies began to be nationalized in the early 1970s. The loss of the Mideast oil made all those gas stations less necessary to their corporate owners, who increasingly viewed them as financial albatrosses. Indeed, the total number of U.S. gas stations has shrunk from 216,000 in 1970 to 162,000 today, even with three times as many vehicles on the road, according to NPN, a company that collects information on the industry. As the big oil companies lost interest in owning gas stations, they began to spin them off to independent operators.

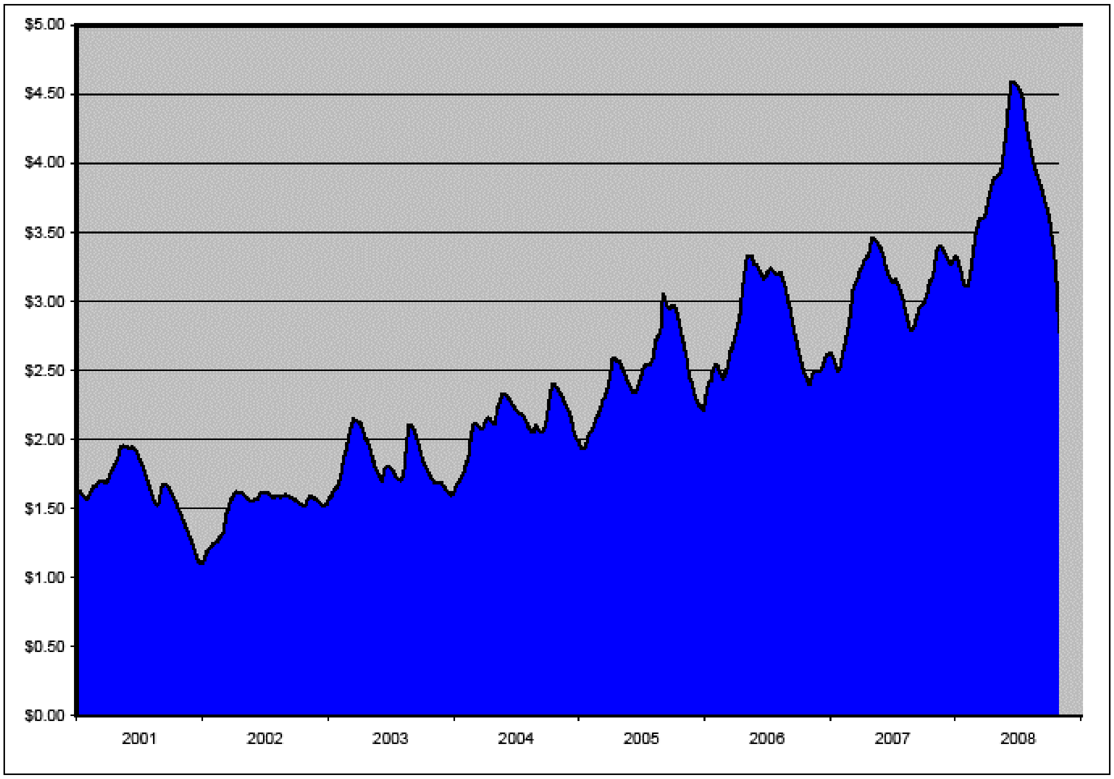
[101] Judy Dugan, *OilWatchdog*, "Greed for pennies," June 13, 2008. ("Exxon is selling off its 820 company-owned stations and 1,400 stations run by independent dealers on company-owned land.") <http://www.oilwatchdog.org/articles/?storyId=20816>

If retailers really possessed the ability to collusively maintain their street prices above normal competitive levels – which, after all, is the essence of the "hot fuel rip-off" allegations – then why do they not similarly maintain prices above competitive levels when presented with an opportunity to do so by sudden increases in their wholesale prices that later are followed by reductions in those same wholesale prices?

A casual inspection of the recent history of California retail prices for regular unleaded gasoline shows a series of "spikes" – caused by such phenomena as international events, refinery incidents and shutdowns, weather, etc. – that regularly are followed by an easing of retail prices. See ***Figure 38***.

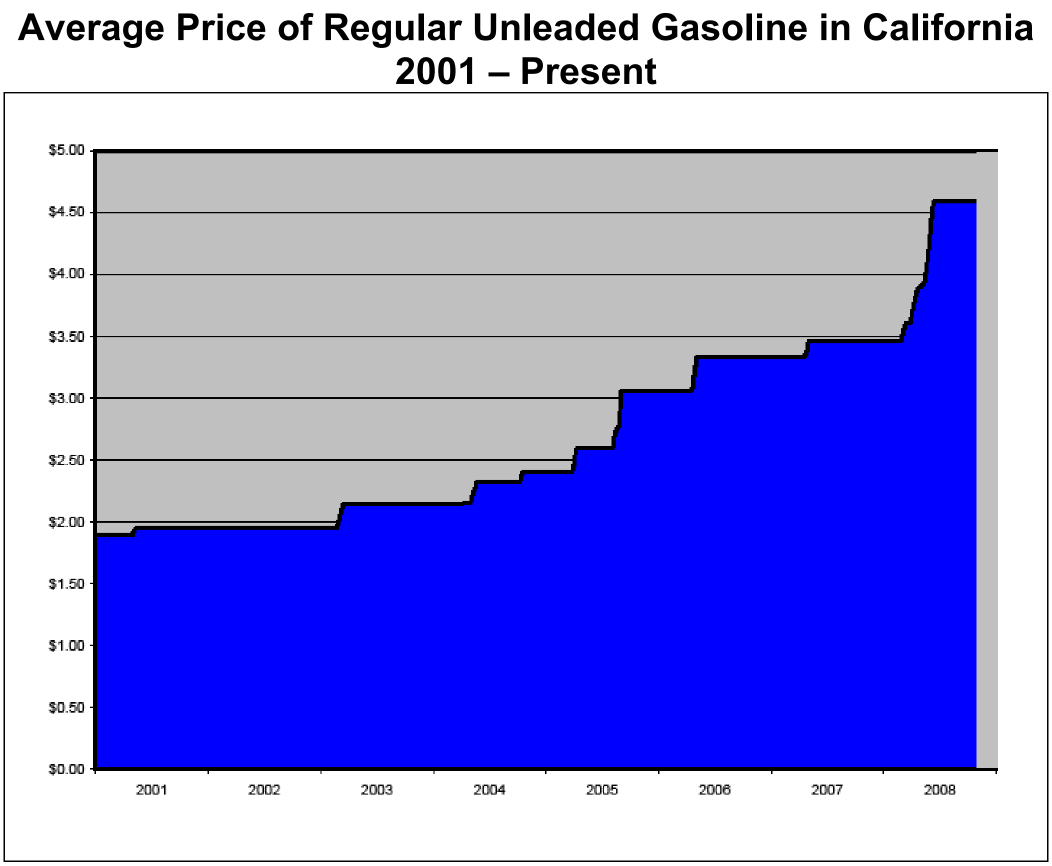
Figure 38.

Average Price of Regular Unleaded Gasoline in California 2001 – 2008



Obviously, dealers would be far more profitable if they tacitly agreed *not* to let their retail prices subside following these episodes. For example – once such a spike in wholesale has given dealers the opportunity to raise their own prices – if retailers could *maintain* their higher pump prices at those levels even after their own wholesale prices have eased, the increase in their profitability would be enormous. This scenario is illustrated in ***Figure 39***. The fact that this never happens speaks volumes about the supposed ability of California (and U.S.) dealers to successfully maintain their retail prices above competitive levels for decades.

Figure 39.
Hypothetical price of regular unleaded gasoline if retailers maintained higher prices.



The recent profitability of U.S. motor fuel retailers

But the strongest evidence against the existence of the "hot fuel rip-off" is the generally modest profitability of U.S. motor fuel retailers. The plain fact is that retail motor fuel stores are not as profitable as the "hot fuel rip-off" allegations would suggest.

U.S. data on the profitability of gasoline stations summarized in ***Figure 40*** support the conclusion that these retail businesses are not particularly profitable, regardless of whether they include convenience stores or not. Even the journalists most responsible for publicizing the supposed "hot fuel rip-off" acknowledge that retailers are not very profitable.[102, 103]

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[102] Steve Everly, "There's little gain in selling gas", *Kansas City Star*, December 26, 2008:

Raj Singh is serving a customer who stops for gas and a Coke at the Independence Conoco station he manages. The customer asks: What's it like selling some of the cheapest fuel in the country?

Figure 40.
Summary data on the profitability of the U.S. gasoline retailers.

	Apr 02 thru Mar 03	Apr 03 thru Mar 04	Apr 04 thru Mar 05	Apr 05 thru Mar 06	Apr 06 thru Mar 07	Five Year Average
Gasoline Stations with Convenience Stores (NAICS 447110)						
Operating Profit as % of Net Sales	1.0%	1.0%	0.7%	0.9%	0.8%	*0.9%*
Profit Before Taxes as % of Net Sales	1.2%	1.2%	0.9%	0.8%	0.8%	*1.0%*
Profit Before Taxes as % of Total Assets	3.5%	3.5%	3.9%	3.2%	4.5%	*3.7%*
Median	3.5%	3.5%	3.9%	3.2%	4.5%	*3.7%*
Lower	-0.5%	-0.3%	0.0%	0.3%	-1.3%	*-0.4%*
Other Gasoline Stations (NAICS 447190)						
Operating Profit as % of Net Sales	0.9%	1.2%	0.9%	1.6%	1.5%	*1.2%*
Profit Before Taxes as % of Net Sales	0.7%	1.1%	1.1%	1.4%	1.2%	*1.1%*
Profit Before Taxes as % of Total Assets	2.4%	3.9%	4.1%	5.2%	4.3%	*4.0%*
Median	2.4%	3.9%	4.1%	5.2%	4.3%	*4.0%*
Lower	-2.2%	0.3%	0.4%	1.1%	0.2%	*0.0%*

Source: RMA (Risk Management Association) Annual Statement Studies

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"Dude, let me show you something," Singh says, shoving a sheet of paper across the counter. Subtracting his wholesale gas costs and 36 cents in state and federal taxes from the pump price, his station makes about 2 cents a gallon.

But that's before any other costs are subtracted. Figure in credit card fees, for example, and the station is losing money on every gallon sold.

"We are praying to God to help us any way he can," he says.

103 Judy Dugan, "Not the Gas Station's Fault," *OilWatchdog*, April 21, 2008: http://www.oilwatchdog.org/articles/?storyId=19837

"I imagine a fair number of drivers think the guy at the corner gas station is raking it in, with the price at the pump getting near – or beyond – $4.00 a gallon. But it ain't so. The *Oil Express* newsletter…which is aimed at fuel retailers, notes that the percentage of the sale price kept by gas station operators is down, not up:

> When petroleum distributors and retailers talk about profit crunches, they often recollect 2002 as the worst of times, at least for the last fifteen years. But 2008 has brought the worst circumstances in a generation…At press time, year-to-date gross rack-to-retail margins for unleaded regular just slipped below 4% of the total sales price.…Taking into consideration higher overhead costs, and a larger percentage of gross margin eaten up by credit card fees, the first 105 days of 2008 appear to have no misery equal.

"So it's not the guy actually taking your money who's getting filthy rich."
http://www.oilwatchdog.org/articles/?storyId=19837

Figure 41.
Total "hot fuel" profits by state (Kansas City Star methodology).

TOTAL CONSUMER LOSSES AND GAINS IN 2006 DUE TO "HOT FUEL"
(STATES AS RANKED BY THE KANSAS CITY *STAR*)

STATE	AVERAGE FUEL TEMP (F.)	EFFECT ON RETAIL GAS CONSUMPTION IN MILLIONS OF GALLONS	2006 CONSUMERS' GAIN OR LOSS IN MILLIONS OF DOLLARS	STATE	AVERAGE FUEL TEMP (F.)	EFFECT ON RETAIL GAS CONSUMPTION IN MILLIONS OF GALLONS	2006 CONSUMERS' GAIN OR LOSS IN MILLIONS OF DOLLARS
California	75	158	-$509	Rhode Island	59.8	-0.1	$0.1
Texas	78	143	-$416	West Virginia	59.6	-0.2	$0.6
Florida	82	122	-$367	Indiana	59.9	-0.3	$0.9
Georgia	72	41	-$123	Wyoming	55	-1.0	$3
Arizona	82	39	-$115	Washington	59.5	-1.0	$3
Louisiana	77	28	-$81	Montana	57	-0.9	$3
North Carolina	69	25	-$74	New Hampshire	58	-1.0	$4
Alabama	72	22	-$63	Vermont	54	-1.4	$4
South Carolina	73	22	-$61	*South Dakota*	*54*	*-1.2*	*$4*
Tennessee	70	21	-$60	*North Dakota*	*53*	*-1.9*	*$6*
Virginia	66	16	-$46	Alaska	47	-2.0	$7
Mississippi	74	16	-$46	Massachusetts	59	-2.0	$7
Arkansas	71	11	-$32	Maine	55	-2.5	$7
Nevada	75	10	-$31	Connecticut	59	-3.0	$8
Oklahoma	69	11	-$31	Nebraska	54	-3.0	$10
New Jersey	63	8	-$22	Iowa	57	-4.0	$11
Maryland	64	7	-$22	Ohio	59	-4.0	$12
New Mexico	69	6	-$17	Illinois	57	-9.0	$29
Missouri	62	5	-$15	Wisconsin	55	-9.3	$29
Kentucky	63	5	-$14	Michigan	57	-10.0	$29
Kansas	65	4	-$12	Minnesota	53	-13.0	$37
Oregon	63	3.5	-$10				
New York	61	3.0	-$9				
Utah	63	3.0	-$7				
Colorado	62	2.0	-$7				
Hawaii *	86	2.0	-$6				
Delaware	64	1.0	-$3				
Pennsylvania	60.3	1.0	-$3				
Washington, DC	66	0.7	-$2				
Idaho	60.5	0.2	-$0.6				

Summary:

Consumer Gains in "Cold States" ($ millions)	***$214***
Consumer Losses in "Hot States" ($ millions)	***-$2,205***
Consumer Net Losses ($ millions)	***-$1,991***

Figure 41 reproduces the data in the chart published by the *Kansas City Star* that "documented" its claims regarding the amount of the supposed "hot fuel rip-off".[104] For each state, ***Figure 41*** shows:

- The (estimated) average annual fuel temperature,

- The supposed aggregate annual effect of temperature expansion (or contraction) on the gasoline sales made by retail stores (measured in millions of gallons), and

- The total consumer loss (or gain) in millions of dollars supposedly resulting from that temperature expansion.

The data in ***Figure 41*** have been augmented (from the original chart published by the *Kansas City Star*) to include estimates for North Dakota[105] and South Dakota,[106] and to summarize the supposed aggregate "gains" and "losses" by U.S. consumers due to "hot fuel". As shown by the summary in ***Figure 41***, U.S. motor fuel retailers supposedly extracted $1.991 billion from consumers in *net* "hot fuel" profits.[107] When this figure is divided by 167,500 (the *NPN Station Count* for 2006), the implication is that the average U.S. dealer enjoyed nearly $12,000[108] in net "hot fuel" profits in 2006.

Viewed from the perspective of the country as a whole, these implied "hot fuel" profits per store are implausibly large in comparison with the actual average profitability of retail stores in the U.S. According to the *CEC Staff Report*, the *total annual pre-tax* profits of U.S. convenience stores – generated by *all* sales, not just of gasoline and diesel fuel – during the period from 1998 through 2007, averaged less than $33,000.[109] This means that – if one accepts the logic of the *Kansas City Star* and the "hot fuel" activists – in 2006 the average dealer's hidden "hot fuel" profit was more than one-third as large as his total reported pre-tax profit. It is

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104 *Kansas City Star*, "The Colder The Better – For The Consumer" (chart), August 27, 2006, p. A8.

105 Assumed to have the same average fuel temperature as Minnesota. The calculated effect of "hot fuel" on retail gasoline consumption in North Dakota is based on total gasoline sales data for North Dakota published by the Energy Information Administration.

106 Assumed to have the same average fuel temperature as Iowa. The calculated effect of "hot fuel" on retail gasoline consumption in South Dakota is based on total gasoline sales data for South Dakota from the Energy Information Administration.

107 This is obtained by subtracting $214 million in "consumer gains" in the "cold" states from the total of $2.205 billion in supposed "consumer losses" in the "hot states" resulting from "hot fuel".

108 The exact result is $11,887.

109 *CEC Staff Report* at p. 83.

hard to imagine how this could go unnoticed by industry analysts and especially by tax authorities.

Figure 42.
"Hot fuel" profits per retailer by state (Kansas City Star methodology)

STATE	2006 CONSUMERS' GAIN OR LOSS IN MILLIONS OF DOLLARS	2006 AVERAGE RETAILER GAIN OR LOSS PER STORE	STATE	2006 CONSUMERS' GAIN OR LOSS IN MILLIONS OF DOLLARS	2006 NPN STATION COUNT	2006 AVERAGE RETAILER GAIN OR LOSS PER STORE
California	-$509	$51,638	Rhode Island	$0.1	375	-$267
Texas	-$416	$25,212	West Virginia	$0.6	1,300	-$462
Florida	-$367	$39,818	Indiana	$0.9	1,684	-$534
Georgia	-$123	$16,005	Wyoming	$3	598	-$5,017
Arizona	-$115	$52,511	Washington	$3	3,228	-$929
Louisiana	-$81	$19,843	Montana	$3	900	-$3,333
North Carolina	-$74	$10,493	New Hampshire	$4	800	-$5,000
Alabama	-$63	$11,455	Vermont	$4	621	-$6,441
South Carolina	-$61	$15,545	South Dakota	$4	1,073	-$3,728
Tennessee	-$60	$12,731	North Dakota	$6	930	-$6,452
Virginia	-$46	$9,892	Alaska	$7	460	-$15,217
Mississippi	-$46	$12,925	Massachusetts	$7	2,700	-$2,593
Arkansas	-$32	$9,697	Maine	$7	1,436	-$4,875
Nevada	-$31	$28,336	Connecticut	$8	1,475	-$5,424
Oklahoma	-$31	$8,857	Nebraska	$10	1,542	-$6,485
New Jersey	-$22	$6,665	Iowa	$11	2,658	-$4,138
Maryland	-$22	$9,378	Ohio	$12	4,935	-$2,432
New Mexico	-$17	$11,502	Illinois	$29	5,100	-$5,686
Missouri	-$15	$3,479	Wisconsin	$29	4,126	-$7,029
Kentucky	-$14	$3,992	Michigan	$29	5,076	-$5,713
Kansas	-$12	$4,800	Minnesota	$37	3,656	-$10,120
Oregon	-$10	$5,800				
New York	-$9	$1,277				
Utah	-$7	$6,341				
Colorado	-$7	$3,043				
Hawaii *	-$6	$18,293				
Delaware	-$3	$7,813				
Pennsylvania	-$3	$641				
Washington, DC	-$2	$16,529				
Idaho	-$0.6	$708				

Figure 42 takes the results in ***Figure 41*** one step farther by incorporating the *NPN Station Counts* for individual states and then calculating the "gain" or "loss" supposedly realized by the average retailer in each state due to "hot fuel". According to the results reported in ***Figure 42***, the average retailer in California and Arizona supposedly pocketed about $51,500 and $52,500, respectively, in "hot fuel" profits in 2006. Dealers in Florida supposedly received an average of about $40,000 each, while Texas retailers averaged $25,000 in annual "hot fuel"

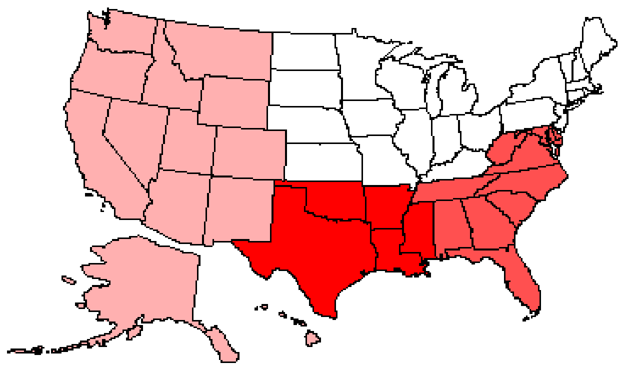
profits.[110] These figures either significantly exceed – or are at least equivalent to – the average *total pre-tax profits* per convenience store noted in the *CEC Staff Report*. It strains credulity to think that no one – not the U.S. Commerce Department, the Internal Revenue Service or the retailers themselves – appears to have noticed these phenomenal results. At the same time, retailers in several states were significant "losers" as the result of the supposed tacit collusion among U.S. retailers to hide their "hot fuel" gains *and losses*. As shown in ***Figure 42***, the average dealer in Minnesota suffered annual *losses* exceeding $10,000, while the typical Alaska retailer lost over $15,000 in 2006. It is difficult to understand how these retailers would have willingly accepted such losses – amounting to nearly one-third and one-half, respectively – of the typical convenience store's *total pre-tax profit* – so that their brethren in warmer states could pocket their "hot fuel" profits.

The predicted geographic pattern of the "hot fuel rip-off" profits.

But an even more powerful test of the "hot fuel rip-off" allegations can be constructed - based on the calculations in ***Figure 42*** - by comparing the geographic differences in the average "hot fuel" profits per retail store to independent data on the actual profitability of retail gasoline stores by U.S. region. Such data are available from RMA (Risk Management Association) for the six regions of the U.S. shown in ***Figure 43***. If these independent data do not reflect the regional differentials in per-station profitability that are predicted by the "hot fuel" allegations, this would raise particularly serious questions about the credibility of those allegations. On the other hand, if the state-by-state profitability patterns turn out to be consistent with the RMA data on retail store profitability by region of the U.S., this would tend to confirm the "hot fuel" allegations.

110 It is important to keep in mind that the per-store average gain and loss figures in ***Figure 42*** were constructed by *assuming* the truth of the "hot fuel" allegations; in no way do these figures *prove* that the "hot fuel rip-off" is a fact.

Figure 43.
Regions of the U.S. for which retailer profitability data are available.



RMA Region	Avg Temp	States Included
South Central	*76*	*AR LA MS OK TX*
Southeast	*72*	*AL DC DE FL GA MD NC SC TN VA WV*
West	*64*	*AK AZ CA CO HI ID MT NM NV OR UT WA WY*
Northeast	*60*	*CT MA ME NH NJ NY PA RI VT*
Central	*59*	*IL IN KY MI OH*
North Central	*57*	*IA KS MN MO ND NE SD WI*

Since independent data on the profitability of retail gasoline stores are available for the six regions of the U.S. shown in ***Figure 43***, one can aggregate the *Kansas City Star* estimates of state-by-state average retail gains (or losses) per store from ***Figure 42*** into these same six regions, with the results that are depicted in ***Figure 44***.

Figure 44.
Implied average retailer "hot fuel" profits by U.S. region.

	AVERAGE FUEL TEMPERATURE (DEGREES F.)	EFFECT ON RETAIL GAS CONSUMPTION IN MILLIONS OF GALLONS	2006 CONSUMERS' GAIN OR LOSS IN MILLIONS OF DOLLARS	2006 NPN STATION COUNT	2006 AVERAGE RETAILER GAIN OR LOSS PER STORE
West	**64**	**181.8**	**-$579**	**23,458**	***$24,665***
South Central	**76**	**209**	**-$606**	**30,941**	***$19,586***
Southeast	**72**	**277.5**	**-$820**	**46,892**	***$17,496***
Northeast	**60**	**2.05**	**-$4**	**22,436**	***$174***
Central	**59**	**-18.3**	**$57**	**20,302**	***-$2,803***
North Central	**67**	**-23.4**	**$70**	**20,797**	***-$3,366***

The variation among U.S. regions shown in ***Figure 44*** is particularly striking. If one accepts the truth of the "hot fuel" allegations and the calculations offered by the *Kansas City Star*, the unavoidable result is that the average retailer in the relatively-warmer *West*, *South Central* and *Southeast* regions of the U.S. should be *significantly* more profitable – by amounts ranging from $17,000[111] to $28,000[112] per year – than his counterparts in the three "cooler" regions (*North Central*, *Central* and *Northeast*). The question, then, is whether these *predicted* regional differences are consistent with the independent measures of gasoline station profitability in these same regions available from RMA.

Figure 45 facilitates this comparison by combining the average retailer gain or loss per store due to "hot fuel" (from ***Figure 44***) to the profit rates reported by RMA for retailers in the same six regions. ***Figure 45*** compels the conclusion that there is something seriously amiss with the "hidden profits" implied by the "hot fuel" allegations.[113] Measured by their profit before taxes (as a percent of sales) and by their median profit before taxes (as a percent of assets), the retail stores in the "hot" parts of the U.S. actually are no more profitable than their counterparts in the "cold" regions. These independent data cannot be reconciled with the implications of the "hot fuel" allegations.

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[111] Gotten by comparing the average retailer gain or loss per store in the *Southeast* to that in the *Northeast*.

[112] The result of comparing the average retailer gain per store in the *West* to the average loss per store in the *North Central* region.

[113] It should be added that only the transactions between retailers and consumers are at issue in the CEC study and in the "hot fuel" allegations, not the "upstream" sales from refiners to retail stations. In the U.S., there are approximately 168,000 retail stores (or stations) that are owned by over 50,000 separate companies and individuals. Only a distinct minority – well below 10 percent – of retail stations remain under the ownership and operation of so-called "Big Oil". Moreover, that percentage continues to decline, as the "majors" (i.e., the integrated refiner-marketers) continue to shed their "company-owned" stores, apparently due to the comparatively unattractive profit levels available at the retail level.

But it is important to dispose of one possible rejoinder to the showing that the actual geographic pattern of retail store profitability does not match the pattern implied by the predicted state-by-state distribution of "hot fuel" overcharges. It might be argued that the failure to find these "hot fuel" overcharge profits at the retail level could be due to the fact that these profits have been captured by the integrated refiner-marketers through the manipulation of their dealer tankwagon pricing to squeeze retailers' gross margins in warmer states.

However, a statistical test of the hypothesis that there is a systematic inverse relationship between each state's average fuel temperature and its corresponding average retail margin (measured as the difference between average DTW prices and average retail prices) showed that there was no such relationship at all, much less one that was statistically significant.

Figure 45.
Implied average "hot fuel" profits vs. independent RMA data.

	2006 AVERAGE RETAILER GAIN OR LOSS PER STORE DUE TO "HOT FUEL" (*Kansas City Star*)	1998-2007 PROFIT BEFORE TAXES AS PERCENT OF SALES (*RMA*)	1998-2007 MEDIAN PROFIT BEFORE TAXES AS PERCENT OF ASSETS (*RMA*)
West	**$24,665**	**1.1%**	**4.1%**
South Central	**$19,586**	**1.2%**	**4.8%**
Southeast	**$17,496**	**1.3%**	**3.7%**
Northeast	**$174**	**1.1%**	**5.0%**
Central	**-$2,803**	**0.7%**	**4.0%**
North Central	**-$3,366**	**1.0%**	**3.3%**

So the question posed at the beginning of this section remains: What happened to the "hot fuel" profits? The only reasonable answer is that those "profits" never existed in the first place.

Concluding remarks

The "hot fuel" controversy and the *CEC Staff Report* should be seen as misguided attempts to lower the retail price of gasoline and diesel fuel by extracting revenue from dealers, without regard to the fact that – because of the highly competitive business environment within which they operate – these dealers' margins already are razor thin, and in ignorance of the fact that the measures they urge would have no effect on consumers' outlays for motor fuel.

Put differently, the *CEC Staff Report* evaluates possible solutions to a problem that never existed in the first place. The "hot fuel" controversy has been generated by activists' claims that amount to nothing more than conjectures based on the thin foundation that motor fuel expands as its temperature increases. This has been combined with the erroneous assumption that all transactions involving motor fuel that are "upstream" from the consumer are conducted on a temperature-compensated basis.

In short, the "hot fuel allegations" are a myth, one that is readily apparent to anyone who seriously tries to investigate and test its implications. Retailers as a whole earn no more than normal competitive returns. There simply are no "hot fuel" profits to be recaptured and given to consumers via automatic temperature compensation. Given the structure and price and profit performance of the retail motor fuel industry, the "hot fuel" allegations are nonsensical as a matter of economics.

While the *CEC Staff Report* grudgingly comes to the correct conclusion that, overall, the net benefit of the proposed *ATC Retrofit* would be negative, it makes the question sound closer than it actually is.[114] Because there would be *no* benefits whatever from the proposed *ATC Retrofit* – motorists would *not* enjoy "more fuel", nor would they realize the supposed "increased price transparency benefits" – and because the *CEC Staff Report* has significantly underestimated its total cost, the economic case against the *ATC Retrofit* actually should be seen as overwhelming.[115]

This is not to say that adjusting retail prices for temperature-induced volume expansion is inappropriate. The point is that retail competition and repeated purchases by consumers *already* accomplish what the *ATC Retrofit* proposes to do. The difference is that relying on retail competition and the effect of repeated purchases has already been shown to work efficiently at no incremental cost. The *ATC Retrofit*, on the other hand, would impose significant incremental costs while providing no incremental benefits. Indeed, following implementation of the proposed *ATC Retrofit*, the only real beneficiaries would be the vendors of the needed equipment and services.

Despite the costs and confusion that likely would attend its introduction, the new reference temperature option also would accomplish nothing. This is because retail competition would quickly result in new, higher prices per "gallon" that keep constant consumers' outlays for a given quantum of fuel, no matter whether actual fuel temperatures were close to that new reference temperature or differed substantially from it.

The conclusions that retail competition already adjusts pump prices for temperature variation and that any attempt to enlarge the unit by which retail fuel sales are measured will necessarily result in higher pump prices per unit are not original contributions of this paper. As evidenced by the quotations at its beginning, these conclusions have been offered and accessible at least as far back as Hawaii's misguided initiative nearly forty years ago and as recently as the public workshops that preceded the *CEC Staff Report*.

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[114] *CEC Staff Report* at p. 3.

[115] This point is important because some stakeholders suggest – notwithstanding the negative net benefits estimated by the CEC staff – that automatic temperature compensation nevertheless *should* be required in California, given the *CEC Staff Report's* finding that the *ATC Retrofit* would impose increased costs of less than one cent per gallon. See letter to the California Energy Commission from Robert G. Harris, County of San Diego, December 19, 2008.