CNG Feasibility Study – Facility and Fleet Conversion (Kansas City Area Transportation Authority)

APTA EXPO
October 14, 2014

Sarah Frost, AICP – Project Manager/Transportation Planner

TranSystems Background

TranSystems

- **Multidisciplinary E/A Firm**
- **1,000 people in 38 offices in U.S.**
- **Corporate HQ in Kansas City**
- **Work in 9 Primary Market Sectors**

Airports and Carriers

Energy/Communications

Federal Government

Freight Railroads

Ports and Maritime

Shippers/Distribution

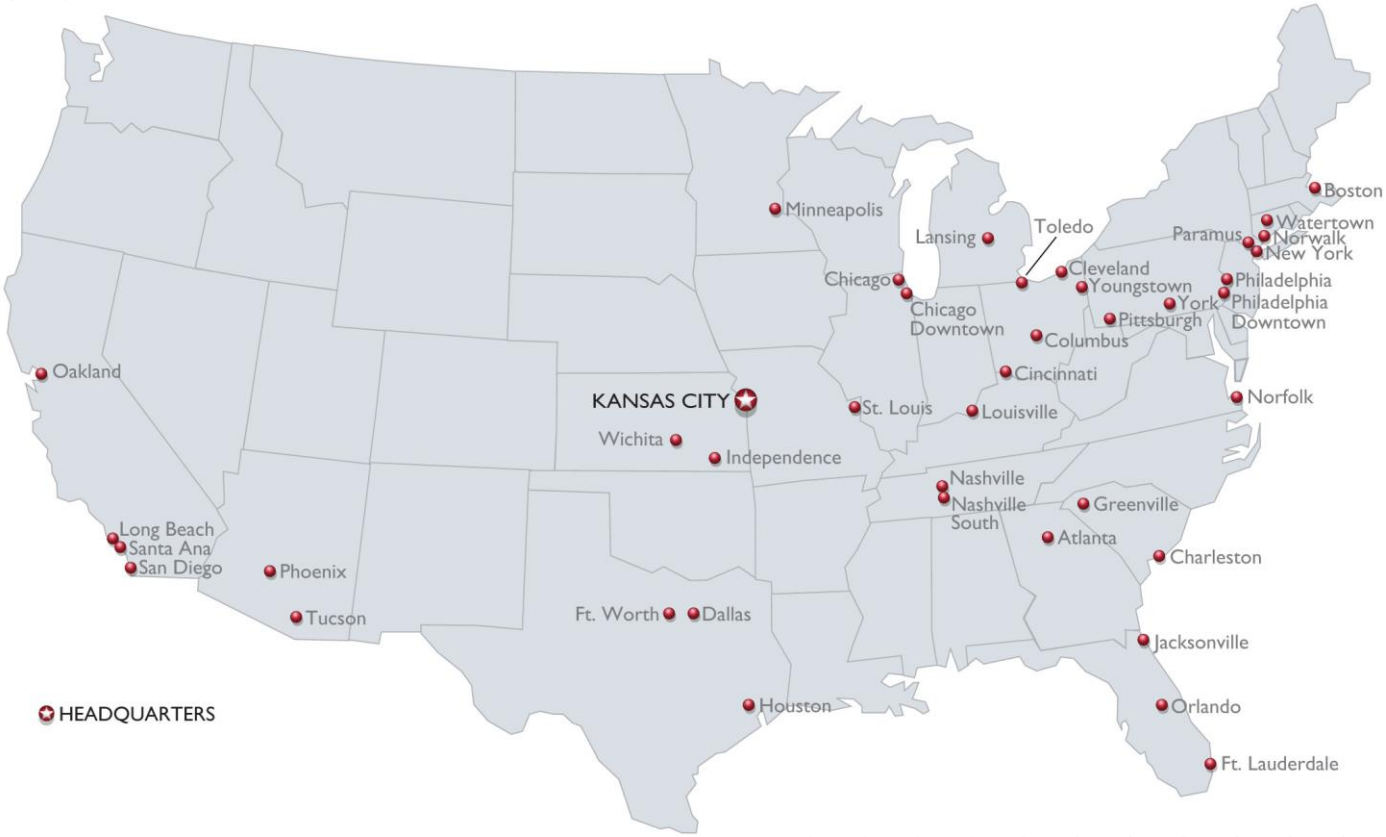
States & Municipalities

Trucking/Automotive

Passenger Rail and Transit

TranSystems Background

TranSystems has more than 1,100 professionals in 40 offices



KCATA – CNG Feasibility Study

Project Background - Motivation

Preliminary Feasibility Study to assist the KCATA in making a decision to pursue implementation of a CNG based fleet.

- **Project Team:**

  TranSystems

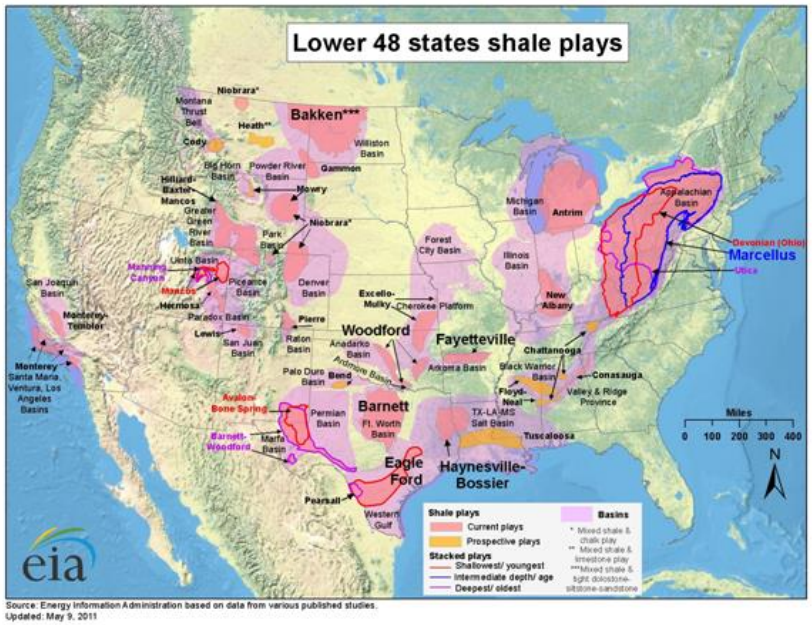
  Gibbens Drake Scott

Courtesy of The National Renewable Energy Laboratory (NREL)

KCATA – CNG Feasibility Study

National Emphasis on Natural Gas

- **Reduced GHG emissions**
- **Being embraced by transit agencies, municipalities**
- **Abundant, domestic fuel source**



CNG Conversion Support

Kansas City, Mo. Support for Transit CNG

Feb. 2012 City Council Resolution Supporting ATA's Conversion To Natural Gas Fuel

"… the City of Kansas City supports the KCATA in its pursuit of compressed natural gas as a viable option for fueling the KCATA vehicle fleet."

Feasibility Study Approach

Feasibility Study - A Systematic Approach

Define Motivators

- Lower Fuel Costs
- Lower Cost of Operations
- Lower Emissions
- Domestic Fuel Source

Define Challenges

- Site Constraints
- Dual-Fuel Facility
- Utility Availability
- Implementation Schedule

Recommendation

Fleet Conversion – What is Required?

- **Buses**
  - To be phased in on current retirement schedule.
  - CNG buses – cost $25K - $50K more than diesel equivalent.
  - CNG buses – modified engine (gaseous injection, spark ignition system)
  - Some geometric differences – tank location

Fleet Conversion – What is Required?

- **Facility Conversion (Buildings built in 1977)**
  - Vehicle Storage, Vehicle Maintenance (Code Required)
    - Enhanced Ventilation Requirements
    - Elimination of "Gas Pockets"
    - Electrical Requirements
    - Elimination of High Temperature Surfaces

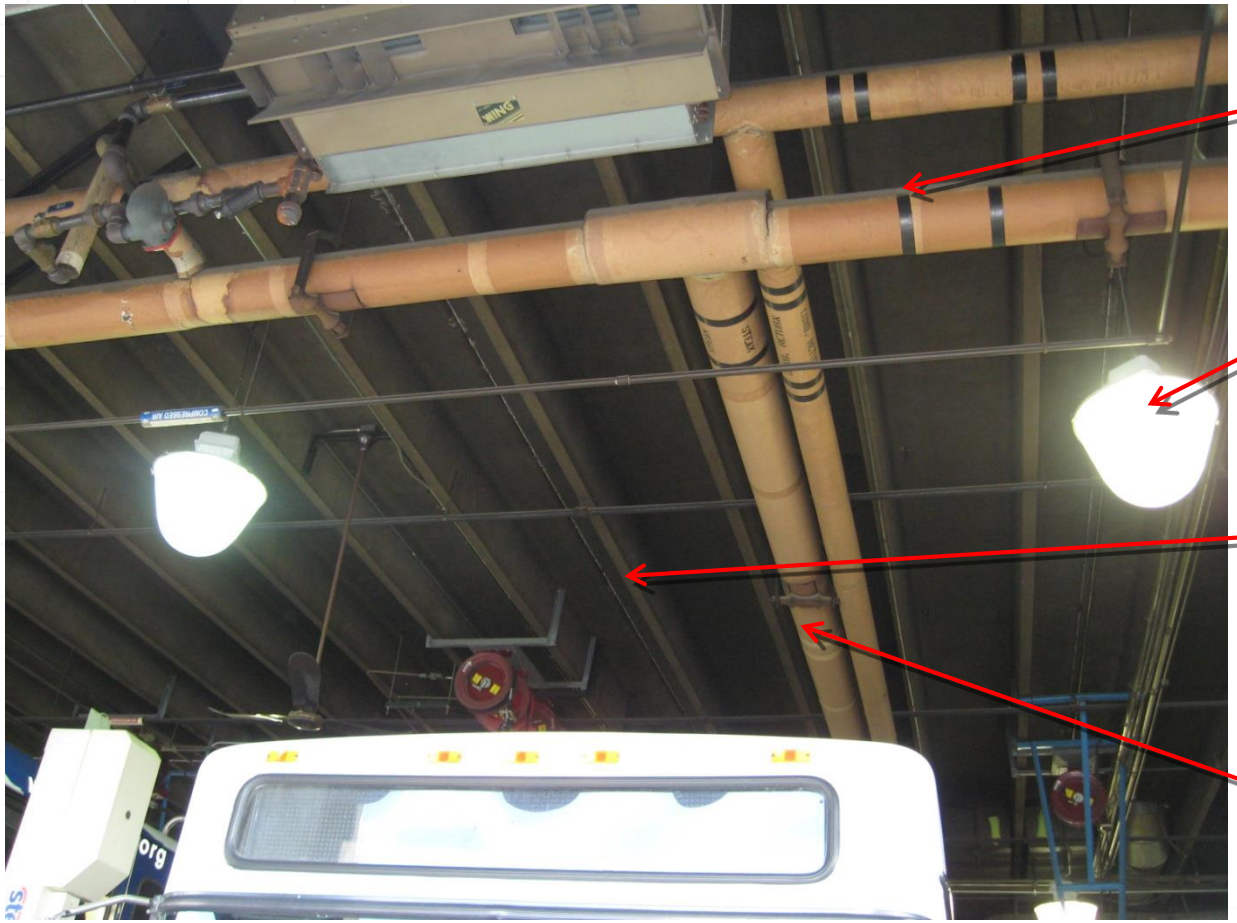
KCATA – CNG Feasibility Study

LEGEND

- Maintenance
- Bus Storage
- Bus Service (Fueling, Wash)

KCATA Site

KCATA – CNG Feasibility Study



Ensure adequate Ventilation

Ensure Compliant Electrical components

Accommodate existing structural systems.

No interference with existing systems

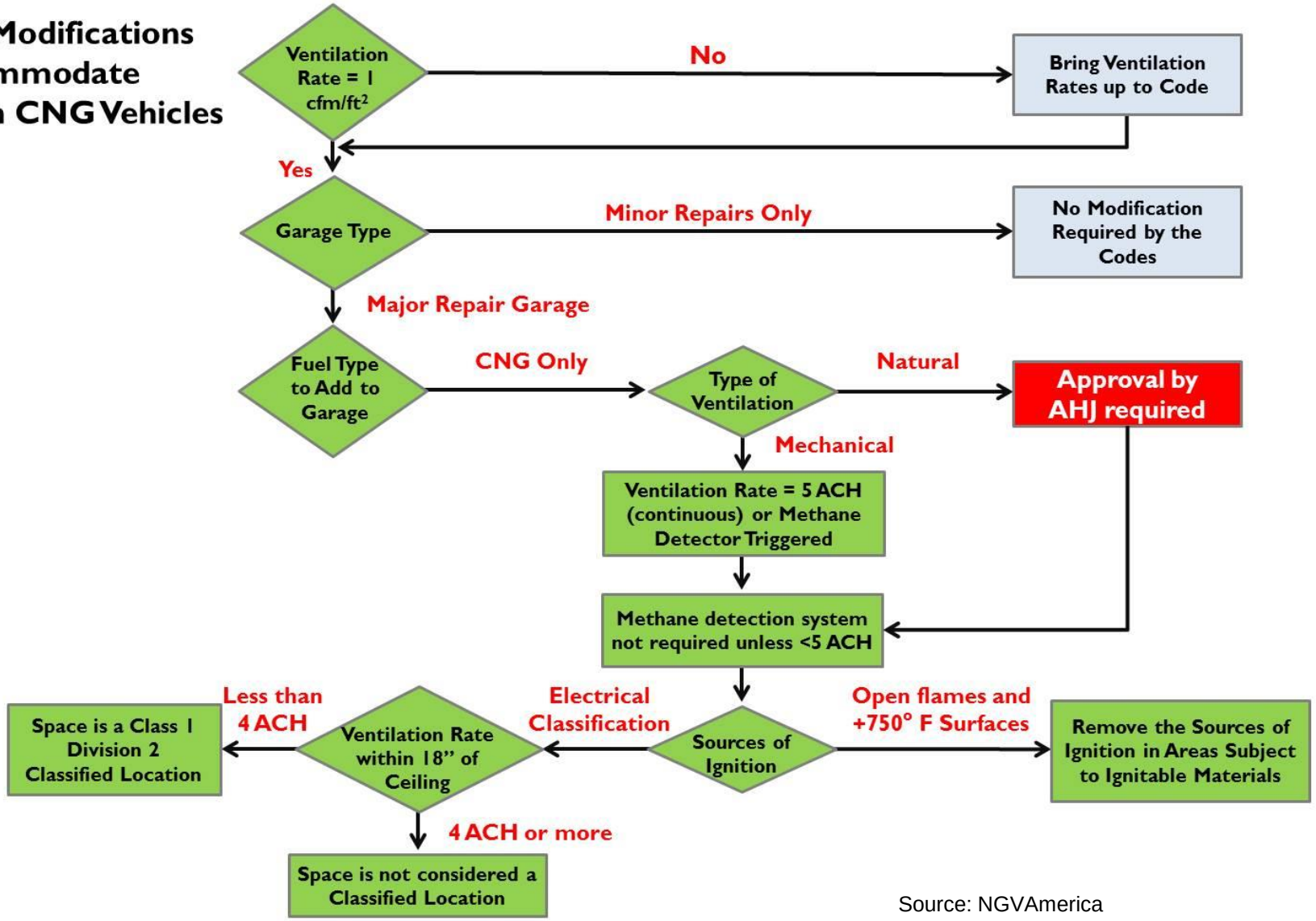
KCATA – CNG Feasibility Study

- **Facility Modifications**
- **Design Services**

International
Building
Code

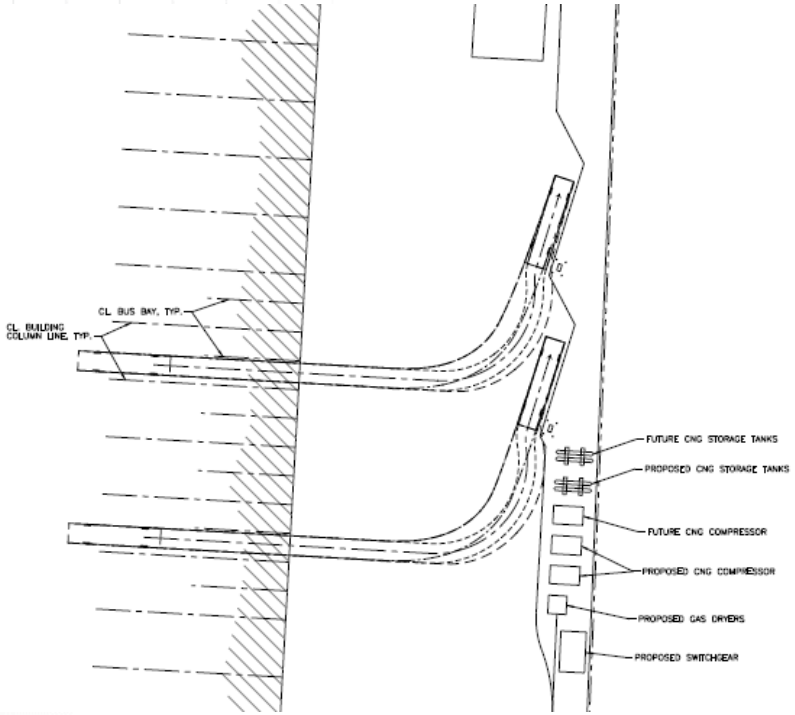
Ventilation **Gas Detection** **Sources of Ignition** **Electrical Installations**

Facility Modifications to Accommodate Work on CNG Vehicles

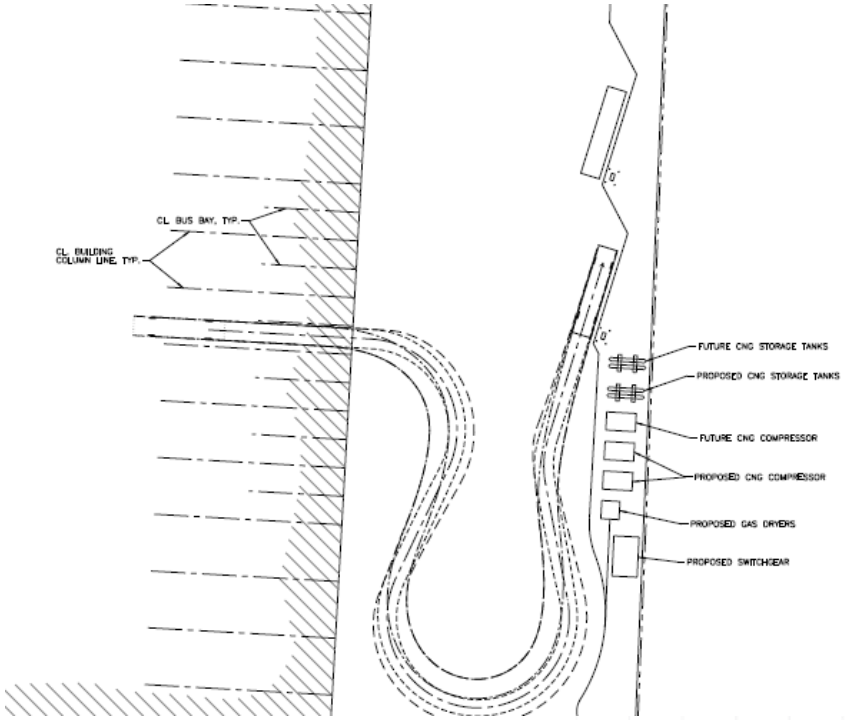


Source: NGVAmerica

Facility Evaluation

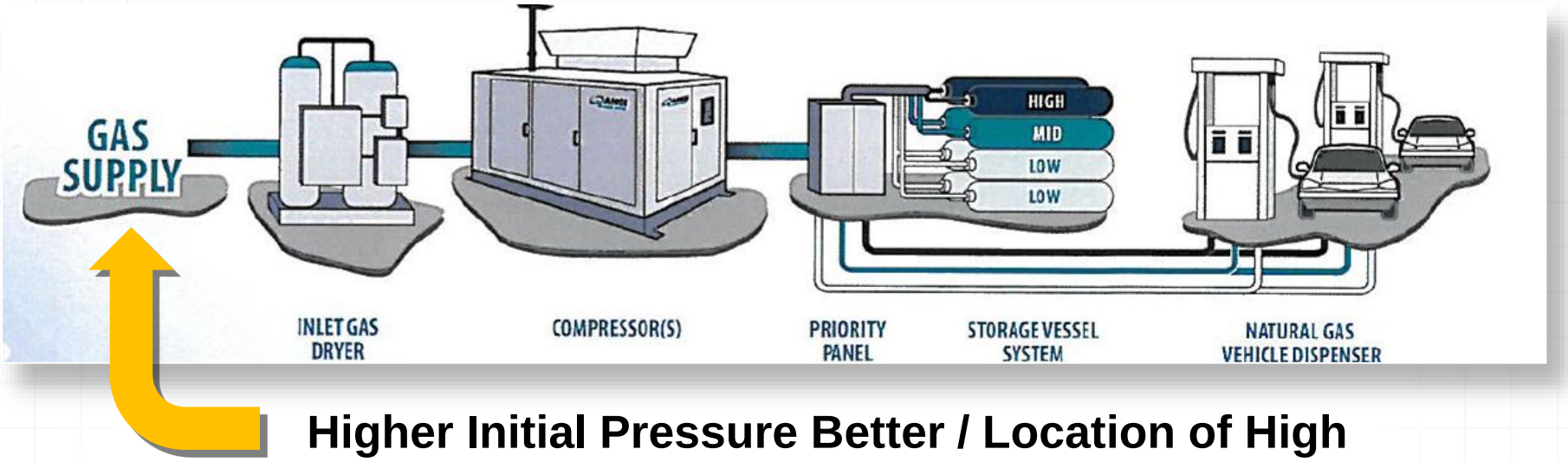


Scenario A



Scenario B

Site and Utility Evaluations



Higher Initial Pressure Better / Location of High Pressure Main

Electrical Supply

High Voltage Supply Available / Location

KCATA – CNG Feasibility Study

Fleet Conversion – What is Required?

- **CNG Fueling Facility**
  - Stand-Alone, "Fast Fuel" Facility

    Requires Series (Redundant) Compressors

    Special Canopies – No Gas Pockets

    Storage Tanks

    Increased Electrical Demands

    ($0.14/DGE)

KCATA Fueling CNG Fueling Station

Financial Analysis (Cost-Benefit Analysis)

- **Basis of Analysis**

  U.S. Dept. of Energy

  Vehicle and Infrastructure Cash-Flow Evaluation

- **Model – Present Value Analysis**

  Costs = Facility Modifications, Vehicles, Operational

  Benefits = Fuel Cost Savings, Reduced Emissions

  (political , tax, or social benefits)

Financial Analysis (Cost-Benefit Analysis)

- **Primary Assumptions and Input Values – Benefits**
  - Miles / Bus / Year (KCATA Data)
  - Fuel Economy – 4.0 mpg – Existing Diesel Fleet
  - Fuel economy - 3.28 mpDGE – CNG Fleet
  - Fuel Cost – $3.00/gal (current KCATA contract)
  - Fuel Cost – $1.56/DGE (local price comparisons, with adds)
  - No. of CNG Buses – on KCATA replacement Schedule (7 yrs.)

RESULT – Increasing benefit stream as buses are replaced.

Financial Analysis (Cost-Benefit Analysis)

- **Primary Assumptions and Input Values – Costs**
  - Bus Replacement – incremental costs of CNG buses =$50k ea.
  - Storage Building – Ventilation, electrical
  - Maintenance Building(s) – Ventilation, electrical upgrades
  - New Fueling Facility – Stand-Alone CNG
  - Site Modifications /Utility Upgrades
  - Future Upgrades as Fleet is replaced

RESULT – Large initial capital expense, smaller yearly expenses following.

Financial Analysis (Cost-Benefit Analysis)

- **Preliminary Results – "Payback" Period**
  - **All Costs – 8-9 Year Payback Period**

Analysis Sensitivity:

- Difference between Diesel and CNG prices
- Accelerated implementation of buses (more miles)

KCATA – CNG Feasibility Study

Economic Analysis (Net Present Value Analysis)

Basic Analysis Parmeters		
Assumed CNG bus order/yr		Varies
Miles per vehicle/yr. (JOCO Transit)		30344
Miles per vehicle/yr. (KCATA)		35967
Analysis Start - two years in future		(2013)
Current Est. CNG cost / DGE (Sept. 2011)	$	1.51
Current Est. Diesel cost / DGE	$	3.50
Estimated Incremental Cost of CNG Bus	$	50,000

Federal Mandated Discount Rate =	3.0%
Assumed Life of Facility Improvements =	20 years
Salvage Value Determination; linear evaluation with 14 year useful life for buses	
CNG Price Escalation Rate per year =	2.4%
Diesel Price Escalation Rate per year =	4.1%

PROJECT YEAR	0	1	2	3	4	5	6	7	8	9	10	11
CALENDAR YEAR	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
BENEFITS SUMMARY												
No. of CNG Buses / year to be Purchased	0	25	25	20	20	20	20	20	20	20	20	20
Cumulative CNG bus total in fleet		25	50	70	90	110	130	150	170	190	210	230
Cumulative Milage for CNG Bus Fleet - KCATA	0	449588	1798350	2517690	3237030	3956370	4675710	5395050	6114390	6833730	7553070	8272410
Supplementary Mileage Possible	0	0	0	0	0	0	0	0	0	0	0	0
Cumulative Milage for CNG Bus Fleet - all buses	0	449587.5	1798350	2517690	3237030	3956370	4675710	5395050	6114390	6833730	7553070	8272410
Diesel Cost/gal	$ 3.50	$ 3.64	$ 3.79	$ 3.95	$ 4.11	$ 4.28	$ 4.45	$ 4.64	$ 4.83	$ 5.02	$ 5.23	$ 5.45
CNG Equiv. Cost/Gal (DGE basis)	$ 1.51	$ 1.55	$ 1.58	$ 1.62	$ 1.66	$ 1.70	$ 1.74	$ 1.78	$ 1.83	$ 1.87	$ 1.91	$ 1.96
Diesel Gallons @ 4 MPG	-	112,397	449,588	629,423	809,258	989,093	1,168,928	1,348,763	1,528,598	1,708,433	1,888,268	2,068,103
CNG - DGE @ 3.28 MPG	-	137,069	548,277	767,588	986,899	1,206,210	1,425,521	1,644,832	1,864,143	2,083,454	2,302,765	2,522,076
Total Fuel Savings (DGE basis)	$ -	$ 197,576	$ 837,118	$ 1,240,677	$ 1,687,759	$ 2,181,437	$ 2,724,963	$ 3,321,779	$ 3,975,530	$ 4,690,068	$ 5,469,470	$ 6,318,047
Diesel costs												
Undiscounted Benefit Value per Year	$ -	$ 197,576	$ 837,118	$ 1,240,677	$ 1,687,759	$ 2,181,437	$ 2,724,963	$ 3,321,779	$ 3,975,530	$ 4,690,068	$ 5,469,470	$ 6,318,047
Discounted Benefit Value per year to Present	**$ -**	**$ 191,821**	**$ 789,064**	**$ 1,135,395**	**$ 1,499,552**	**$ 1,881,727**	**$ 2,282,114**	**$ 2,700,911**	**$ 3,138,320**	**$ 3,594,546**	**$ 4,069,800**	**$ 4,564,292**
Discount Index	1.000	0.971	0.943	0.915	0.888	0.863	0.837	0.813	0.789	0.766	0.744	0.722

C

PROJECT YEAR	0	1	2	3	4	5	6	7	8	9	10	11
CALENDAR YEAR	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
COST SUMMARY with CNG FACILITY IMPROVEMENTS												
CNG Bus Cost (Delta)		$ 1,250,000	$ 1,250,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000	$ 1,000,000
JCT Buses		$ 2,100,000										
Electrical Upgrades/Gas Upgrades	$ 135,000	$ 135,000										
Bus Fueling Facility (includes canopy)	$ 1,630,000	$ 1,630,000	$ 50,000	$ 50,000	$ 500,000	$ 50,000	$ 50,000	$ 500,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Storage Building Modifications	$ 3,000,000	$ 2,000,000										
Maintenance Building Modifications	$ 450,000	$ 400,000			$ 250,000			$ 250,000				
Bus Wash Bay Modifications	$ 150,000	$ 100,000										
Site Reconfiguration/Pkg. (plumbing, grading, paving)	$ 250,000	$ 250,000										
Maintenance Equipment		$ 75,000	$ 25,000	$ 15,000								
Maintenance Training		$ 75,000	$ 25,000	$ 15,000								
Administration Costs	$ 150,000	$ 150,000										
Design Costs	$ 500,000	$ 500,000										
Additional Electricity Costs (in fuel number = $0.14/DGE))												
Undiscounted Cost Value per Year	$ 6,265,000	$ 8,665,000	$ 1,350,000	$ 1,080,000	$ 1,750,000	$ 1,050,000	$ 1,050,000	$ 1,750,000	$ 1,050,000	$ 1,050,000	$ 1,050,000	$ 1,050,000
Discounted Cost Value per year to Present	$ 6,265,000	$ 8,412,621	$ 1,272,504	$ 988,353	$ 1,554,852	$ 905,739	$ 879,358	$ 1,422,910	$ 828,880	$ 804,738	$ 781,299	$ 758,542
Total Project Cost	$ 14,677,621											

- **Multiple Variables**
  - fuel price
  - fuel price escalation
  - implementation time
  - discount rate
  - average miles driven
  - average miles/DGE
  - flexible cost types
- **Other City Fleets**

RETURN ON INVESTMENT

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