

Redefining Renewable Fuels

A demonstration of the long-term adaptability and economic feasibility of E30 consumption in non-flex fuel vehicles

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Nebraska Ethanol Board

AGENDA

- Recap/Summary of the 2019 E30 Demonstration (Phase I)
- Changes implemented by the U.S. EPA to 40 CFR 1090.610
- The application and approval process for the 2022-2025 E30 Demonstration (Phase II)
- Update on Phase II progress



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PHASE I OBJECTIVES

- Determine long-term vehicle adaptability to use of E30
- Quantify differences in engine performance between E15 and E30
- Investigate economic feasibility of using E30
- Impact of state-wide use of E30



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PHASE I EXPERIMENTAL DESIGN

- Drivers were trained to seek out and obtain retail E30 or E15 fuels.
- Drivers were also asked to keep handwritten logs to document fuel purchases (type, volume, etc.) and comment on drivability, noting issues as needed.



Date Station name & location	Fuel Blend (E10 or E15)	Gallons filled	Mileage	Driver Signature	General Comments
9/24/19 Pump & Pantry 36 + 370	E15	10.951	45084	AW	N/A
10/3 Pump & Pantry 36 + 370	E15	8.9	45325	WF	N/A
10/8 Pump & Pantry	E15	7.34	45431	Anthony Wiese	N/A
10/18 Pump & Pantry	E15	8.46	45638	Anthony Wiese	N/A
10/22 Pump & Pantry	E15	10.73	45906	Anthony Wiese	N/A

Vehicle Make, Model, Year: 2013 Dodge Avenger 18713 - 33123
 Last 6 digits of vehicle VIN: 773239 Refuel with a full tank & fill out each time



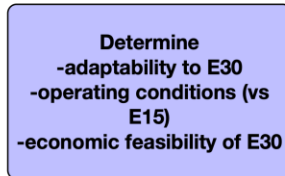
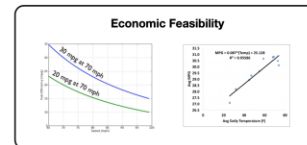
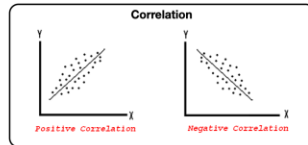
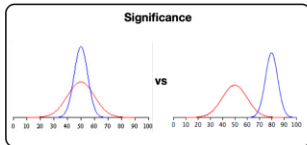
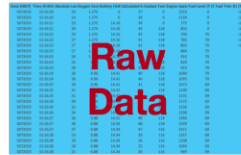
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PHASE I EXPERIMENTAL DESIGN



Date	Station name & location	Fuel blend (E15 or E15)	Gallons filled	Mileage	Driver Signature	General Comments
9/24/18	Pump & Store 36 + 370	E15	10.951	45084	AU	N/A
10/3	Pump & Store 370 + 370	E15	8.9	45325	N/A	N/A
10/8	Pump & Store	E15	7.31	45434	W. K. K.	N/A
10/18	Pump & Store	E15	8.46	45638	Anthony Wiese	N/A
10/18	Pump & Store	E15	12.73	45706	Anthony Wiese	N/A

Vehicle Make, Model, Year: 2013 Dodge Charger R713 - 33,123
 Last 6 digits of vehicle VIN: 113,245 Retest with a full tank & fill out each time



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PHASE I EXPERIMENTAL DESIGN

- PLX Devices Kiwi4 OBDII Data Loggers were utilized to collect the following parameters:
 1. **Long Term Fuel Trim** – Fuel mixture adjustment required to maintain ideal air/fuel mixture.
 2. **Vehicle Speed** – Used to determine miles traveled and driving conditions (e.g., city vs. highway).
 3. **Engine Load** – The engine’s capacity to produce power.
 4. **Oxygen Sensor** – Determines how much unburned oxygen is in the exhaust.
 5. **Engine Speed** – Number of rotations made by the crankshaft per minute (RPM).
 6. **Throttle Position Sensor** – Determines the amount of air flowing into an engine’s intake manifold.
 7. **Intake Air Temperature** – Measures ambient temperature to determine air density.
 8. **Coolant Temperature** – A measure of engine temperature and must be below 245F.



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PHASE I EXPERIMENTAL DESIGN

- 49 total vehicles participated
- 9 vehicles from NE State Patrol
- 40 vehicles from NE TSB

E15 Control Vehicles

Fuel Type	Make	Model	Year
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Dodge	Avenger	2013
E15	Ford	Fusion	2014
E15	Ford	Fusion	2014
E15	Dodge	Charger	2015
E15	Dodge	Charger	2015
E15	Dodge	Charger	2015
E15	Dodge	Charger	2015
E15	Dodge	Charger	2015
E15	Dodge	Charger	2015

E30 Test Vehicles

Fuel Type	Make	Model	Year
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Ford	Fusion	2014
E30	Ford	Fusion	2014
E30	Dodge	Avenger	2013
E30	Dodge	Avenger	2013
E30	Dodge	Charger	2015
E30	Dodge	Charger	2015
E30	Dodge	Charger	2015
E30	Dodge	Charger	2015
E30	Dodge	Charger	2014
E30	Dodge	Charger	2014



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PHASE I RESULTS

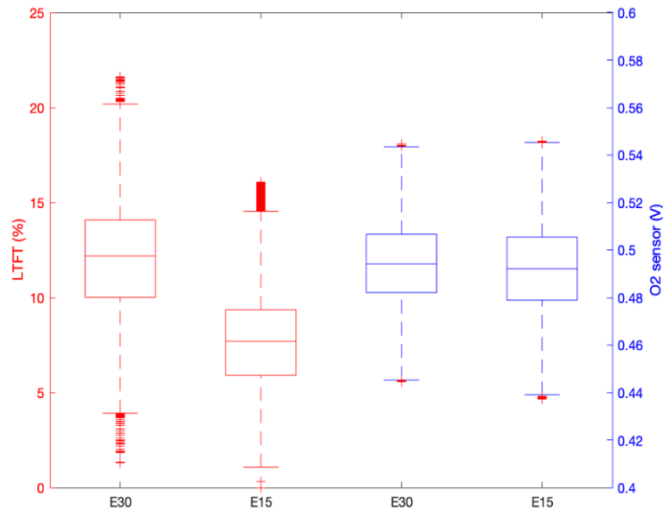
Fuel Type	Miles Driven (SP)	Miles Driven (TSB)	Total Miles Driven
E15	89410	242073	331483
E30	100387	207129	307516
Total	189797	449202	638999



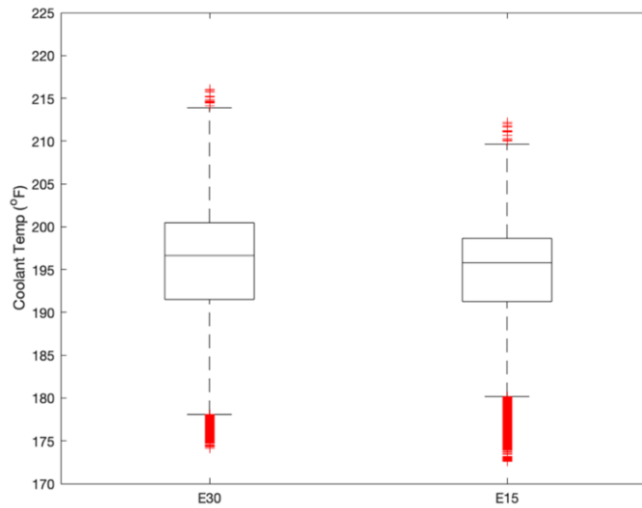
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PHASE I RESULTS

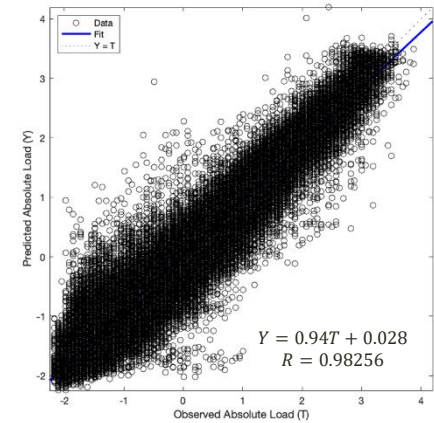
Air to Fuel Ratio



Temperature



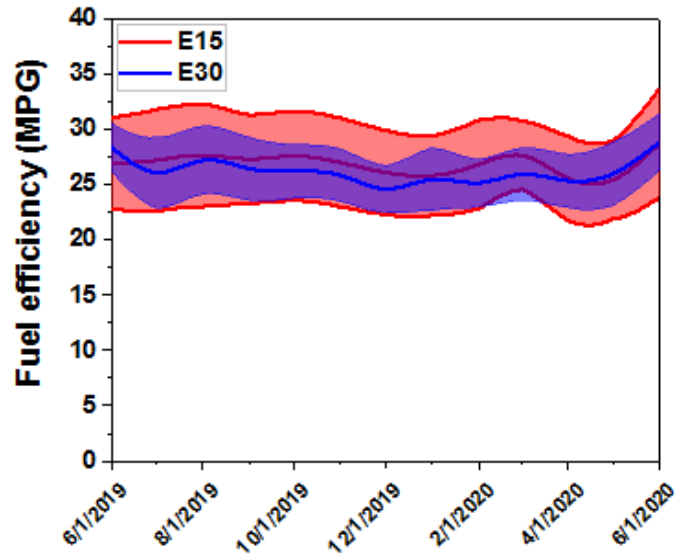
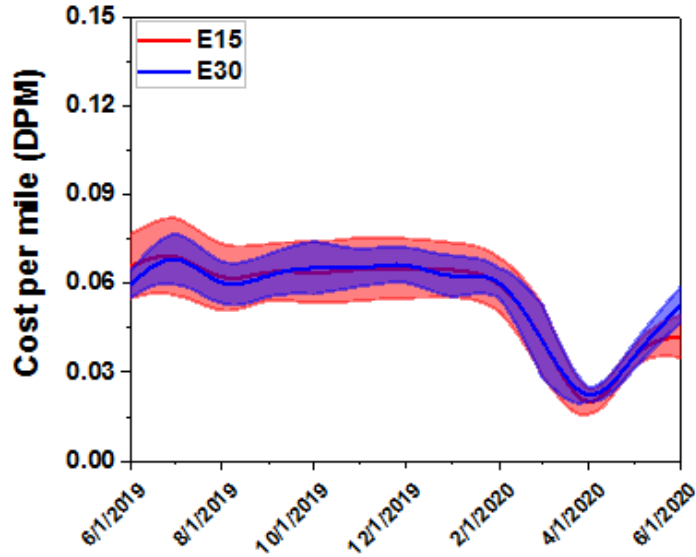
Absolute Load



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PHASE I RESULTS

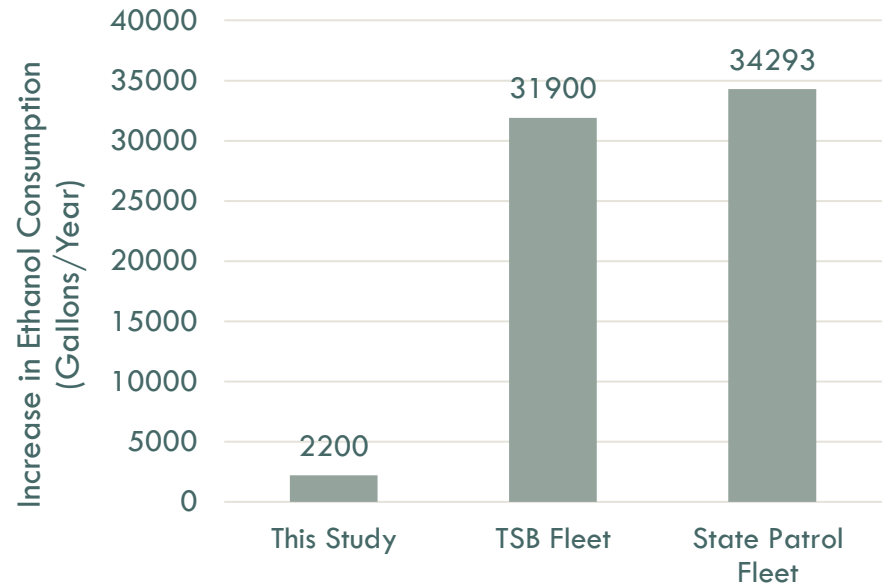
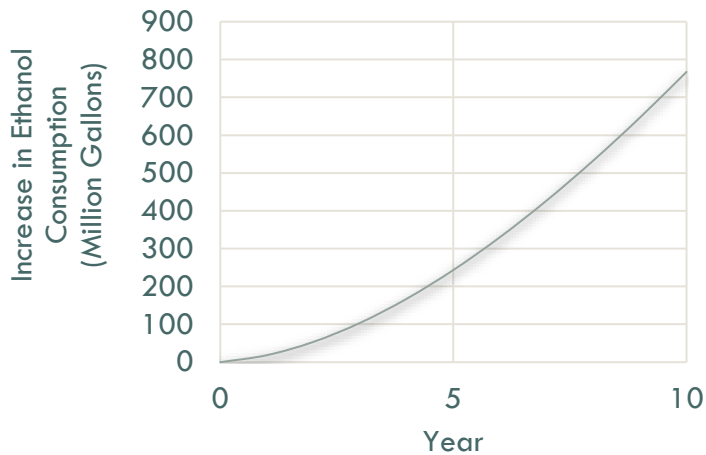
- Price difference of $>2.5\%$ makes E30 the more economically viable fuel.



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PHASE I RESULTS

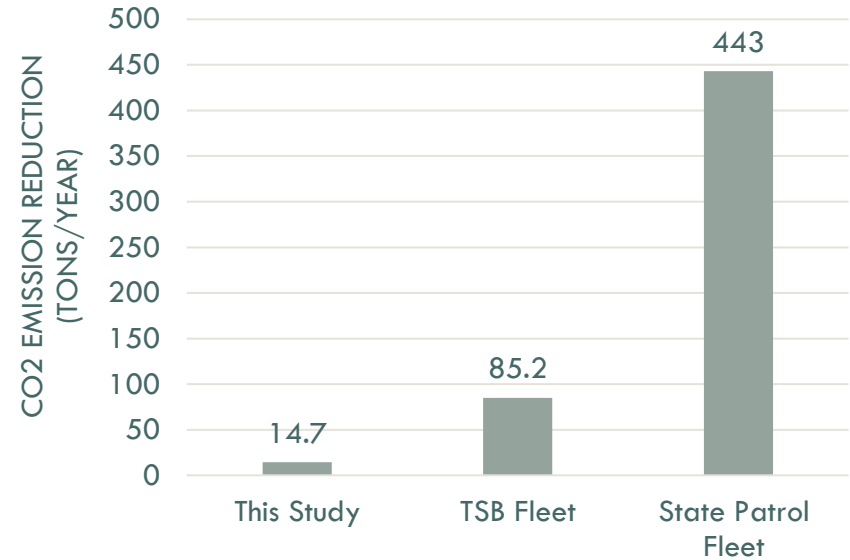
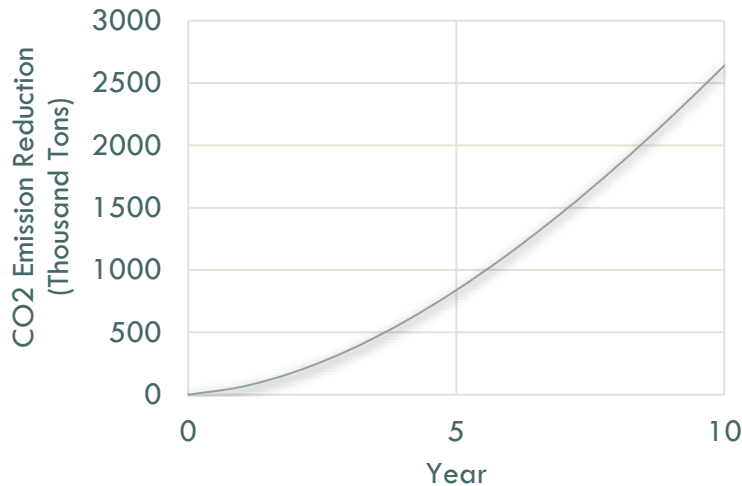
- Approximately 66,000 more gallons of ethanol consumed if TSB and SP fleets switch to E30.
- 18.5 million gallons per year if 10% of NE registered non-FFV vehicles convert to E30.



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PHASE I RESULTS

- CO2 emissions would decrease by 529 tons per year if TSB and SP fleets switch to E30.
- 64,000 tons per year if 10% of NE registered non-FFV vehicles convert to E30.



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PHASE I RESULTS

- Non-FFVs were able to adjust the air-to-fuel ration (AFR) to adapt to the higher oxygen content of E30.
- E30 had no observable negative effect on overall vehicle performance.
- The cost per mile for E15 and E30 fueled vehicles were nearly identical over the one-year demonstration.



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PHASE I TAKEAWAYS

The UNL Research Team recommended to implement the following:

1. Perform the demonstration over a longer length of time
2. Analyze data from different makes/models and years
3. Use retail price instead of rack prices for economic analysis



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WHAT DID EPA CHANGE?

- EPA released a proposed rule Friday, December 4, 2020, making changes to the requirements for exemptions for fuels used for national security/military purposes, temporary R&D, racing and aviation.

“First, we are including language that imposes conditions on parties operating under an R&D test program to prevent the inadvertent use of test fuels exempted under a temporary R&D exemptions by participants not included in the test program. Recently, we have received requests for R&D exemptions that focus on the effect of a certain fuel’s use in more real-world operation conditions (as opposed to a contained laboratory type situation)...”



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WHAT DID EPA CHANGE?

- EPA added several requirements under a new section of the law titled “(d) Additional Requirements”. (4) prohibits the use of fuel retailers.

(d) Additional requirements.

(1) The PTDs associated with fuel must comply with the requirements of subpart L of this part.

(2) The fuel must be designated as exempt fuel by the fuel manufacturer or supplier, as applicable.

(3) The fuel must be kept segregated from non-exempt fuel at all points in the distribution system.

(4) The fuel must not be sold, distributed, offered for sale or distribution, dispensed, supplied, offered for supply, transported to or from, or stored by a retail outlet or WPC facility, unless the WPC facility is associated with the R&D program that uses the fuel.

(5) At the completion of the program, any emission control systems or elements of design that are damaged or rendered inoperative must be replaced on vehicles remaining in service or the responsible person will be liable for a violation of 42 U.S.C. 7522(a)(3), unless sufficient evidence is supplied that the emission controls or elements of design were not damaged.



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PHASE II APPROVAL PROCESS

- 1) Prepare a formal application for your demonstration project using the criteria established in the Federal Register under 40 CFR § 1090.610.
 - a. Essentially, this is answering a series of questions or providing information including (but not limited to) the following:
 - i. **(1) A concise statement of the purpose** of the program demonstrating that the program has an appropriate R&D purpose.
 - ii. **(3) A demonstration of the reasonableness** of the scope of the program, including all the following: (i) **An estimate of the programs' duration in time** (including beginning and ending dates). (ii) **An estimate of the maximum number of vehicles, engines, and equipment involved** in the program, and the number of miles and engine hours that will be accumulated on each.
 - iii. **(iv) The manner in which information** on the fuel used in the program (including quantity, fuel properties, name, address, telephone number, and contact person of the supplier, and the date received from the supplier) **will be recorded and made available to EPA upon request.**
 - iv. **(v) The manner in which the party will ensure that the fuel will be segregated from fuel that meets the requirements of subparts C and D** of this part, as applicable, and how fuel dispensed will be labeled to ensure that the fuel is not dispensed for use in motor vehicle or nonroad engines, vehicles, or equipment, including locomotive or marine engines, that are part of the R&D test program.



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PHASE II APPROVAL PROCESS

- a. The most important elements of the application to the EPA are the following:
 - i. **There must be a clear research and development purpose/cause.**
 - ii. **The E30 test fuel must be completely segregated from all legally tendered fuels** as a misfuelling mitigation.

- a. Generally, to do the E30 Demonstration waivers will be needed for the following regulations:
 - i. RVP limitations outlined in Section 211(h)(1) of the Clean Air Act.
 - ii. 40 CFR § 1090.200(f), which sets limits to the amount of ethanol in gasoline.

- 1) **The two most critical pieces to Nebraska's success through the application process were:**
 - a. The State of Nebraska ***owns the fueling infrastructure*** that the state fleet uses.
 - b. The State of Nebraska has ***set a precedent of a research purpose*** through the previous demonstration.



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PHASE II APPROVAL PROCESS

- Formally approved by the EPA to begin the demonstration in late October 2022.
- EPA is aligned with a multi-year demonstration with interim-reports. However, approvals must be maintained annually.
- Several month 'ramp-up' time to ensure integrity of fuel infrastructure and consistent availability of the E30 fuel.
- Approval includes the use of up to 825 non-FFVs using E30 and 90,000 gallons per month of E30 as needed.
- The Model Year range for the approved vehicles is 2002 – 2023 and includes light duty passenger cars, SUVs & trucks of various makes/models.



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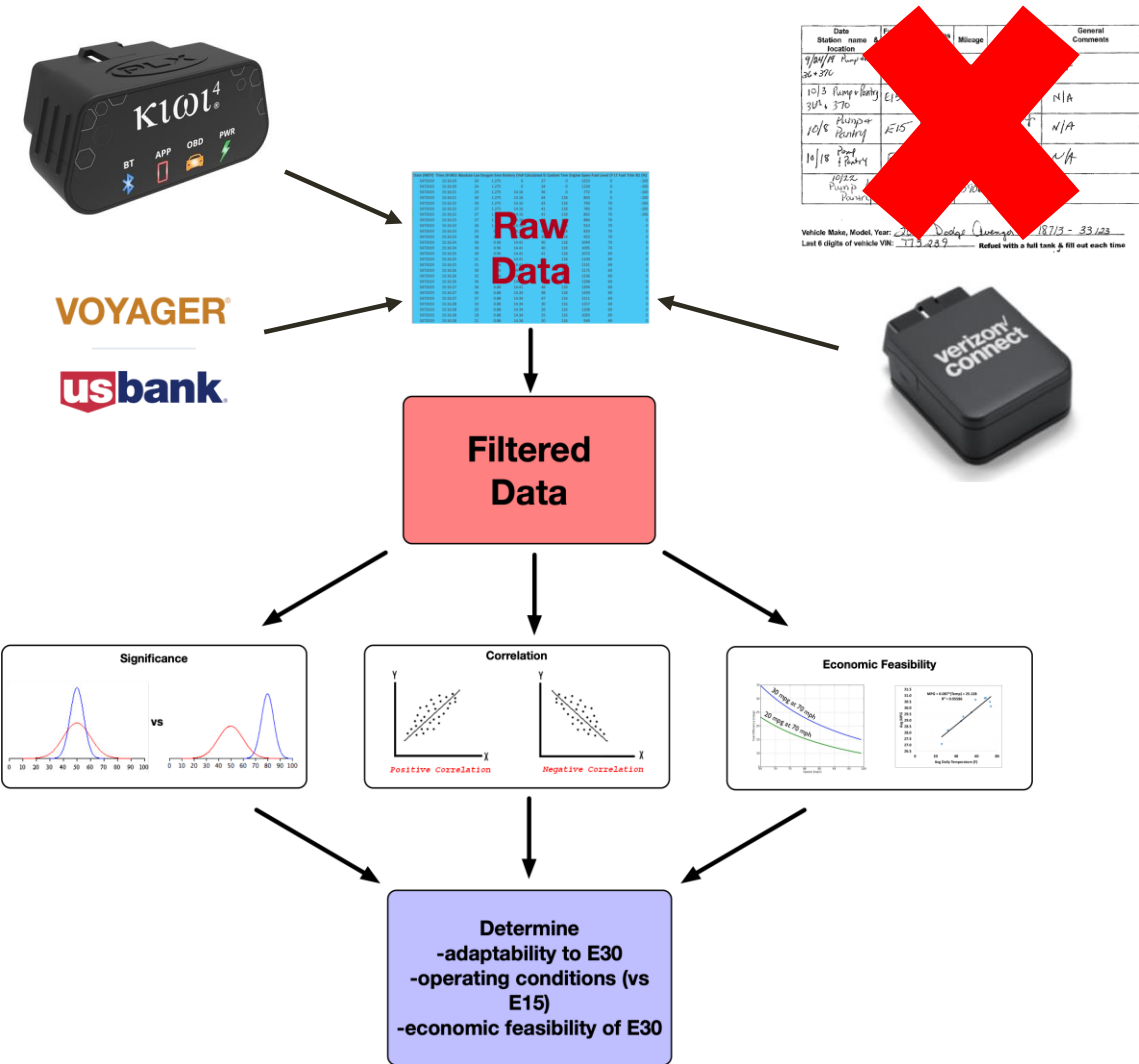
PHASE II EXPERIMENTAL DESIGN

- E30 fuel will be purchased, stored and dispensed from NE-owned fueling infrastructure into State of NE fleet vehicles.
- Mileage, economic, and maintenance (check engine coding) data will be captured via OBDII Data Loggers, GPS Trackers, and fuel purchasing reports from Voyager fleet credit cards.
- All data will be analyzed by the UNL Research Team.



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PHASE I EXPERIMENTAL DESIGN



Date	Station name & location	Mileage	General Comments
9/24/18	Pump & Bakery	36 + 376	
10/3	Pump & Bakery	E15	N/A
3/21	376		
10/8	Pump & Bakery	E15	N/A
10/18	Pump & Bakery		N/A
10/25	Pump & Bakery		N/A

Vehicle Make, Model, Year: Dodge Charger 2013 - 33,123
 Last 4 digits of vehicle VIN: 113-245 Retest with a full tank & fill out each time

PHASE II PROGRESS UPDATE

- Over 22,000 gallons of E30 have been purchased for use in the state fleet of vehicles.
- The price spread for the purchased E30 has averaged 40 cents/gallon cheaper than the price of E15. This has culminated in \$9,000 in savings for the state already.
- With over four months of vehicles running on E30, there have been zero mechanical issues with any of the vehicles.
- With over four months of ordering E30, there have been zero mechanical issues with fueling infrastructure.
- Nearly 40 vehicles outfitted with advanced onboard diagnostic (OBD) trackers.
- 85% of the vehicles in the TSB fleet already have GPS trackers, which also track check engine codes, and more vehicles are planned to have GPS trackers installed.
- The GPS trackers in the TSB fleet, in all the demonstration vehicles running on E30, have so far shown zero check engine code warnings.



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PHASE II GENERAL BENEFITS

- E30 bulk pricing can achieve a spread of nearly a quarter (25 cents) compared to E15. This is an estimated cost savings opportunity for the state of close to \$115,000 annually.
- The conversion of all E15 used by the State of Nebraska to E30 would instantly more than double the amount of ethanol used by the state fleet, to 230,000 gallons of ethanol per year.
- If we use E30 in all the vehicles approved by the EPA, Phase II could easily eclipse 30 times as many miles driven on E30 in Phase I.
- With Phase II, we have the capability to reduce the state fleet's carbon footprint by nearly 225 tons of CO2 emissions per year.



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QUESTIONS?

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