



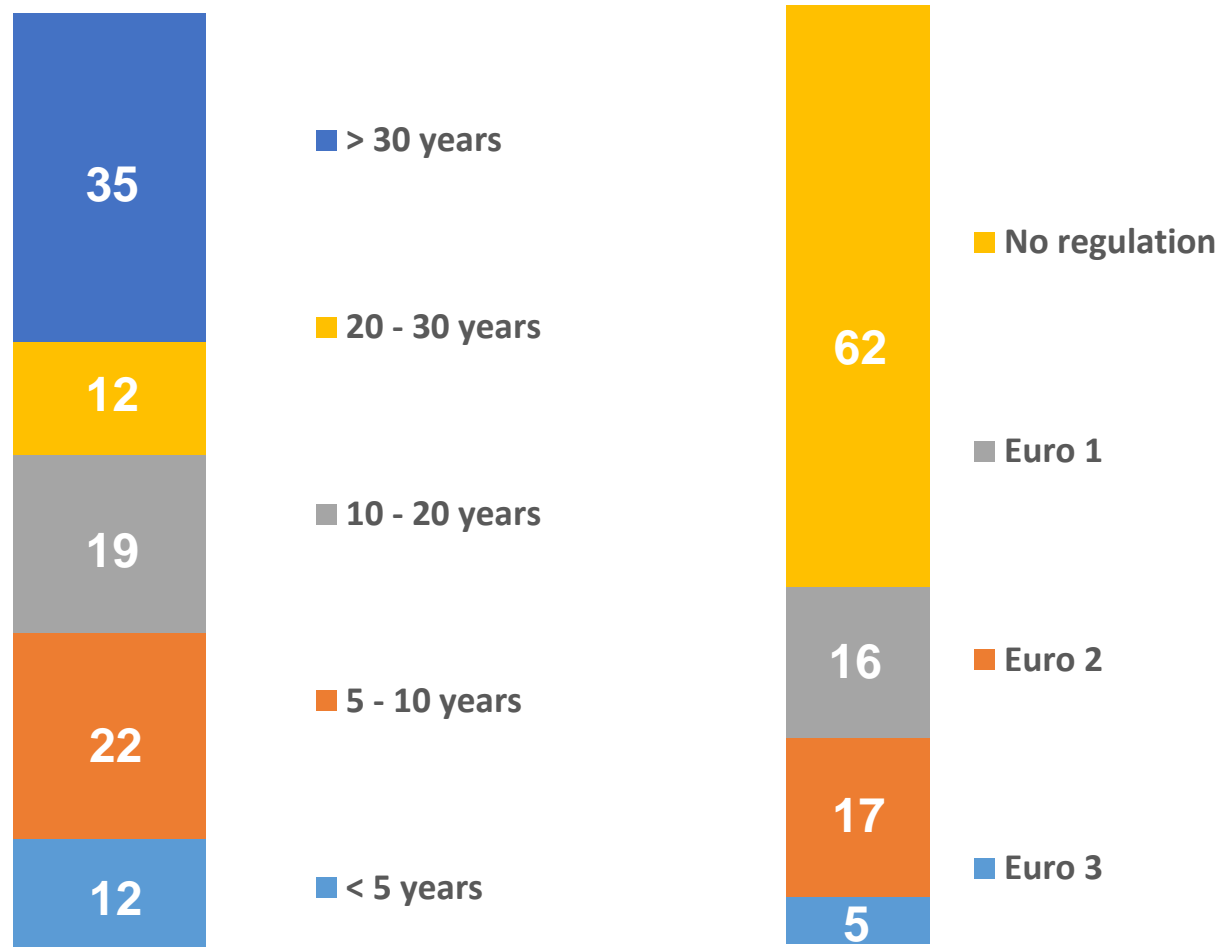
DPF-RETROFIT AND DPF FIRST FIT FOR ALL NEW DIESEL VEHICLE IN IRAN

7.VERT-Forum, EMPA, March 2016, Hossein Izanloo

KEY TOPICS

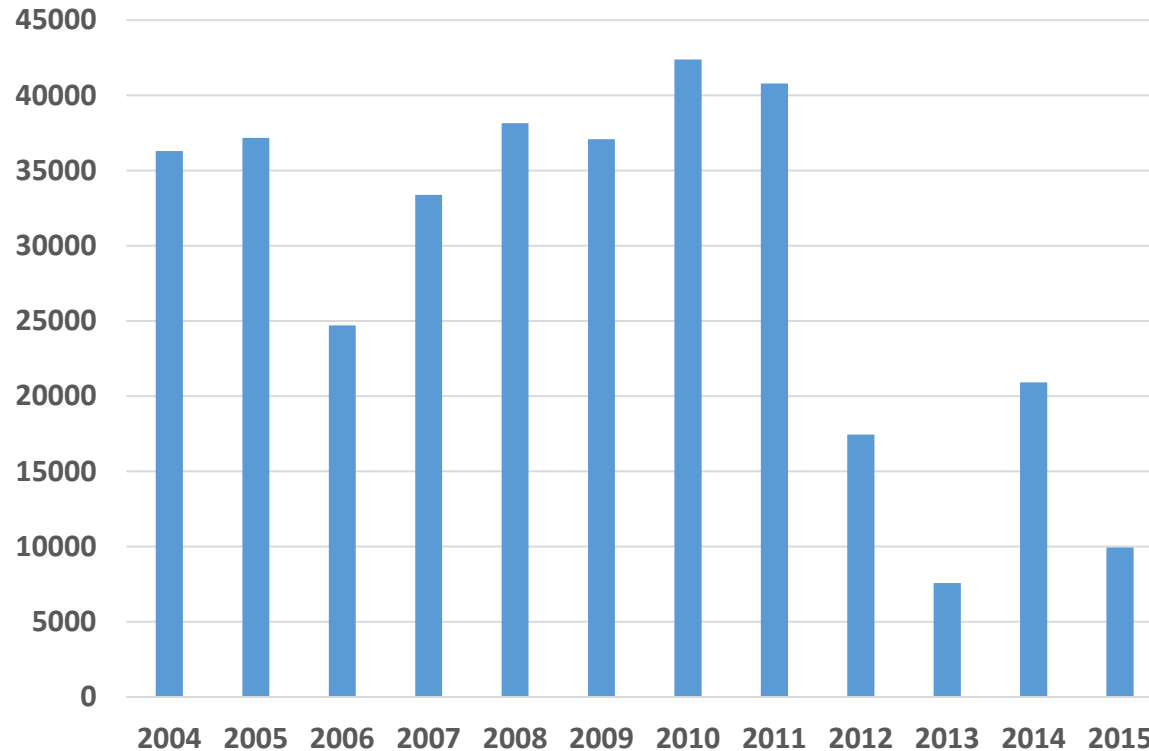
- Iran's commercial vehicle market overview**
- Current status of diesel fuel quality and future development plan**
- PM air pollution problem and related regulations**
- Tehran DPF retrofit program practices**

AGE AND EMISSION REGULATION OF IRAN DIESEL FLEET (%)



Number of total active vehicles in the fleet: about 830,000

HISTORY OF IRAN COMERCIAL VEHICLE PRODUCTION

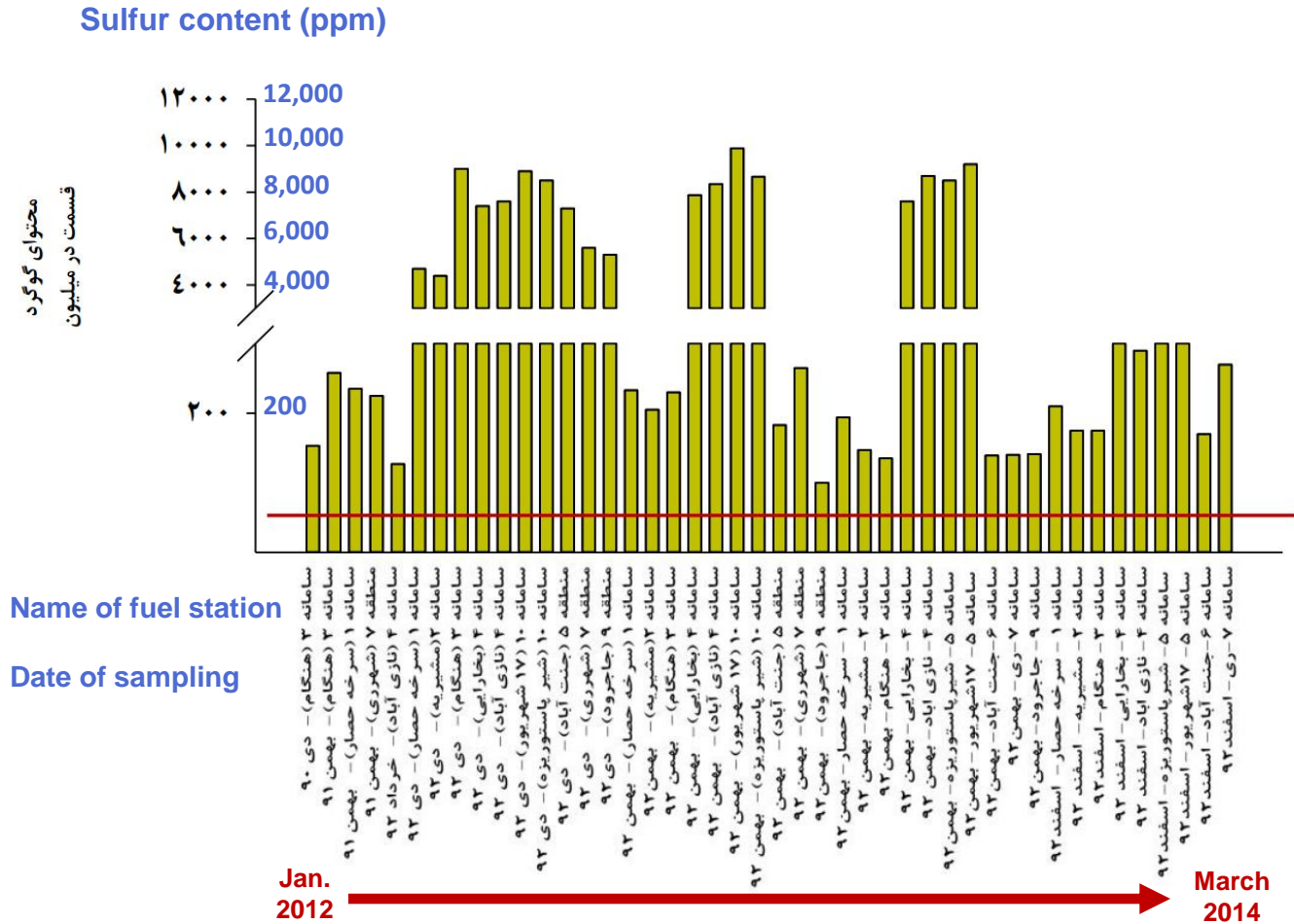


✓ Iran Industrial Ministry's goal is 20,000 domestic production for 2016 and annual 15% growth rate for next 5 years in average!?

MRKET KEY PLAYERS

company		LDV	MDPV	Light-duty Trucks	Heavy-duty Vehicles (GVWR)	Partners	DPF Installation Status
1	IRANKHODRO DIESEL	✓	✓	✓	✓	MERCEDES BENZ; DAIMLER AG; HYUNDAI; FOTON	In talks with partners
2	SAIPA DIESEL	✓	✓	✓	✓	VOLVO TRUCKS; RENUALT TRUCKS; DONGFENG; FOTON	Decided to run pilot test
3	ZAMYAD	✓		✓	✓	IVECO; FAW	In preparation to run pilot test
4	BAHMAN GROUP	✓		✓	✓	ISUZU; MAZDA; YAMAHA; FAW; ZXAUTO	In talks with partners
5	MAMUT				✓	SCANIA	In talks with partner
6	OGHAB AFSHAN		✓			SCANIA	In talks with partner
7	AMICO			✓	✓	? (Chines brands)	No action
8	ADVMCO			✓		IVECO	No action
9	ARIA DIESEL				✓	RENUALT TRUCKS	In talks with partner
10	CARIZAN KHODRO			✓	✓	DFAC	Decided to run pilot test
11	MAYAN			✓		MITSUBISHI FUSO	In talks with partner
12	Azahitks			✓	✓	MAZ; MERCEDES BENZ	

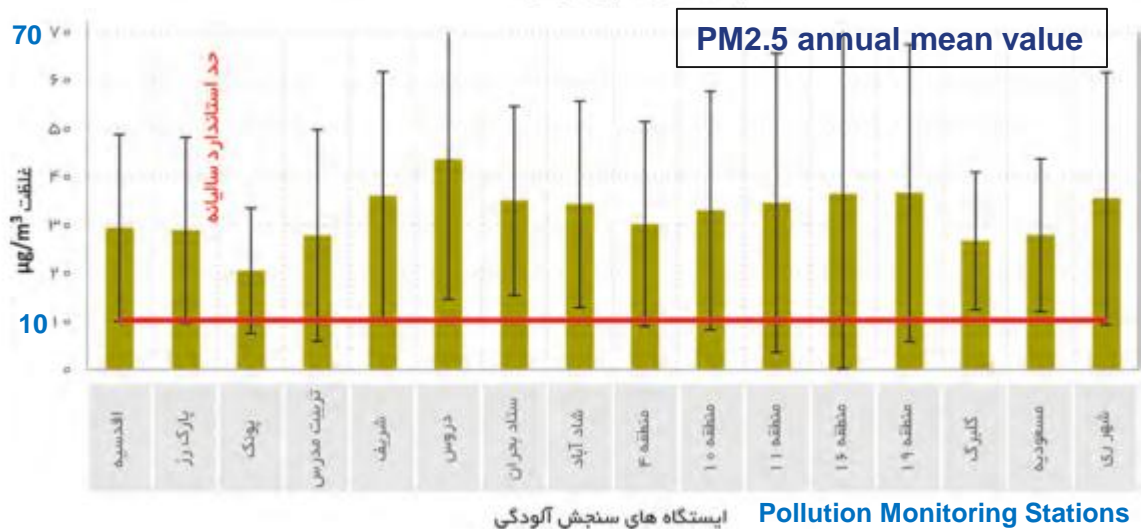
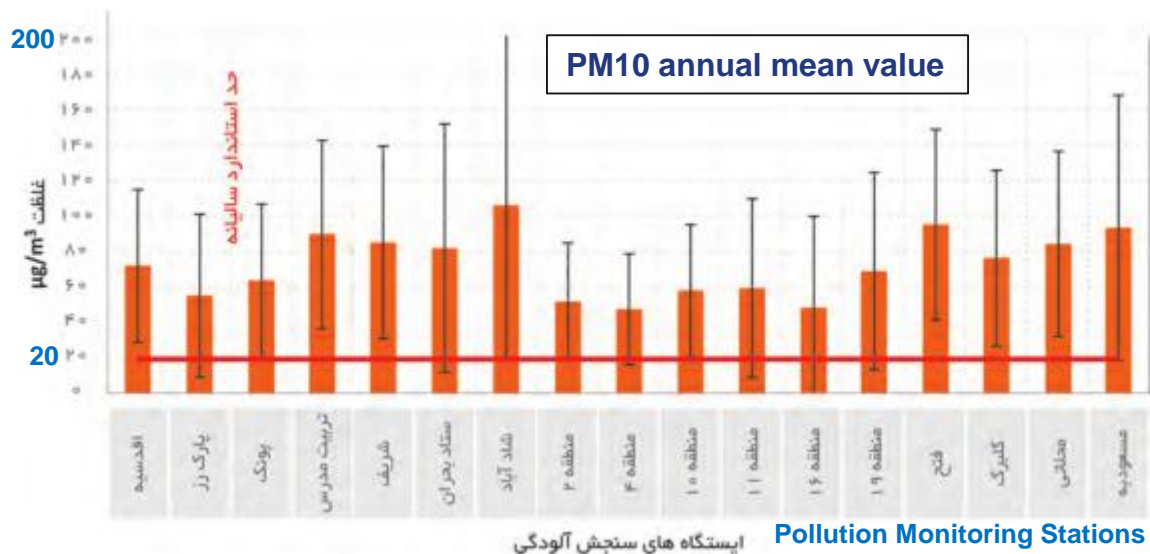
SULFUR CONTENT OF DIESEL FUEL



Diesel consumption in road transport sector: 45 million lit/day

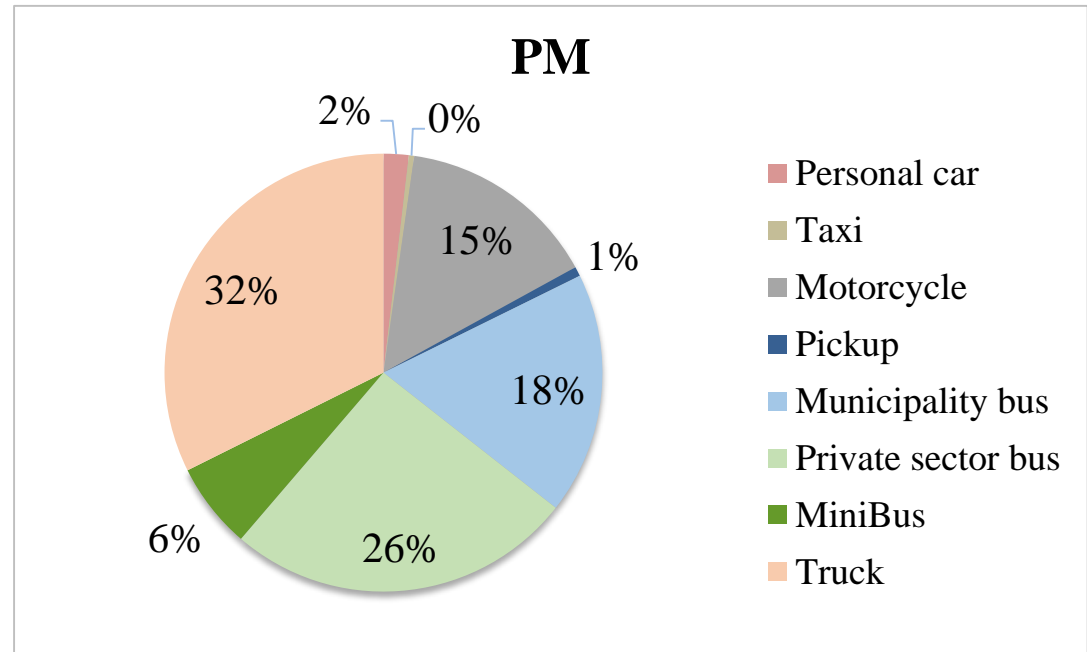
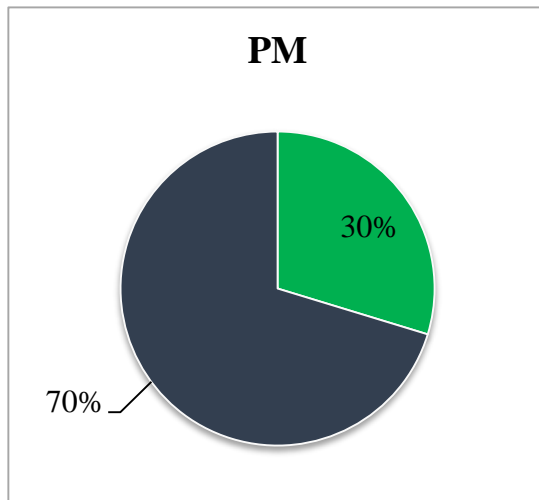
Diesel price: \$ 0.045

Tehran PM problem



منبع: شرکت کنترل کیفیت هوا، گزارش سالانه کیفیت هوای تهران در سال 1393، QM94/02/02(U)/1، خرداد ماه 1394

Contributions of Tehran Primary PM Sources



- Personal car
- Taxi
- Motorcycle
- Pickup
- Municipality bus
- Private sector bus
- MiniBus
- Truck

✓ In Iran 8 megacities have PM problem including Tehran, Isfahan, Mashhad, Tabriz, Karaj, Ahvaz, Shiraz and Qum with total population about 18 million

منبع: شرکت کنترل کیفیت هوا، سیاهه انتشار آلاینده‌گی شهر تهران برای سال مبنای 1392 - جلد دوم: منابع متحرک

IRAN'S PROGRAM FOR PM PROBLEM

- Distribution of Euro 4 fuel in whole country up to 2018**
- DPF Retrofit program for city buses of 8 polluted megacities**
- Installation of DPF on any new diesel vehicle in two stages:**
 - ✓ **Stage IVa will be introduced on Sep. 2016**
 - ✓ **Stage IVb will be introduced on Sep. 2018**
- Main part of new city buses for Tehran and other polluted cities must be CNG**

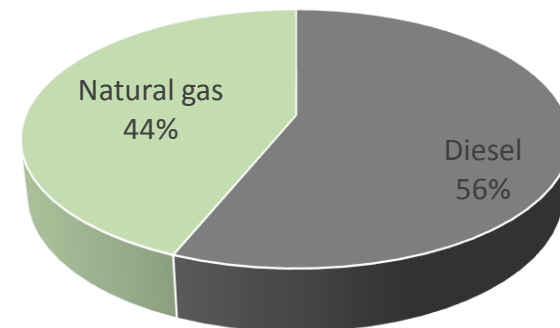
TEHRAN BUS FLEET

Tehran public bus fleet (municipality)

6554

Governmental Sector				Private Sector			
2497				4057			
Diesel		Natural gas		Diesel		Natural gas	
1956		541		1723		2334	
BRTs	Ordinary	BRTs	Ordinary	BRTs	Ordinary	BRTs	Ordinary
1504	452	0	541	0	1723	0	2334

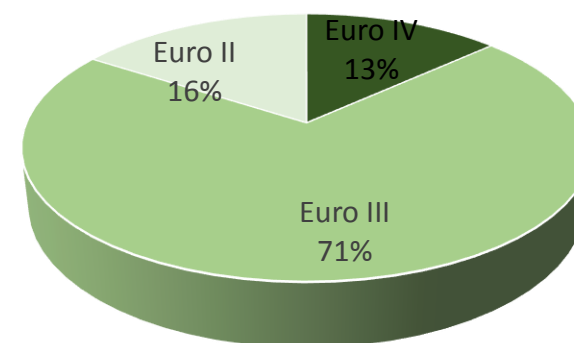
Fuel Classification



Tehran BRTs

Average life	Entrance year	Count	Double cabin	Single Cabin	Engine	Bus Type
5 years	2009-2011	835	X		MAN Euro 3	King Long
5 years	2008-2011	200	X		MAN Euro 3	YOUNGMAN
1 year	2015	200	X		MAN Euro 4	Yutong
9 years	2004-2010	249		X	RENAULT Euro 2	SHAHAB
1 year	2014	20		X	RENAULT Euro 2	SHAHAB
-	-	1504	1235	269	-	Total

BRTs' Emission Standards

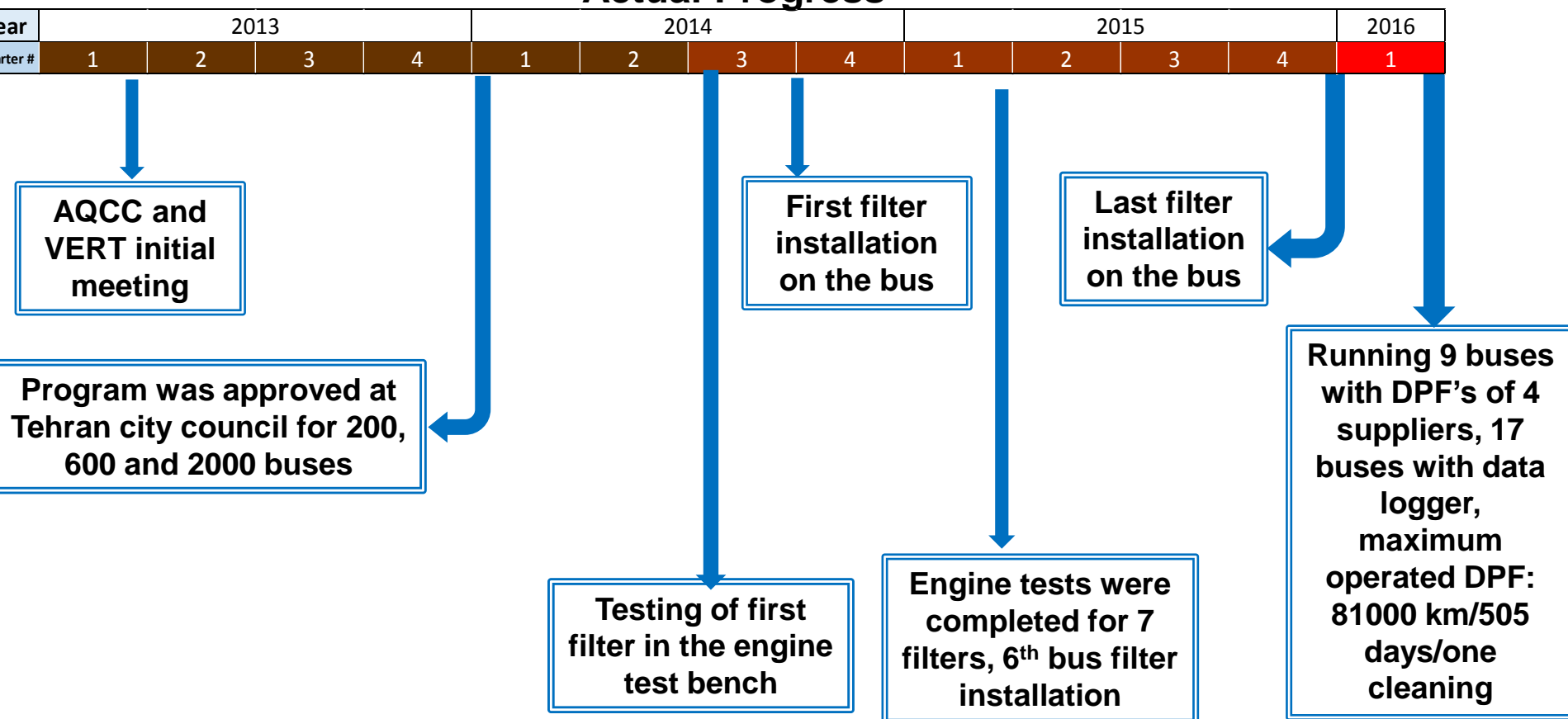


Tehran DPF Project Progress

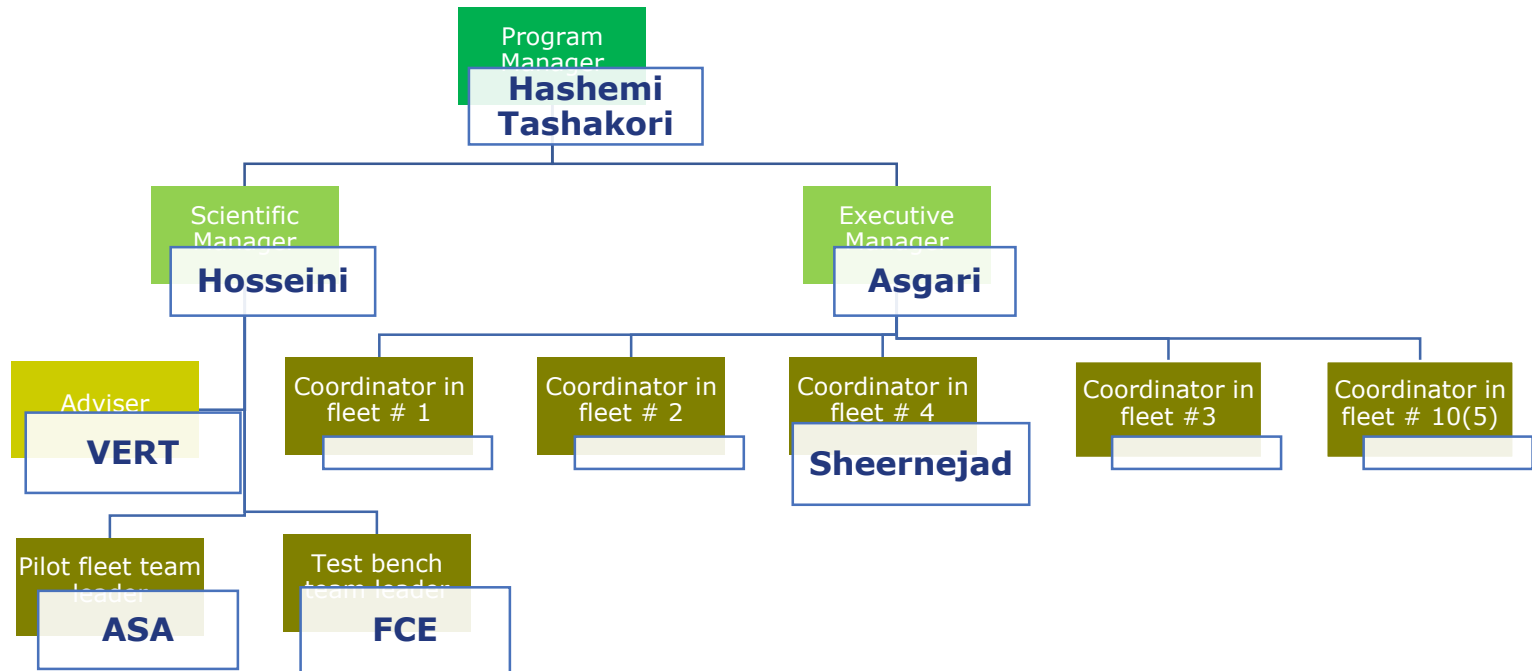
Initial Planning



Actual Progress



Tehran DPF Project Organization



Sulfur Content of Used Fuels and Related Test Results

	Low Sulfur	Medium sulfur	High sulfur
Sulfur level	48-50 ppm	230-250 ppm	7000-7700 ppm

DPF producer company	DPF type	VTF1 (Low Sulfur)	VTF1 (Medium Sulfur)	VTF1 (High Sulfur)
A	Active - Electrical heater	Not tested	Pass	Pass
A	Passive - CRT	Incomplete	Failed	Not tested
B	Passive - FBC	Not tested	Pass	Pass
C	Passive - FBC	Not tested	Pass	Pass
D	Passive - CDPF	Not tested	Pass	Not tested
E	Passive - CRT	Not tested	Failed	Not tested
F	Active - Diesel burner	Not tested	Failed	Not tested
F	Active - Post injection	Not tested	Waiting for VERT and AQCC	Waiting for VERT and AQCC

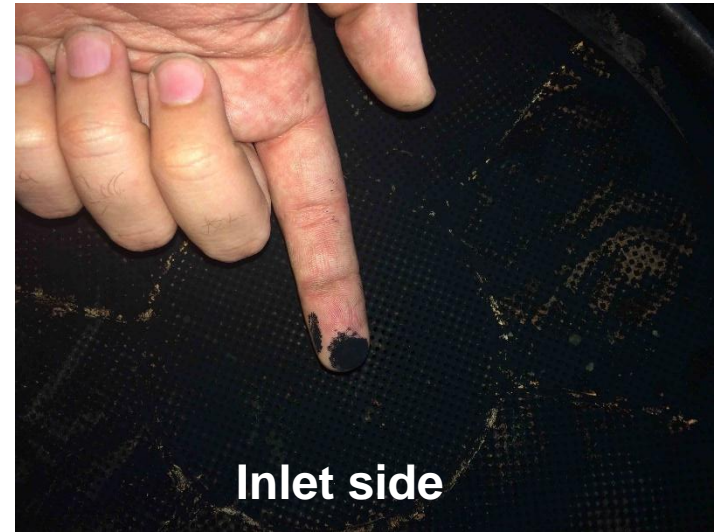
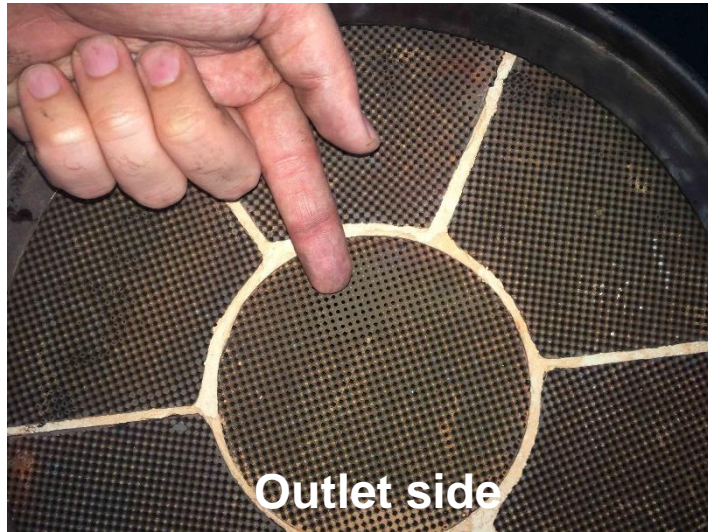
Overall Status of Pilot Fleet Instrumentation

No.	Vehicle ID	Operating Line	Vehicle Brand/ Model	Engine Type	Year Mileage (km)	Emission Standard	Last measured Opacity K (1/m)	CPK data logger ID (LN)
1	32938	Line 3	KINGLONG XMQ 6180G1	MAN D2066LOH12	2008 -	Euro III	1.36	001485
2	33469	Line 1	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 271990	Euro III	1.24	001499
3	85182	Line 10	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 216537	Euro III	1.84	Current CPK 001502
4	78514	Line 4	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 290687	Euro III	1.60	001496
5	78515	Line 4	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 322060	Euro III	1.40	001490
6	33637	Line 3	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 181102	Euro III	2.00	001492
7	33592	Line 2	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 -	Euro III	1.28	001497
8	32923	Line 3	KINGLONG XMQ 6180G1	MAN D2066LOH12	2008 -	Euro III	2.53	001506
9	32914	Line 3	KINGLONG XMQ 6180G1	MAN D2066LOH12	2008 -	Euro III	2.14	001501
10	33453	Line 2	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 -	Euro III	1.97	001522
11	33457	Line 1	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 183983	Euro III	1.37	001495
12	85156	Line 10	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 289225	Euro III	1.55	001491
13	85476	Line 10	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 251310	Euro III	1.84	001508
14	85423	Line 4	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 319651	Euro III	1.78	001505
15	33572	Line 2	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 178966	Euro III	1.80	001521
16	33599	Line 2	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 -	Euro III	2.02	001520
17	78524	Line 4	KINGLONG XMQ 6180G1	MAN D2066LOH12	2011 278973	Euro III	1.90	001443

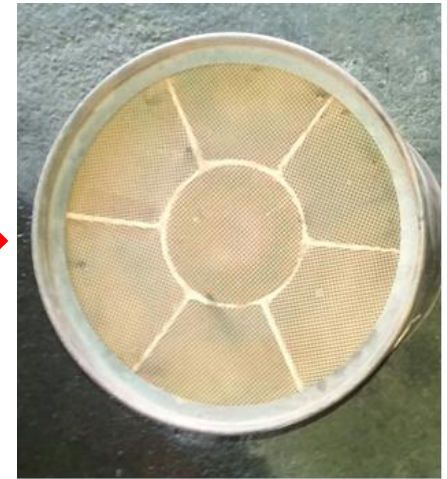
Overall Status of DPFs Installation

DPF installation date	DPF producer company	DPF technology	Vehicle ID	Bus operated Line	Bus mileage until DPF installation (km)	K-value measurement (installation time)	
						B-DPF	A-DPF
10/Sep/2014	B	Passive system + FBC	78514	Line 4	229689	1.80	0.02
22/Oct/2014	A	Passive system + FBC	78515	Line 4	272444	2.00	0.04
28/Jan/2015	C	Passive system + FBC	78524	Line 4	239626	1.70	0.02
19/Feb/2015	B	Active system + FBC	85423	Line 4	280412	1.10	0.02
19/Feb/2015	B	Active system + FBC	33572	Line 2	142717	1.24	0.04
23/Feb/2015	B	Active system + FBC	85476	Line 10	212093	1.60	0.01
02/Jun/2015	A	Passive system + FBC	33637	Line 2	160695	2.00	0.02
24/Sep/2015	D	CDPF (Catalyzed DPF)	85182	Line 10	211553	1.76	0.00
23/Jan/2016	D	CDPF (Catalyzed DPF)	33592	Line 2	-	1.60	0.02

Sample Filter After Six Months Operation



DPF Cleaning



Sample Fuel and Oil Specifications Measurement

Low sulfur fuel for public bus transportation

Fuel Station	Measured Season	Sulfur Content (ppm)	Cetane Number
Tehran- zone 2 (moshirie)	Spring	40.7	54.6
Tehran- zone 2 (moshirie)	Summer	40.8	-
Tehran- zone 2 (moshirie)	Fall	51.2	52.7
Tehran- zone 2 (moshirie)	Winter	78	-

Test Name: Oil Sulfated Ash-wt%

Test Method: ASTM D874

Vehicle ID: 78514

Sample #	Date	Result
1	2014-Nov.	2.29
2	2014-Dec.	2.3
3	2015-Jan.	2.31

Regular Monthly Report (ASA Data Analyzer)

The screenshot displays the Azmoon Sanat Data Analyzer software interface. The window title is "Azmoon Sanat Data Analyzer". The menu bar includes "File", "Configuration", and "Report Forms". The toolbar contains the ASA logo (AZMOON SANAT ARVIN), a "Configuration" icon, a "Generate Report" icon, and several chart types: "Pressure", "Temp1/Temp2", "Speed", "Temp Diff", "Pressure/Speed", "Parameters", and a "REPORT" icon.

The main content area shows a report titled "Diesel Particulate Filters' Feasibility Study Report". The report's period is "2015/10/01 - 2015/10/31" and it is for "Tehran - Iran". The report features a blue bus with a diesel particulate filter, a green background, and various icons representing different transport modes (bus, car, motorcycle, bicycle, train, tram, trolleybus). The text on the right side of the report reads: "Diesel Particulate Filter an effective way to control solid particulate".

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Tehran Program Test Matrix

Test Matrix of Tehran DPF Program							
Fuel Sulfur content	Type of DPF Technology Engine testing / Bus running	Active			Passive		
		electrical heater + FBC	post injection	diesel burner	FBC	CDPF	CRT
50 ppm	engine testing	-	-	-	-	-	-
	pilot fleet running	√	-	-	√	√	-
230 ppm	engine testing	√	√	√	√	√	√
	pilot fleet running	-	-	-	-	-	-
7000 ppm	engine testing	√	√	-	√	√	-
	pilot fleet running	-	-	-	-	-	-

Pilot fleet general information		
Emission level	Key tech.	Ave. mileage of selected pilot fleet
Euro III	EGR	> 220,000 km
note: tested engine emission level was Euro II		

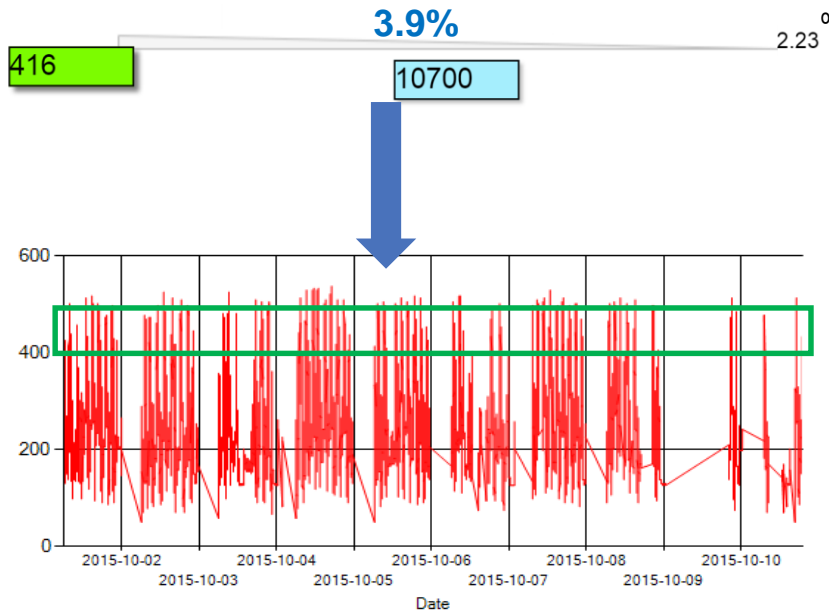
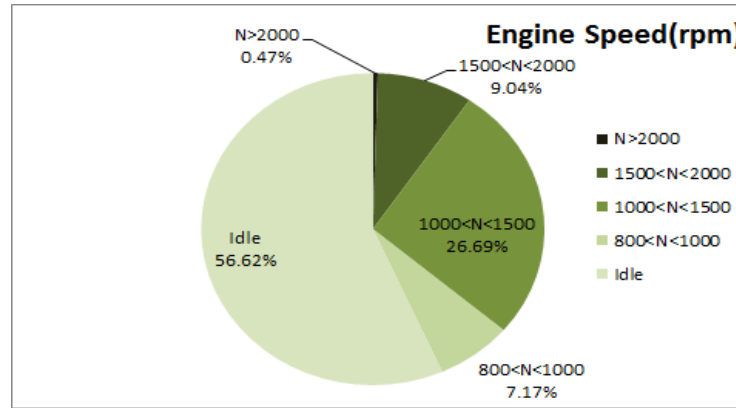
DPF Cleaning Creterias
Continues back pressure: 250 mbar (10 S)
Maximum back pressure:

Overall Status of DPFs

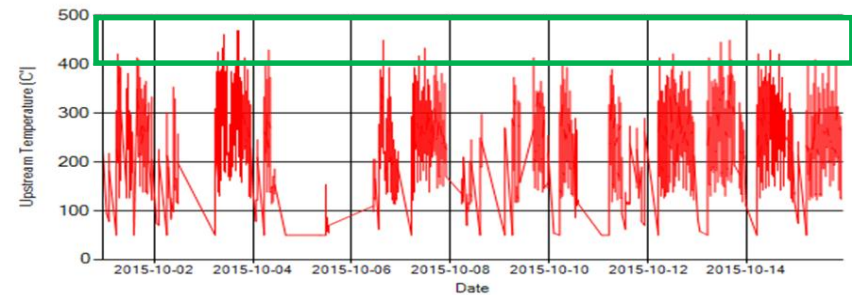
DPF Code	1X	2X	1Y	2Y	3Y	1Z	2Z	3Z	4Z
Working Line	Line 10- South to North Line		Line 2 – West to East Line			Line 4 – South to North Line			
Working Days	340	50	333	21	20	510	371	273	350
Mileage (km)	52,700	12,000	45,800	2,500	5,500	81,000	52,550	38,000	60,500
First cleaning	mileage	23,644	-	30,800	-	36,000	13,253	26,500	55,500
	comment	-	low working days	-	3 times cleaning	-	-	Dosing system was not adjust	-
Second cleaning	mileage	43,700	-	-	-	-	-	few thousands	-
	comment	-	-	-	Not suitable for low temp. line	-	-	cleaning procedure was not Ok	-

Sample Experiences

High idling time share



Different temperature patterns in different lines



*Discussions are welcome
Thank you for your attention*



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