PGMs Use in Automotive Industry and Challenges and Untapped Potentials for Secondary PGM Resources in Turkey

Platirus Exploitation Workshop 21 April 2021, online

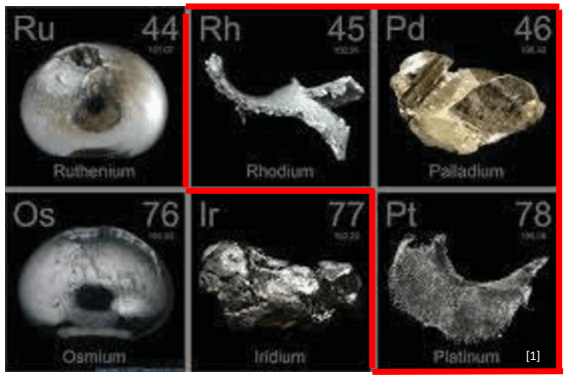
Aidin Sheikhi – Ford Otosan

PLATIRUS is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation program under Grant Agreement n° 730224

Outline

- PGMs use in Automotive Industry
- Secondary PGM resources in Turkey (Challenges and Untapped potentials)

PGMs use in Automotive Industry



Autocatalyst demand percentage of total market demand:

- Pt: 32%
- Pd: 86%
- Rh: 92%

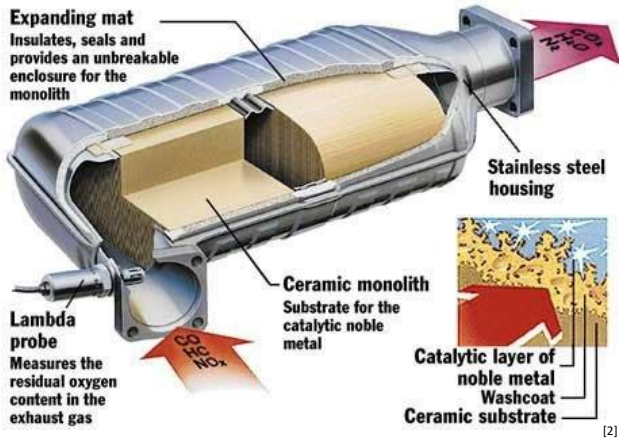
Source: Johnson Matthey – PGM market Feb 2021

Gasoline Engine


[3]

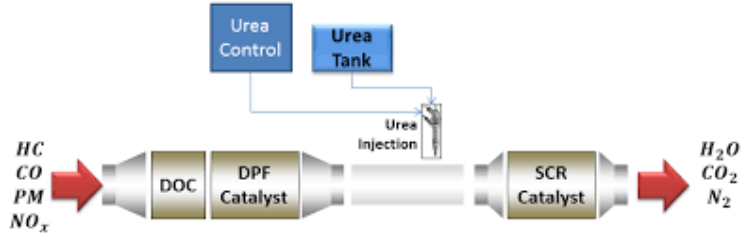
Three Way Catalytic Converters (TWC)

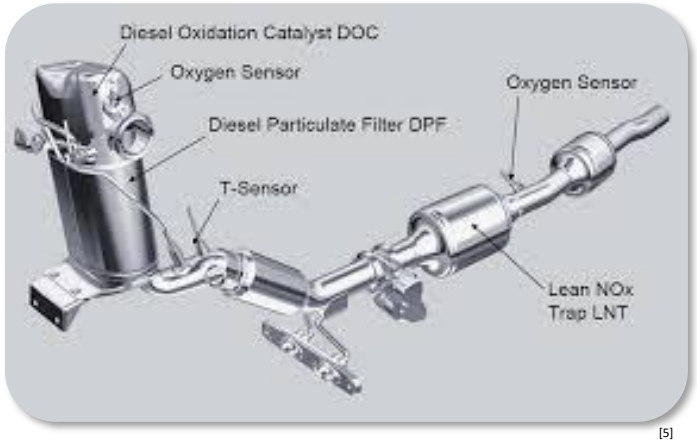
$$2NO_x \rightarrow xO_2 + N_2$$
$$2CO + O_2 \rightarrow 2CO_2$$
$$C_xH_{(2x+2)} + [(3x+1)/2]O_2 \rightarrow xCO_2 + (x+1)H_2O$$



[2]

Diesel Engine

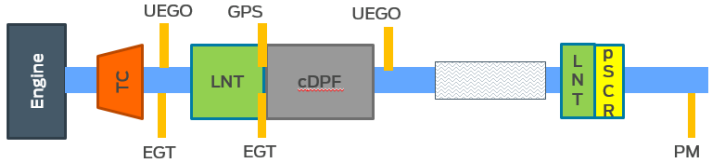




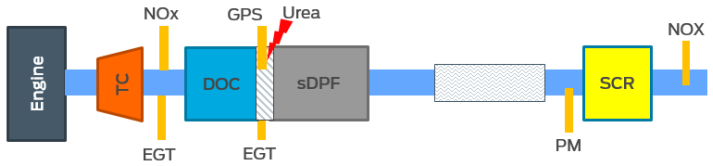
[5]

[1] https://www.researchgate.net/profile/Senem-Cabuk/publication/336305245/figure/fig1/AS:899439132676096@1591454408331/Platinum-Group-Metals-PGMs.png
[2] https://lh3.googleusercontent.com/proxy/j3e_9lGrCoRI_vk-LiKN54BxxV267nd1jCniWMFFh22QpFf3iyVF797tKqA9Eg92YwBnaaeIN_2kerOkCYi-9gRVv1cj-ZIHFTh_V_P6WuF5PBjMNoOu3TeE2cLUlOX56kQx1zeZH8huPBY_OI68DrrAW6ggWGcK4uPmVIlaaPpSL2nKUg
[3] https://www.fordotosan.com.tr/documents/Documents/yatirimci_iliskileri/Capture.JPG
[4] https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRy_E96kH7Zyi2SSEdWEmGAOBK7gpq3wrSjog&usqp=CAU
[5] https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcT6jyC48w2r9NpIpSBSPu3Gi2L7fmN6v3gX1A&usqp=CAU

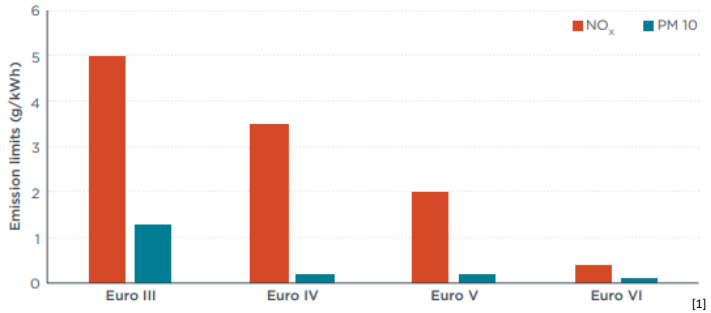
PGMs use in Automotive Industry



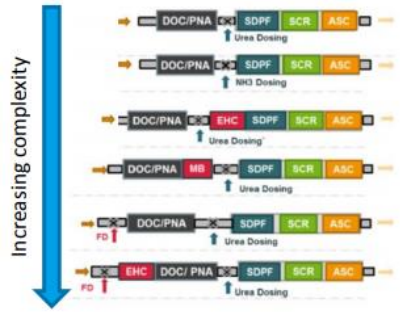
Component	PGM loading (g)	Ratio (Pt:Pd:Rh)
LNT	5.61	72:8:5
cDPF	0.43	1 : 0 : 0
LNT	2.87	70:7:5
SCR	N/A	N/A



Component	PGM loading (g)	Ratio (Pt:Pd:Rd)
DOC	5.24	4:1:0
sDPF	N/A	N/A
SCR	N/A	N/A



[1]

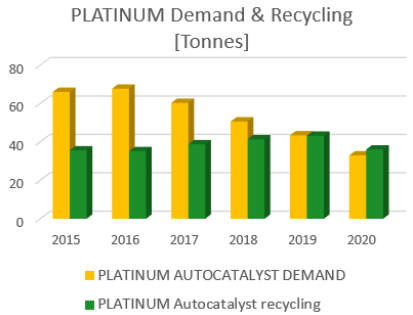


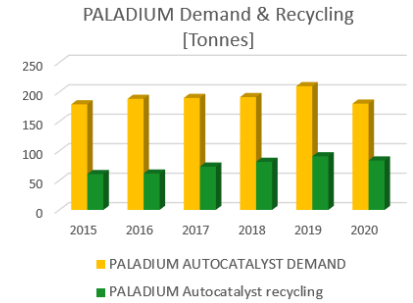
PNA = Passive NOx adsorber
SDPF = SCR coated DPF
ASC = Ammonia slip cat.
MB = Mini burner
EHC = Electrically heated catalyst
FD = Fuel dosing

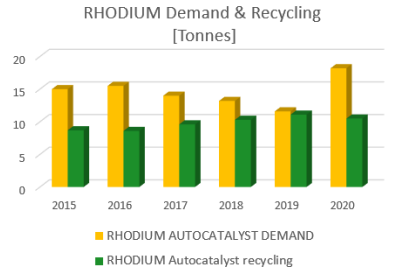
[2]

Pollutant category	Displacement of engine (L)	Otto vehicle PGM, g/car Pt	Pd	Rh	Total	Diesel vehicle Displacement of engine (L)	PGM, g/car
G-Kat 87–90	<1.4	0.95	0.00	0.19	1.14		
	1.4–2	1.43	0.00	0.29	1.71	<2	
	>2	2.09	0.00	0.43	2.52	>2	
Euro I	<1.4	0.95	0.00	0.19	1.14		
	1.4–2	1.71	0.00	0.33	2.04	<2	
	>2	2.76	0.00	0.57	3.33	>2	
Euro II	<1.4	0.29	1.14	0.19	1.62		
	1.4–2	0.38	2.00	0.29	2.66	<2	1.43
	>2	2.09	3.04	0.67	5.80	>2	4.28
Euro III	<1.4	0.10	2.47	0.29	2.85		
	1.4–2	0.48	2.76	0.29	3.52	<2	4.09
	>2	0.57	3.71	0.67	4.94	>2	8.55
Euro IV	<1.4	0.57	0.95	0.29	1.81		
	1.4–2	0.67	2.85	0.48	3.99	<2	4.75
	>2	0.48	4.75	0.67	5.89	>2	8.55

[3]







[1] https://www.ccacoalition.org/sites/default/files/resources/50-ppm-sulfur-impacts-04.2020.pdf
[2] https://pdfs.semanticscholar.org/5c88/88a3b59606c854b111fcec67a2f3dd0a5811.pdf
[3] https://www.researchgate.net/publication/270455068_Potential_of_a_Hydrometallurgical_Recycling_Process_for_Catalysts_to_Cover_the_Demand_for_Critical_Metals_Like_PGMs_and_Cerium/link/5a8d319ca6fdcc786eb06661/download

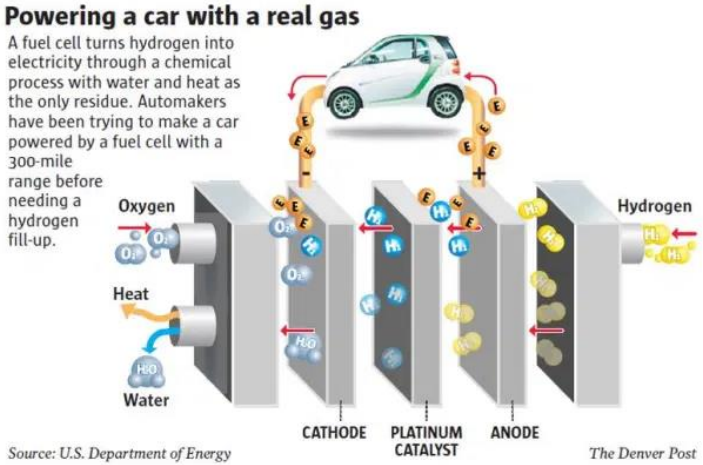
PGMs use in Automotive Industry

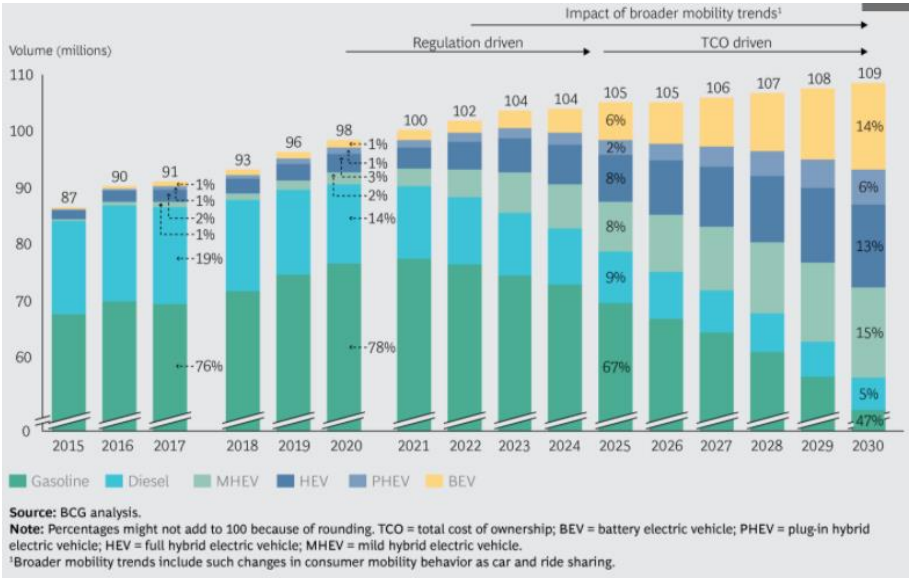

[1]

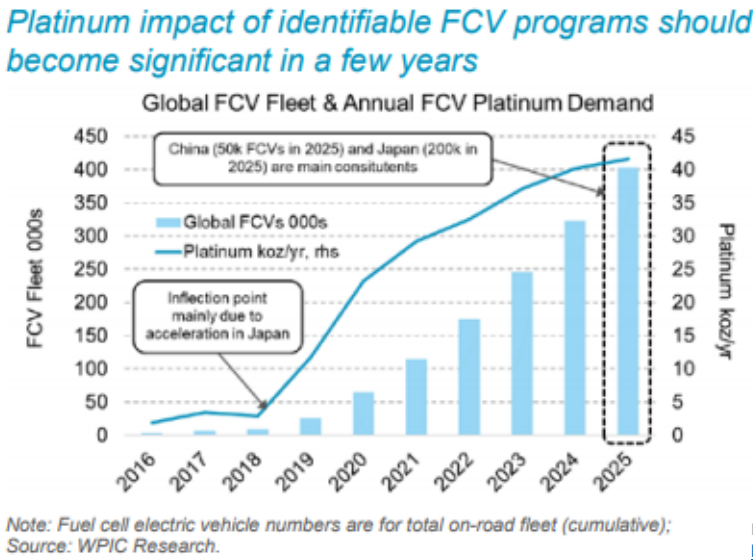

[2]

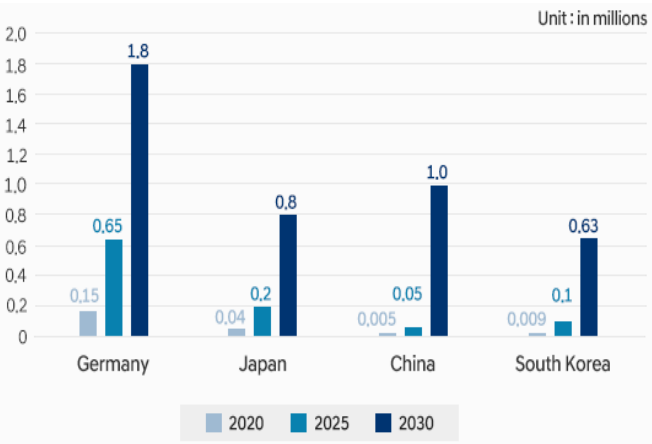

[3]


[4]





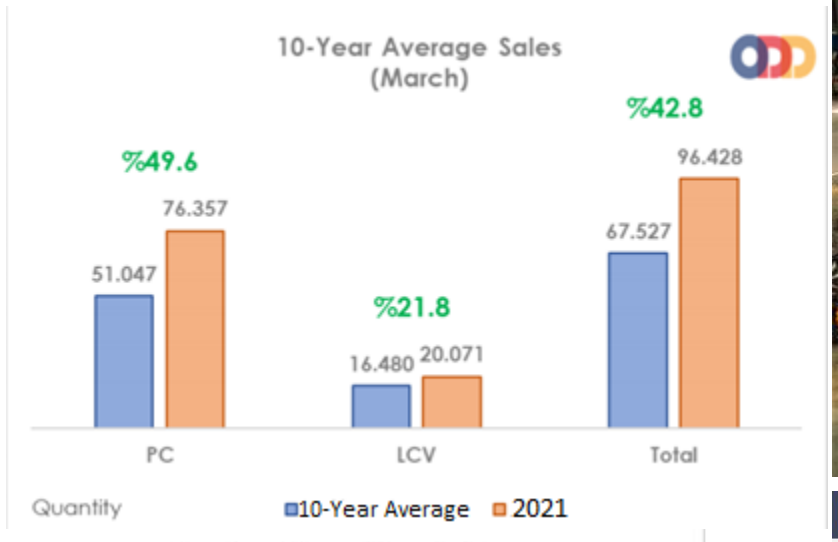


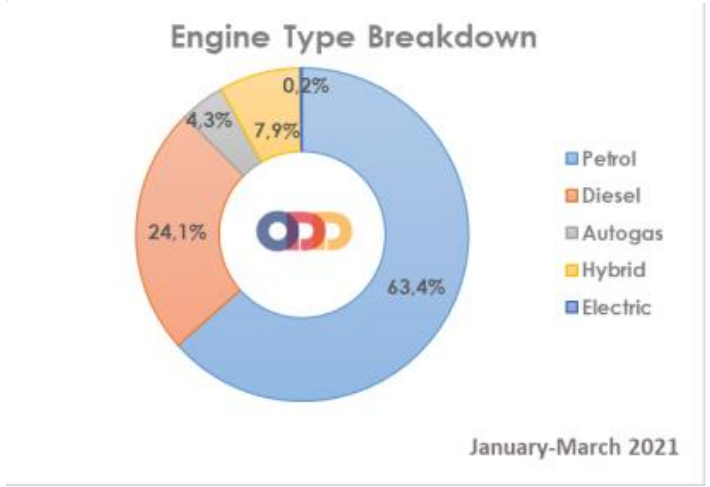


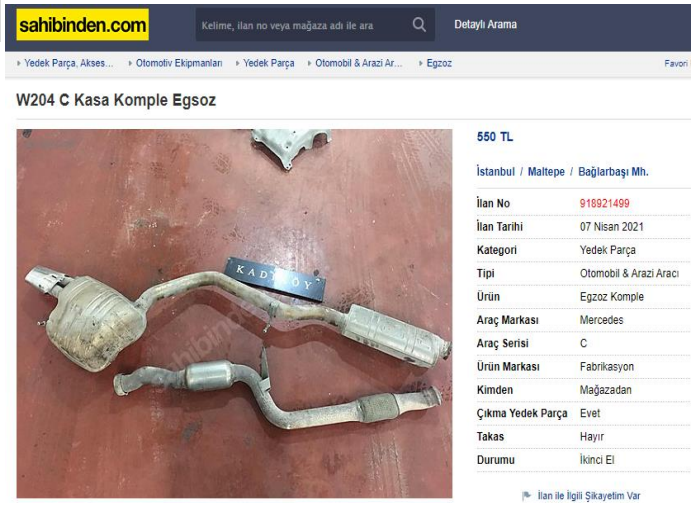
FCEV deployment plans by key countries
https://news.hyundaimotorgroup.com/Article/FCEV-Green-and-Zero-Emissions

[1] https://electriccarsreport.com/wp-content/uploads/2019/09/Ford-Transit-Custom-Plug-in-Hybrid.jpg?559188&559188
[2] https://hips.hearstapps.com/hmg-prod.s3.amazonaws.com/images/2021-mustang-mach-e-01-1598915272.jpg
[3] https://cdn.vox-cdn.com/thumbor/ZpMB9niqV9dw8LNPZQI4q7XZ4MY=/0x0:6440x4197/1200x0/filters:focal(0x0:6440x4197):no_upscale()/cdn.vox-cdn.com/uploads/chorus_asset/file/22030273/All_New_Ford_E_Transit_06.jpg
[4] https://thedriven.io/wp-content/uploads/2018/09/ford-f-vision-semi-2.jpg

Secondary PGM resources in Turkey (Challenges and Untapped potentials)







- Social awareness about the value of PGMs in autocatalysts is increased
- There are lots of small businessess dealing with collecting autocatalysts.
- There are many companies dealing with recycling PGMs.
- The existing refinery systems are expensive and require large space.
- There is no transparency with regards to EoL autocatalysts prices.

[1] https://lh3.googleusercontent.com/proxy/k9-fx4eedQx9TJvMPfUPROHx2fWpQvFNPqu6jMBi8Gq7x3f8C2WmrBWTaunGsmttcbwB54X6ns1cV9Uu5CoEhMxfROuGJBenXDvEIYHsgvXEncnJlkQ1AfkooUdedX43IMoLcl5OQw

Conclusions

- Catalytic converters are the most important secondary PGM resources
- FCEVs will be the future alternative for secondary PGM resources
- There is a great potential for secondary PGM resources in Turkey since it has a large automotive market
- PGM refining systems should be improved in order to be more obtainable by small businessess
- EoL autocatalyst market monitoring should be more organized

Main Contact

FORD OTOSAN

Aidin Sheikhi
Email: asheikhi@ford.com.tr

Project website: www.platirus.eu

PLATIRUS is a project funded by the European Commission.
This project has received funding from the European Union's Horizon 2020 Research and Innovation program under Grant Agreement n° 730224