

شرکت کنترل کیفیت هوا

وابسته به شهرداری تهران

Air Quality Control Company

Subsidiary of Tehran's Municipality

Tehran United Bus Company (TUBC) diesel particulate filter retrofit program: Progress report to VERT forum

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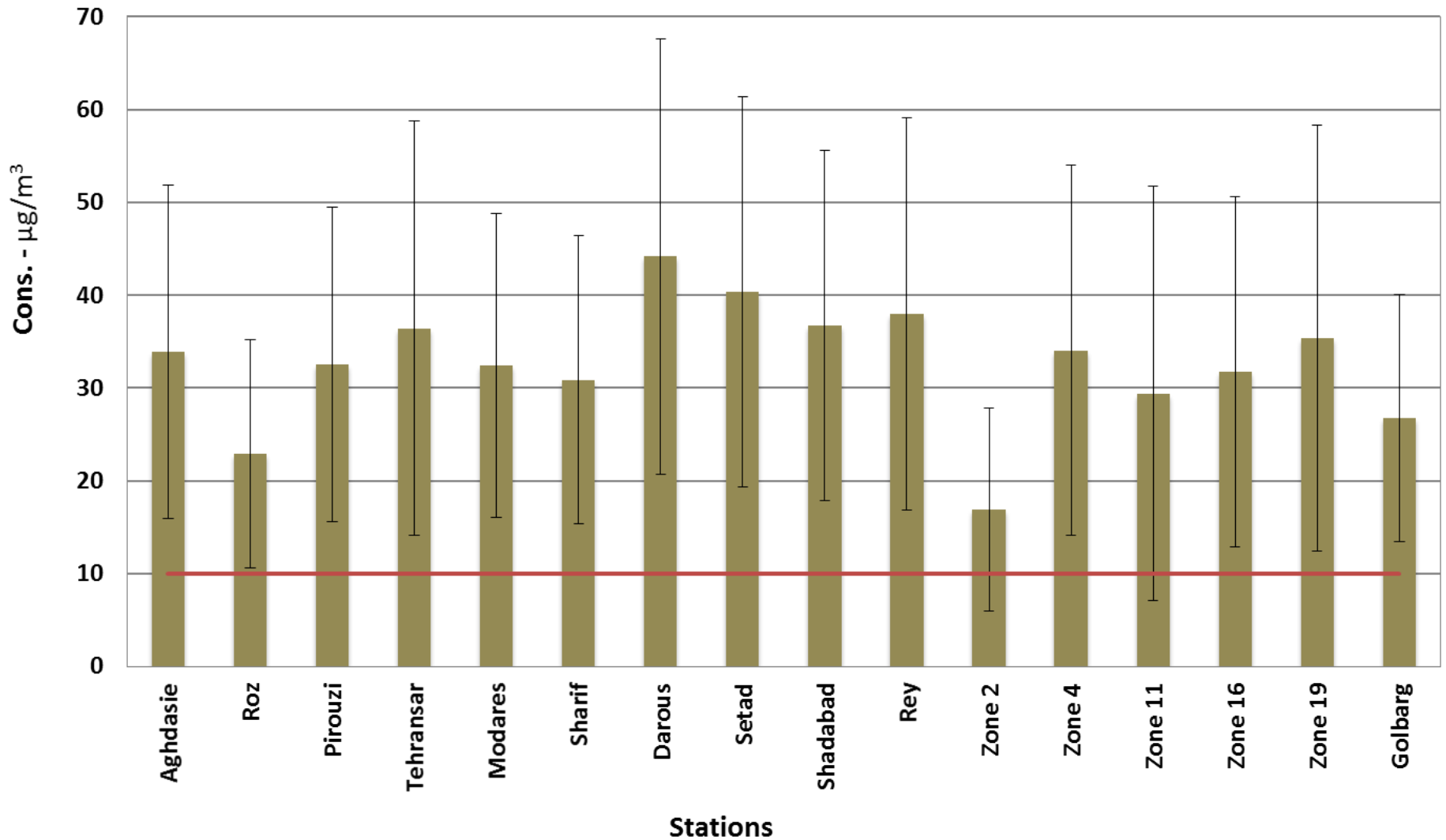
¹Tehran AQCC deputy director

² Tehran AQCC director, Assistant professor and Head of FCE research lab at Sharif University

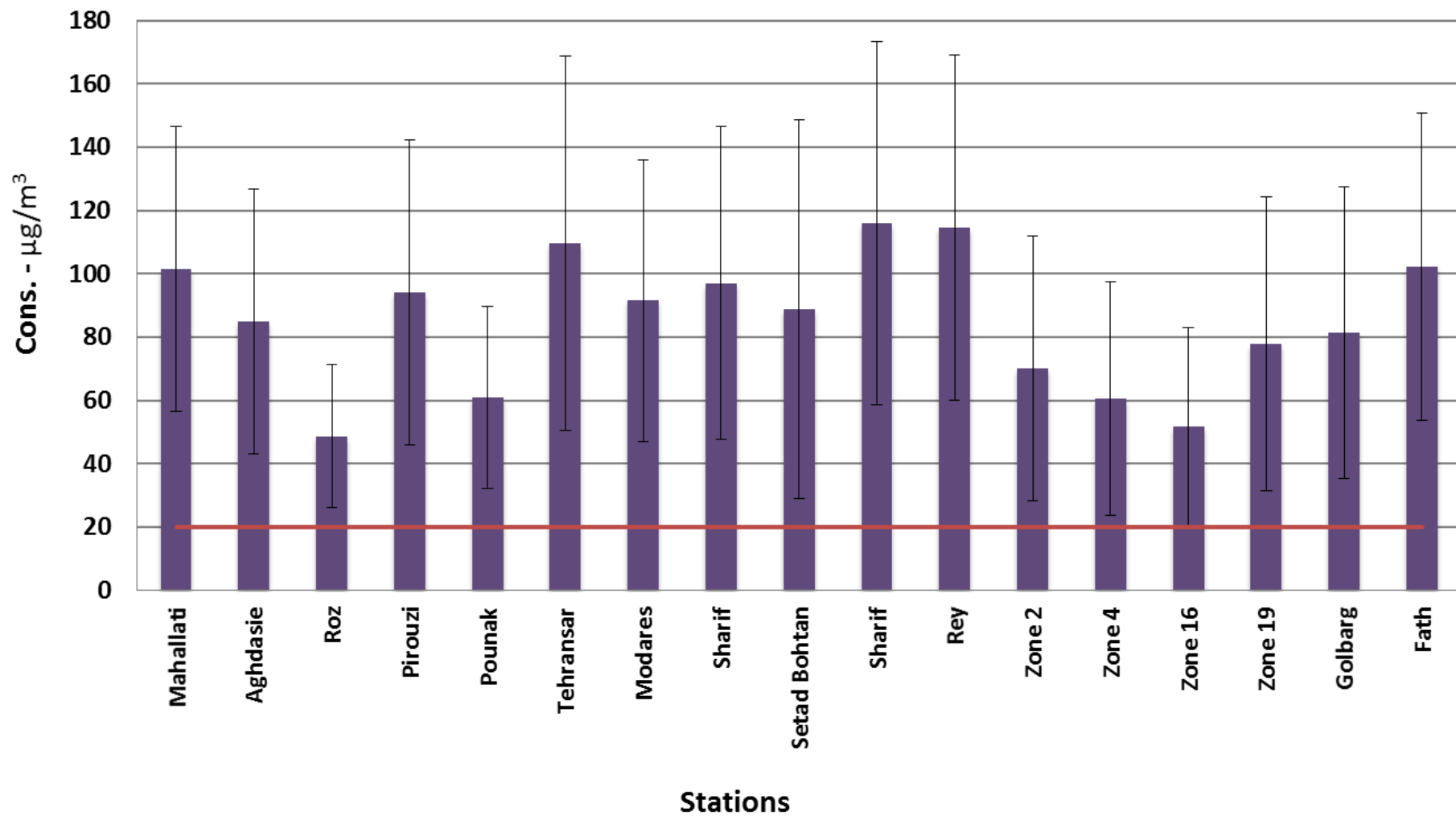
March 20, 2015 – Zurich, 6th VERT forum

Tehran Air Quality with respect to Particles

Annual Concentrations of PM2.5 in AQCC Stations in the City of Tehran
During 21 March 2013 to 20 March 2014
the red line is national standard level

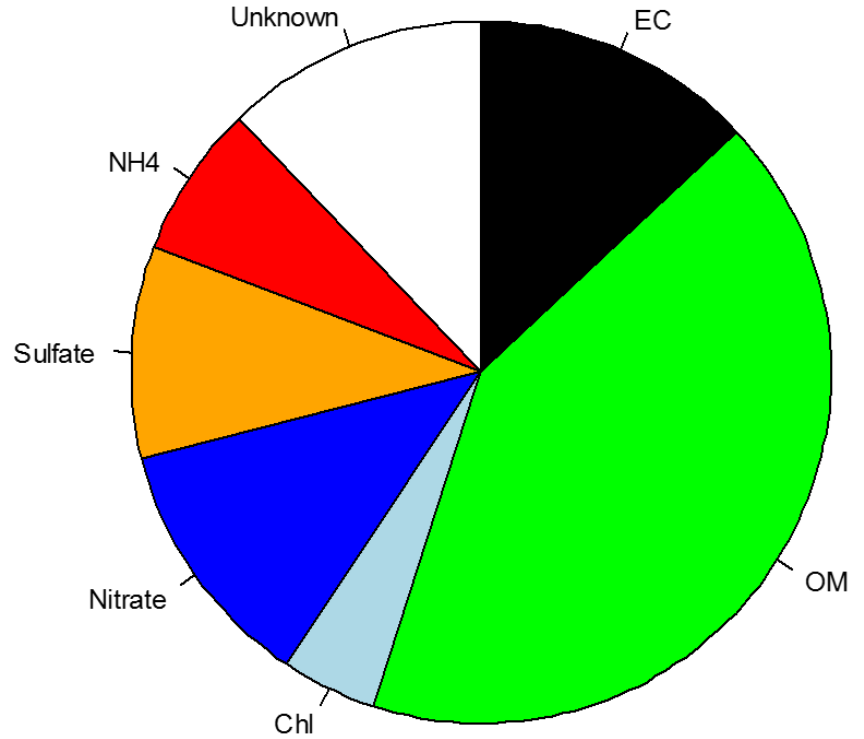
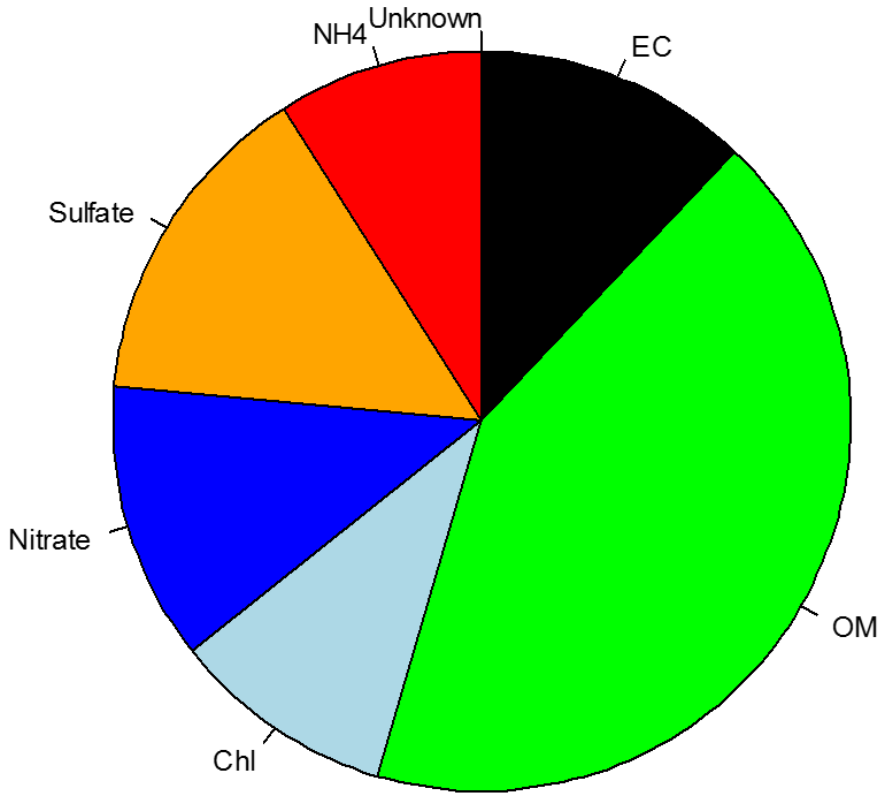


Annual Concentrations of PM10 in AQCC Stations in the City of Tehran During 21 March 2013 to 20 March 2014 The red line is national standard level



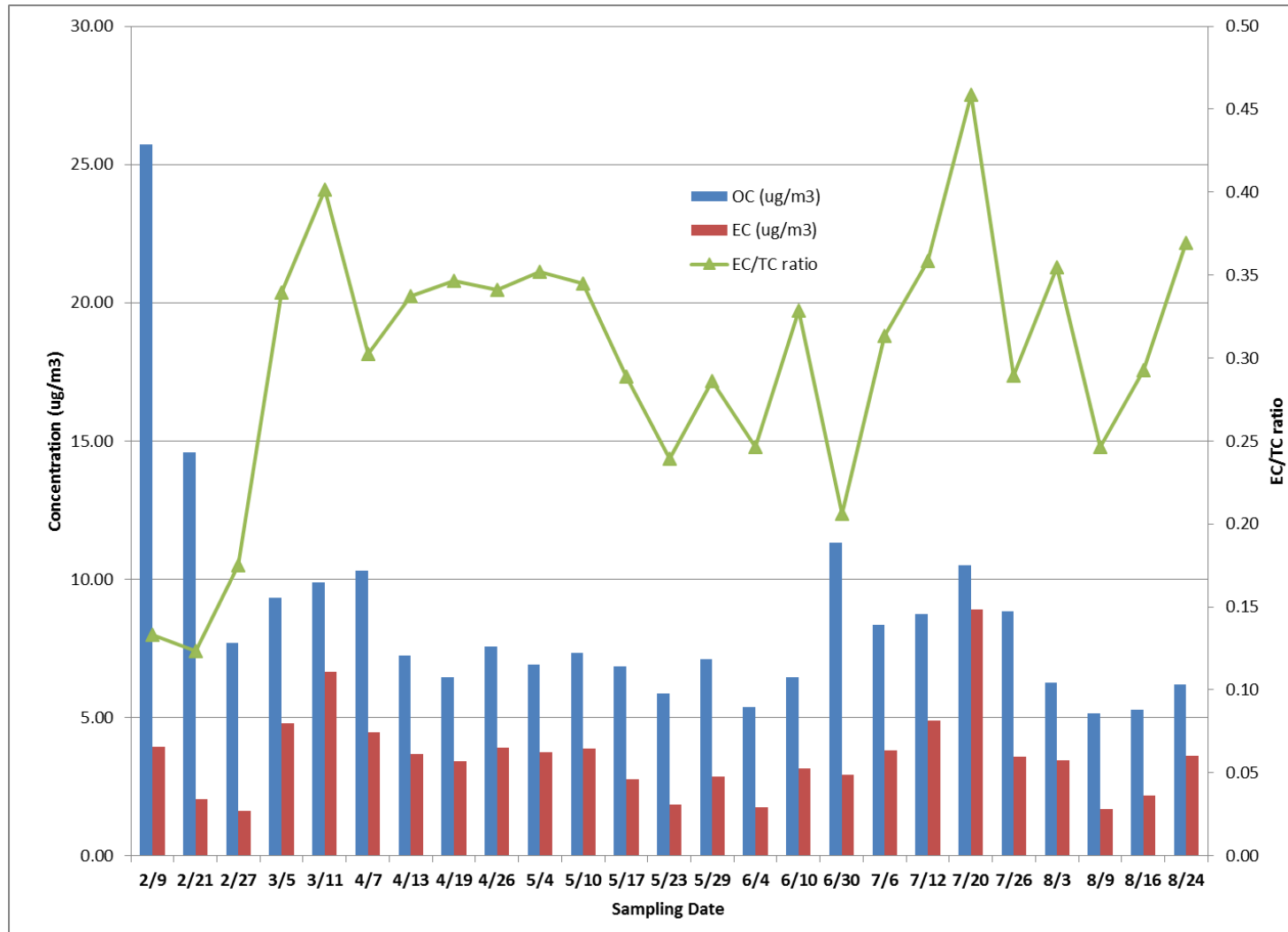
Chemical analysis of PM2.5 in two stations of Tehransar and Aqdasieh stations

Chemical analyses of PM2.5 samples shows high contribution of elemental carbon (soot) and traffic-like patterns
Analyses: EMPA laboratory, Zurich, Switzerland

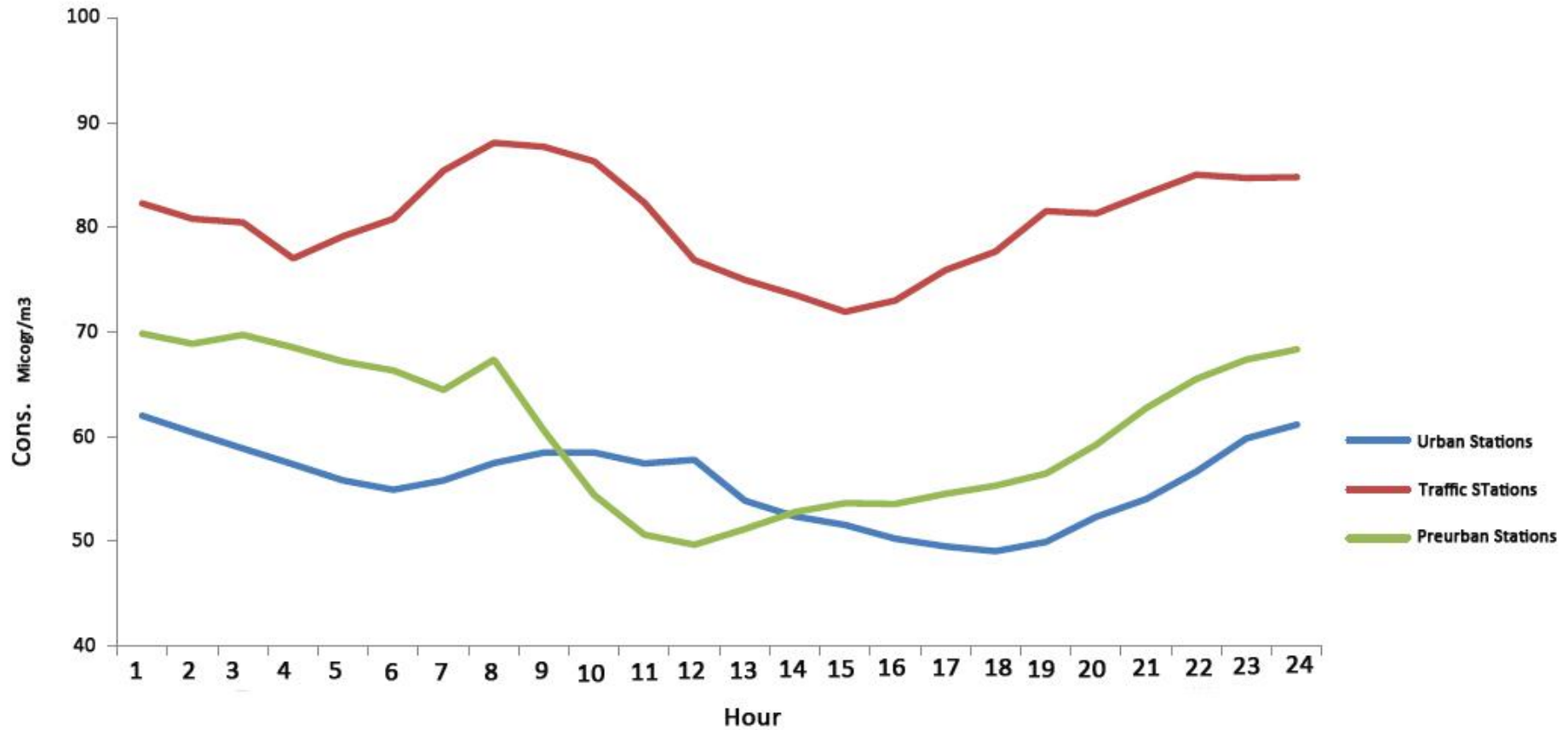


Preliminary results of Tehran source apportionment study Sharif University of Technology in collaboration with University of Wisconsin- Madison, US,

Between Feb – Aug , 2014 at Sharif University
Analyses by James Schauer and his team at University of Wisconsin-Madison

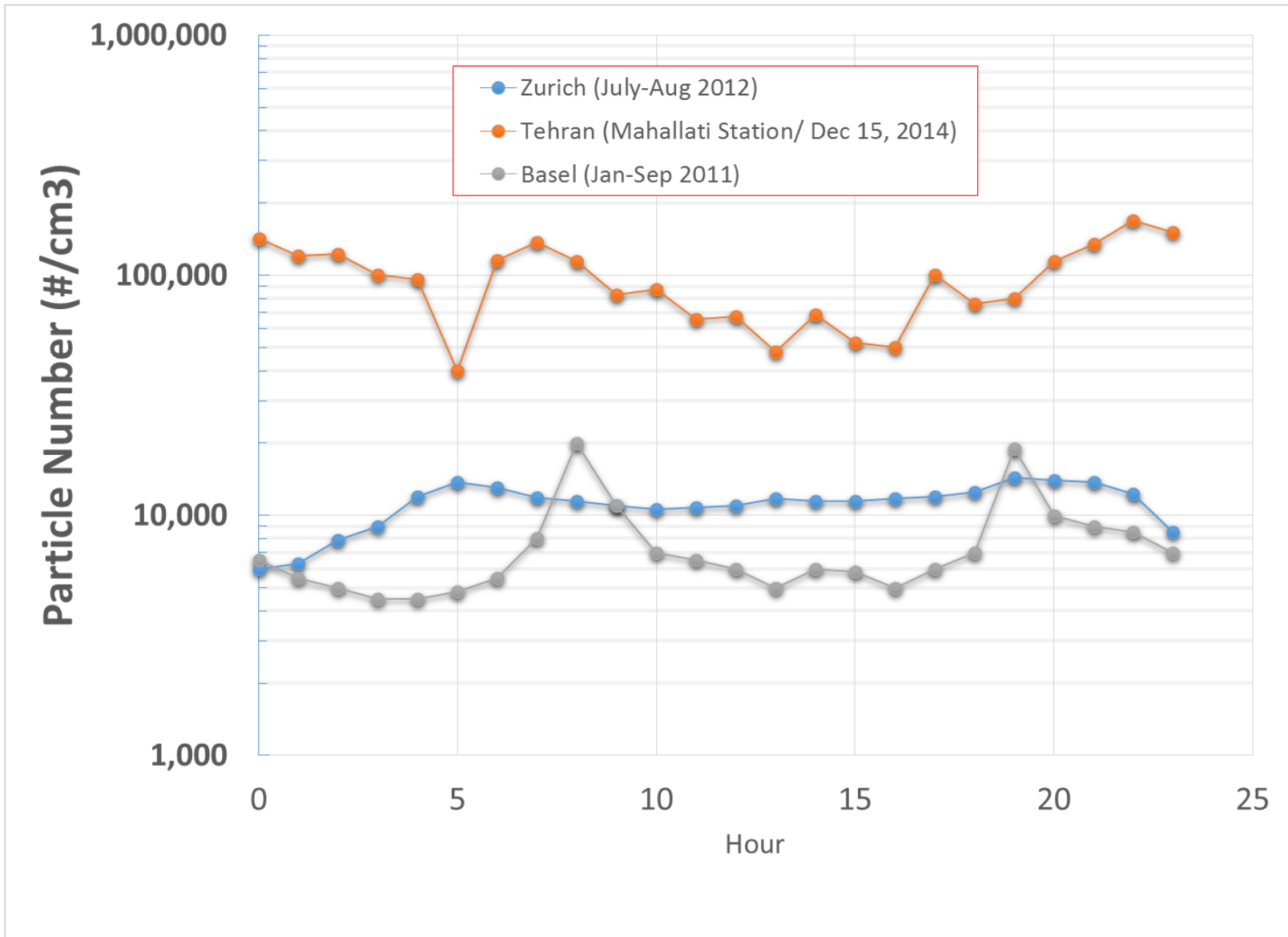


Hourly Concentration of PM10 in Different Station Types During 21 March 2013 to 20 March 2014

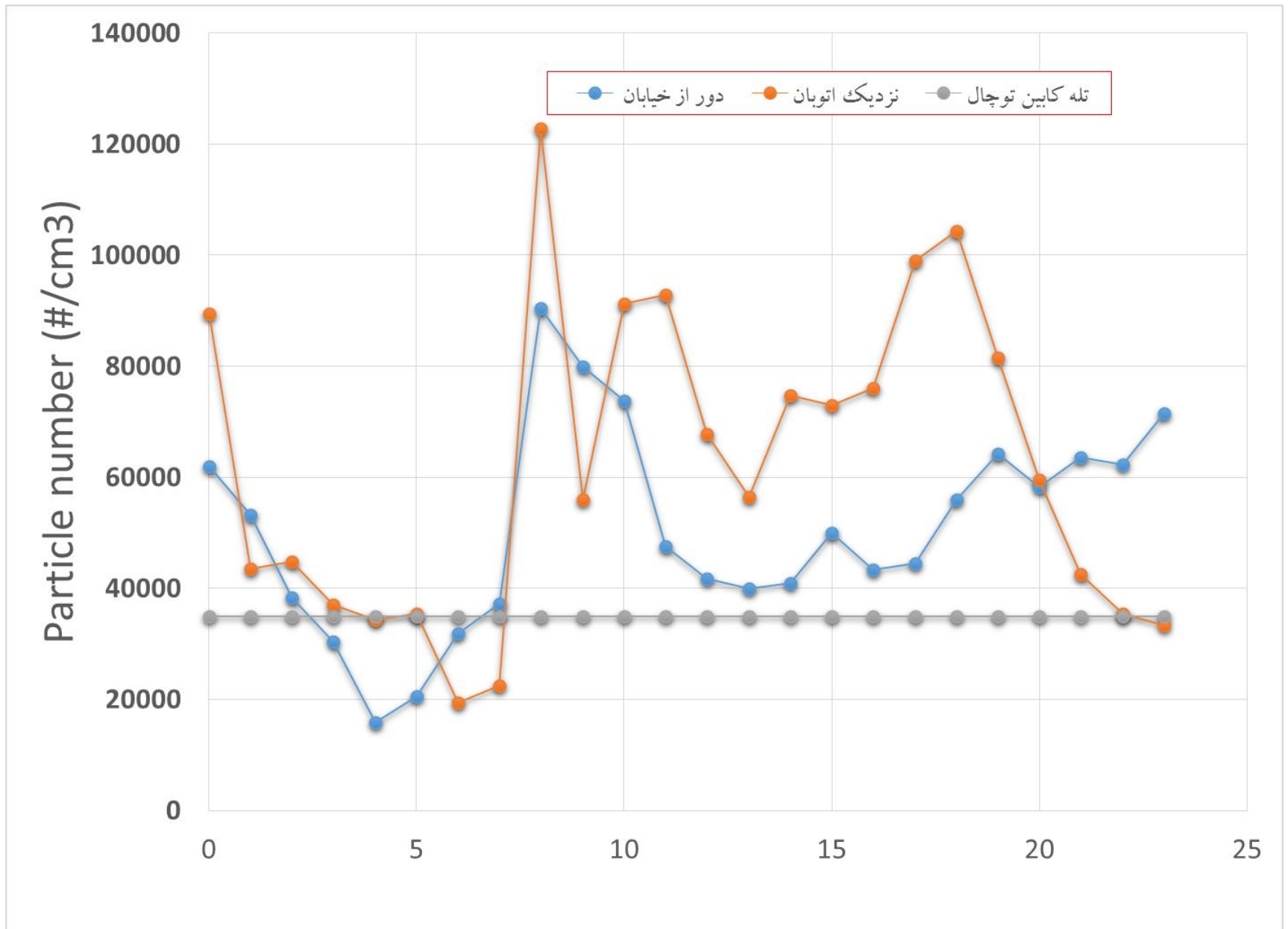


Note the difference between a traffic station and urban station

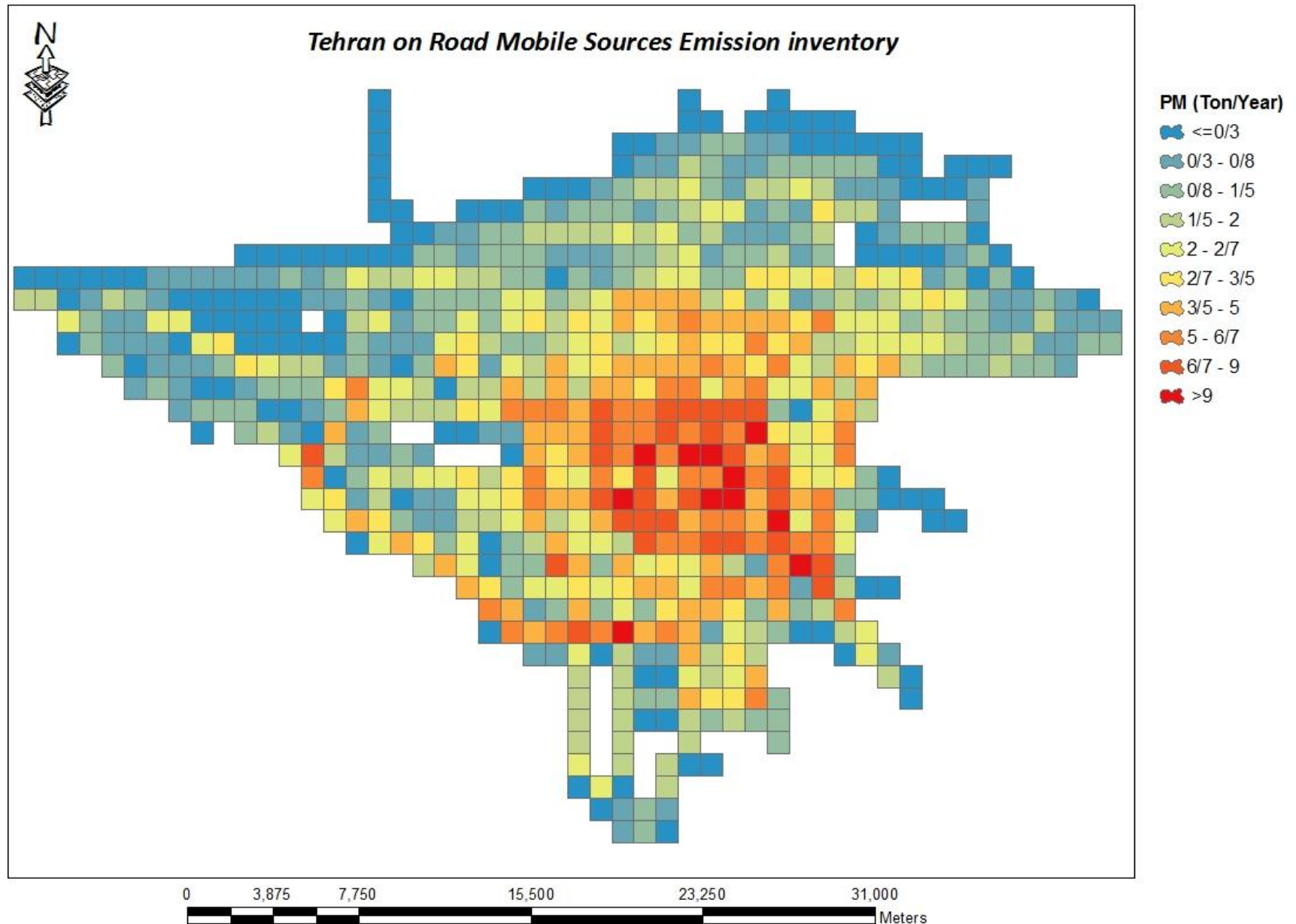
A Comparison of number of fine particles in Tehran air vs Zurich/Basel



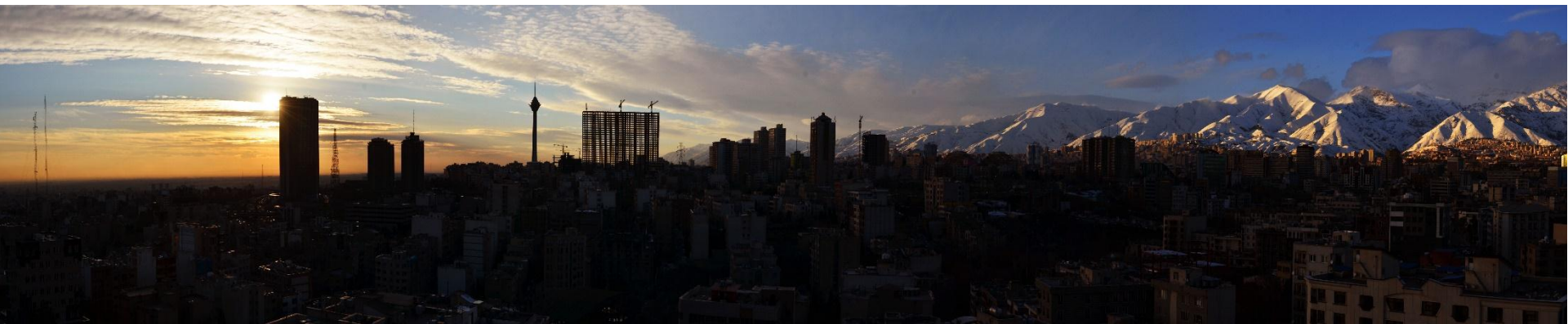
Particle number counts at 3 locations in Tehran



Spatial distribution of annual PM emission from mobile sources







Decisions both at national
and local governments

Tehran Municipality



معاونت حمل و نقل و ترافیک



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- The issue with particles, especially traffic-generated particles became clear for Tehran Municipality in 2012.
- AQCC was mandated to put together a comprehensive program to mitigate anthropogenic particles of Tehran.
- FCE lab of Sharif University was involved on developing the comprehensive plan. VERT was approached in March 2013 for diesel particles mitigating measures.

The big picture



معاونت حمل و نقل و ترافیک



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- The target was set to reduce traffic-related particles.
- The program includes:
 - Removal of carburetor gasoline motorcycles
 - Old fleet renewal for public and private sectors diesel vehicles
 - More natural-gas public transit bus introduction to the city
 - Electric bus for BRT lines
 - The very first Tehran LEZ plan with restrictions for carburetor gasoline vehicles
 - Introduction of BAT DPFs for all public transit buses including those with private companies.

Activities at national level

- At national level, a very strong legislation was approved by cabinet to retrofit diesel buses in all major cities of Iran with DPF.
- Plus, starting March 2015 all new diesel vehicles must be equipped with DPF independent of their emission standard limits which is currently Euro-III and Euro-IV.

Iran legislation to protect the environment ⁴

from April 2014

	Activity	Executor	Supervisor	Time plan
1	Fuel			
1-2	Distributing Euro 4 fuel and diesel having maximum sulfur content of 40 ppm, in Tabriz (Jul. 23, 2014) in Esfahan and Shiraz (Sep. 23, 2014) , in Ahvaz and Mashhad (Nov. 23, 2014)	Ministry of Oil	Department of Environment	*
1-3	Standardization of fuel, at least in metropolises, according to Euro 4 and Euro 5 standards, and standardization of fuel in power plants based on Supreme Council of Department of Environment's act.	Ministry of Oil	Department of Environment	36 months
2	Moving vehicle			
2-1	Replacing public city vehicles' catalyst.	Homeland Ministry(via municipality)	Department of Environment	6 months
2-3	Using particulate filters for diesel heavy-duty vehicles	Homeland Ministry(For urbane public vehicles via municipality) -Ministry of Roads and Transportation	Department of Environment	24 months
4	New vehicles			
4-1	Diesel vehicle registration is complete, stipulating that the soot filter is used.	Traffic Police of Iran	Department of Environment	Mar. 21, 2015

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2	Moving vehicle			
2-1	Replacing public city vehicles' catalyst.	Homeland Ministry(via municipality)	Department of Environment	12 months
2-3	Using particulate filters for diesel heavy-duty vehicles	Homeland Ministry(For urbane public vehicles via municipality) -Ministry of Roads and Transportation	Department of Environment	24 months
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The current fleet in the cities to be retrofitted within 24 month

Iran legislation to protect the environment ⁴

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New diesel vehicles are required to have filter starting March 2015

Municipality strategic plan for reducing PM of all public transit buses

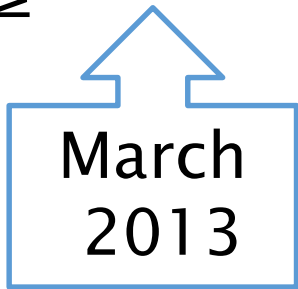
- Tehran air pollution with respect to fine and ultra-fine particles is at a very serious levels, it needs immediate action and attention specially for black carbon and soot
- The idea is to upgrade the current diesel fleet starting with public transit buses to reduce particle number and mass to Euro-6 levels
- A diesel particulate filter retrofit scheme using only closed filters and insensitive technologies to diesel fuel sulfur content is planned.

Progress with Tehran public transit DPF retrofit

DPF retrofit program milestones

March 2013

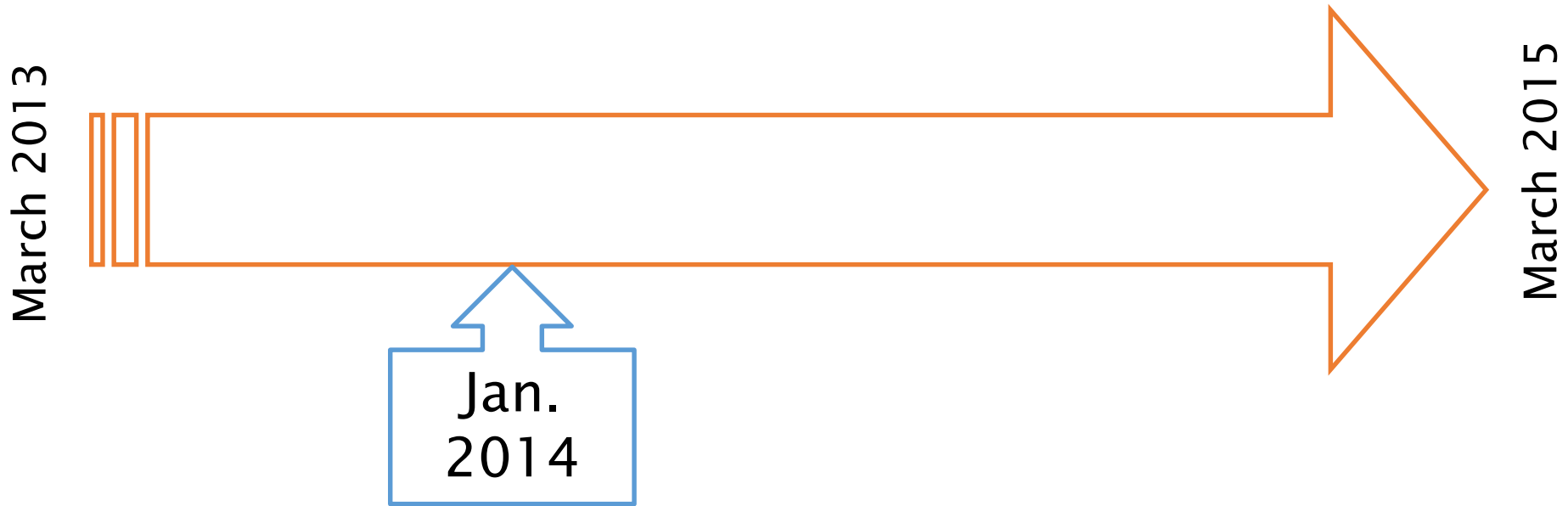
March 2015



- AQCC and VERT initial meetings at VERT forum



DPF retrofit program milestones



- Program was approved at Tehran city council for 200 buses, 600 buses, and 2000 buses

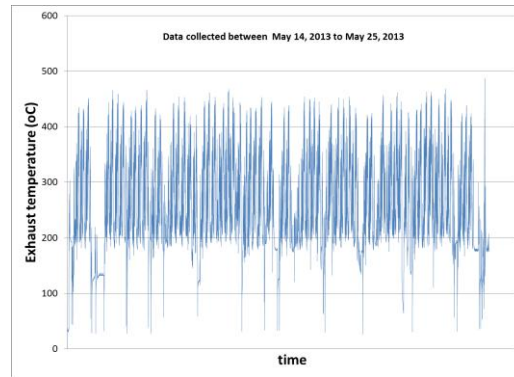
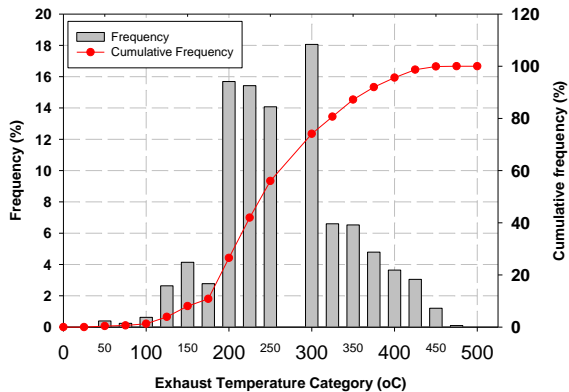
DPF retrofit program milestones

March 2013

March 2015

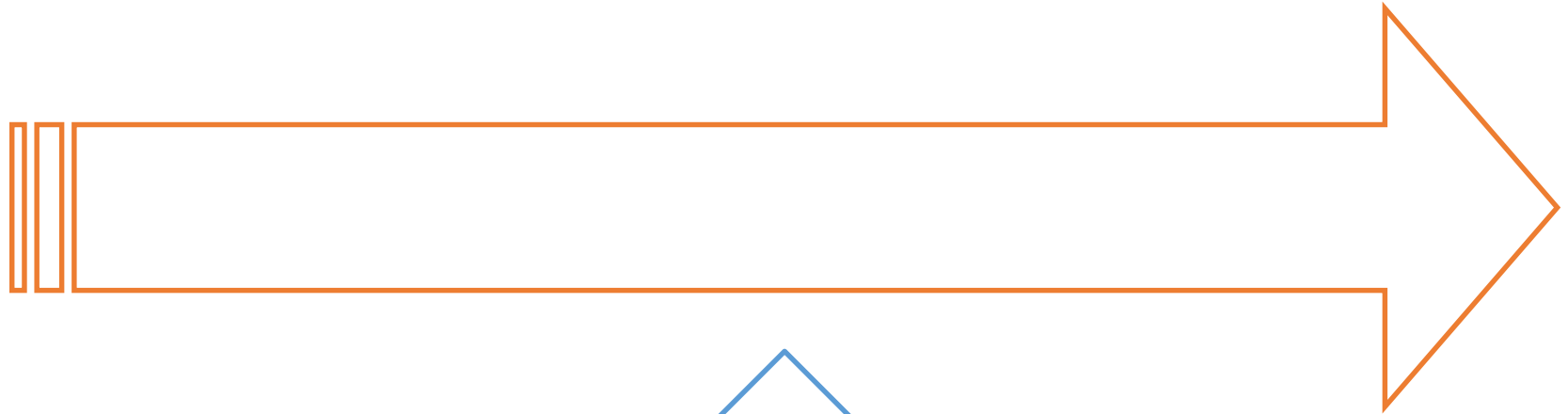
Feb.
2014

- First exhaust data collection of the buses



DPF retrofit program milestones

March 2013



March 2015



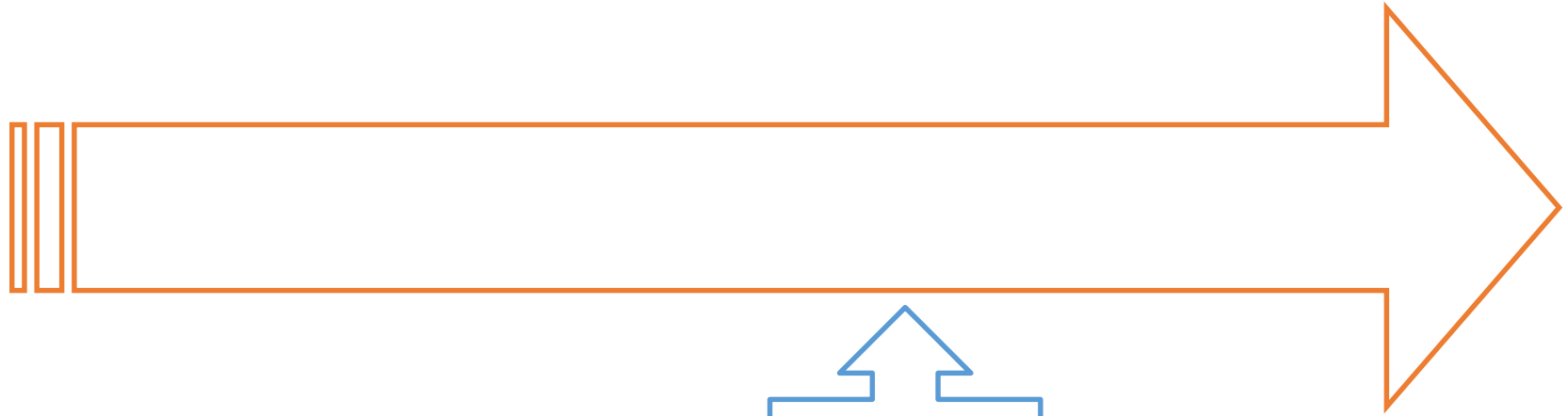
April
2014

- National DPF legislation was approved by cabinet

DPF retrofit program milestones

March 2013

March 2015



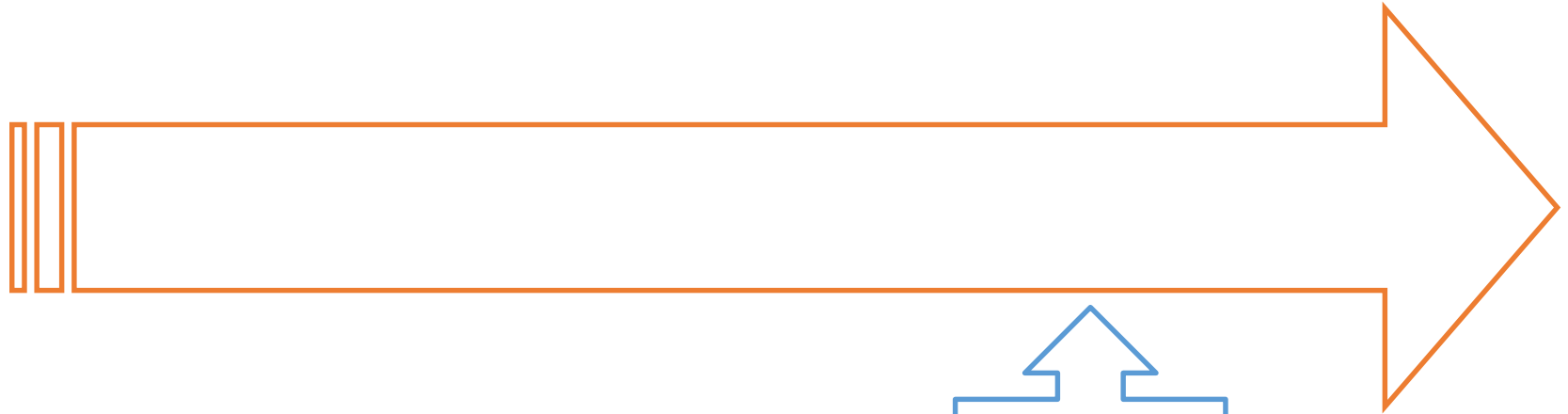
Testing of first filter in the engine lab

July 2014



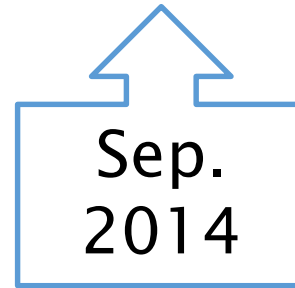
DPF retrofit program milestones

March 2013

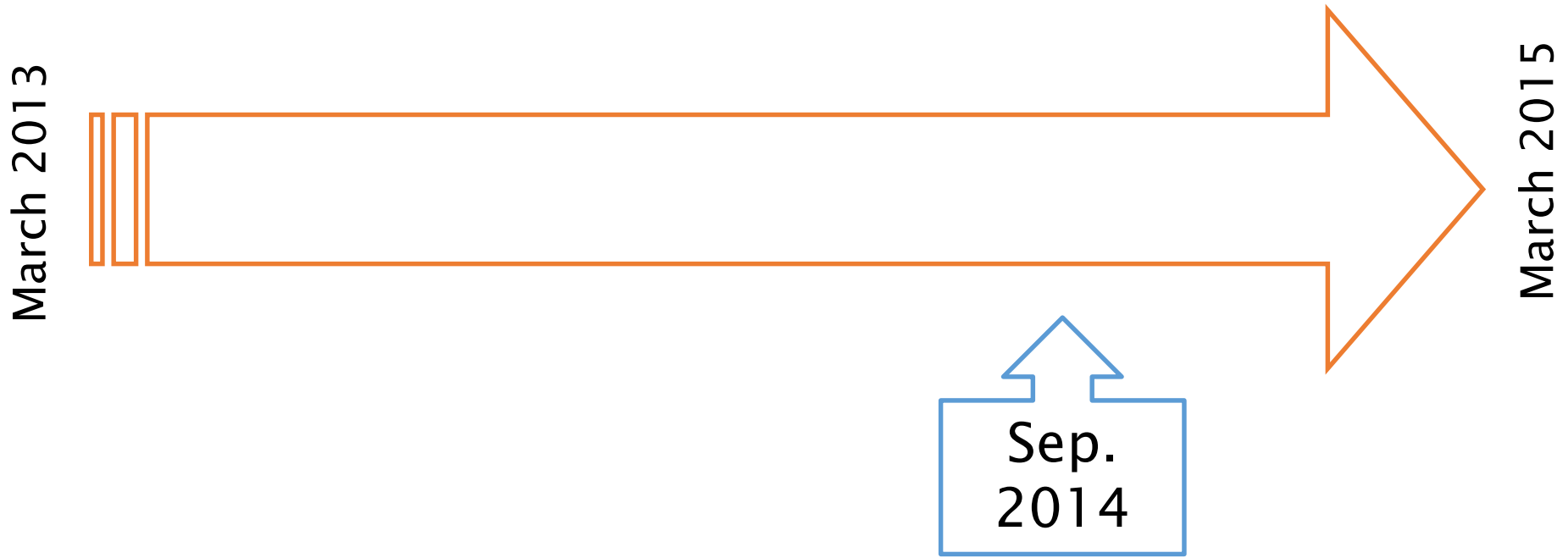


March 2015

First filter installation on the bus

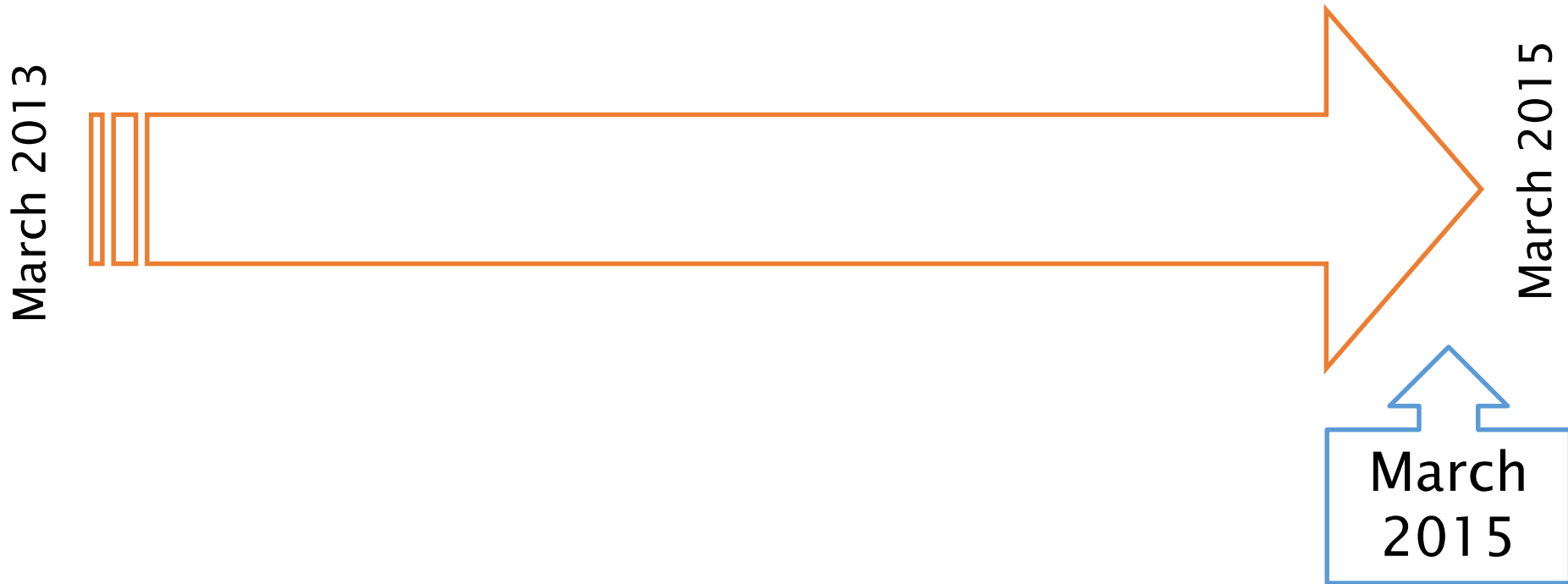


DPF retrofit program milestones



First Iranian OEM meetings to battle the DPF legislation

DPF retrofit program milestones



- Engine tests were completed for 7 filters
- 6 buses have filters on them
- The first tender for 150 buses was decided

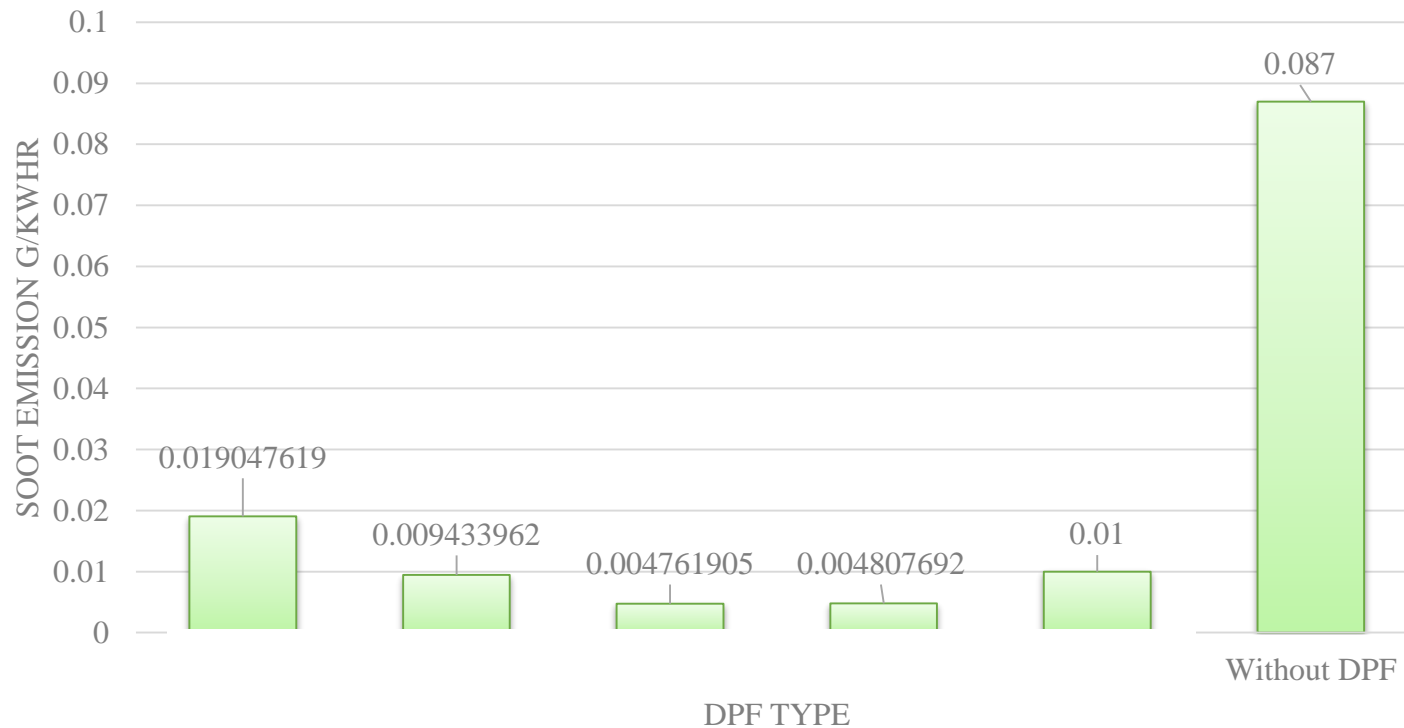
Sample results

Sample results: filter efficiencies

Efficiency with 229ppm %		Efficiency with 7000ppm %	
number	mass	number	mass
98.6	74	98.6	67.5
94.5	83.1	99.4	38.2
99.5	92.5	99	52
98.8	< 0 in some points	N/A	N/A
97	51	N/A	N/A

A sample output of engine test cell experiments in IDEM, Tabriz

PM Emission @ 1000 rpm-50%load-fuel with 229ppm S content



Sample Results: comparison with Euro VI limits

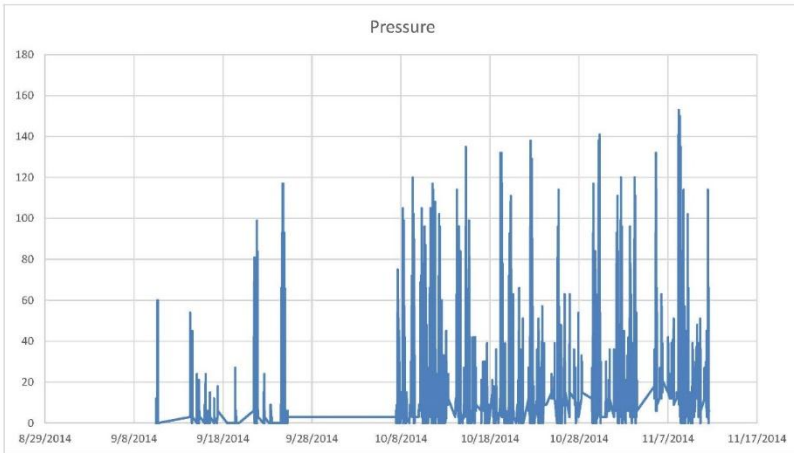
	Particle mass without filtration [gr/kwhr]	Particle mass with filtration [gr/kwhr]	Particle number without filtration [#/cm3]	Particle number with filtration [#/cm3]
Engine	0.120	0.008	3.42E+13	2.21E+11
Euro III	0.10	0.10		
Euro IV	0.02	0.02		
Euro V	0.02	0.02		
Euro VI	0.01	0.01	8.00E+11	8.00E+11

Sample results: exhaust back pressures

10/Sep/2014 - 11/Nov/2014 (63 days)
Vehicle ID : 78-514 / HJS

Engine Running = 321.3 hr
Engine Running in IDEL = 198.9

AQCC Project

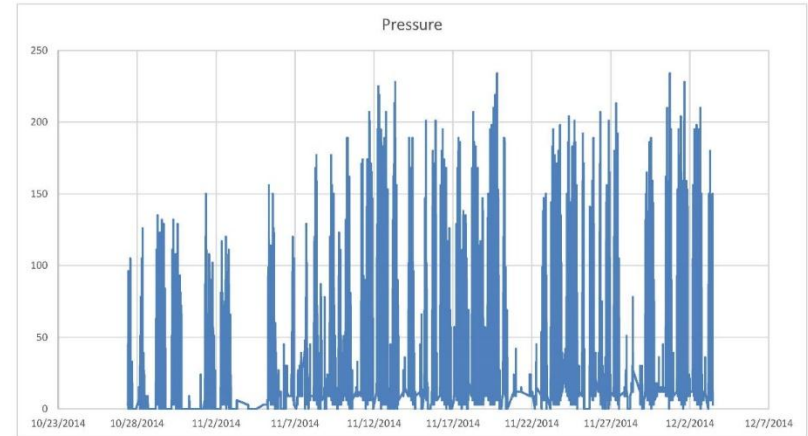


a_masoomi

27/Oct/2014 - 03/Dec/2014 (38 days)
Vehicle ID : 78-515 / Dinex

Total ENGINE Running = 481.4 hr
ENGINE Running in IDEL = 280.7 hr

Temp > 400 °C = 5.88 %
Pressure > 150 mb = 0.935 %
Pressure > 200 mb = 0.094 %



AQCC Project

The very first 3 buses with MAN engines retrofitted with various DPFs, January 2015, Tehran



Future steps

The 1st Iranian public private partnership of clean diesel towards Euro-VI



Private public partnership for elimination of ultrafine particle emissions in Iran The 1st Iranian stakeholder meeting on reducing diesel particle emission

High air pollution in Iranian cities is of concern to authorities in view of public health. Ultrafine particles (UFP) emitted from combustions engines have been identified as the most toxic component of the polluting mixture. Consequently, the Iranian government decided to start elimination by initiating in 2014 retrofitting of HDV, retiring high polluters of elder vehicles and making mandatory that all new HDV vehicles do not emit UFP. Both, national and international engine industries and experts are now challenged to comply according to best available technology (BAT).

Organizers	<ul style="list-style-type: none"> • Department of Environment (DoE) • Tehran Air Quality Control Co. (AQCC) • VERT Association • Sharif University Fuel, Combustion, and Emission (FCE) research center
Participants (by invitation only)	Local and national regulatory organizations and policy makers. Iranian diesel vehicle OEM, Diesel engine manufacturers. Ministry of industry and ministry of oil

Future steps

- Continuation of pilot study for 16 buses for all approved filters
- Further tenders for the next set of fleet
- PPP meeting in Tehran on April 15, 2015.

Thank you for your attention

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