

# Sub-23nm TPN emissions from different engine technologies

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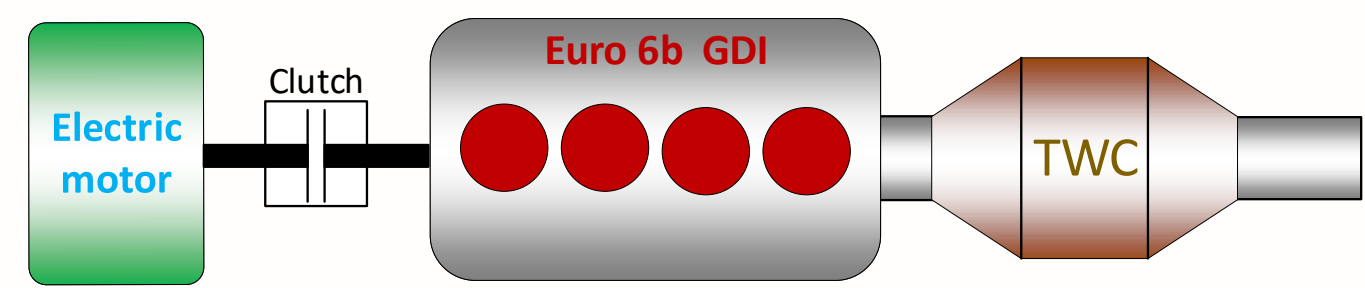
## Introduction & main targets

- Total particle emission (TPN) level can be several orders of magnitude higher than regulated solid (non-volatile) particle emissions (SPN).
- The current presents TPN emissions from different fuels, engine technologies under various sampling conditions. For comparative purposes SPN emission levels are also investigated.

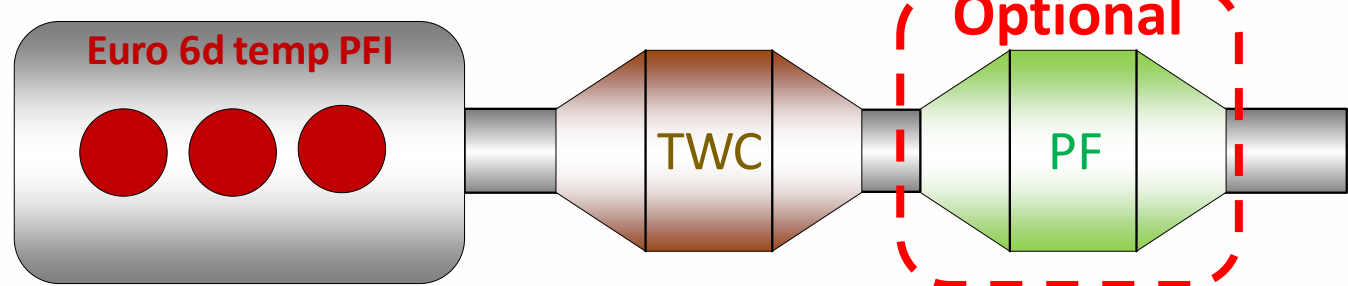
## Methodology

Vehicle specifications		
Vehicle	PHEV	Bi-fuel CNG/Gasoline
Cylinders	4 in line	3 in line
Engine size [cm <sup>3</sup> ]	1580	1000
Injection	DI	PFI
EURO Standard	EURO 6b	EURO 6d temp.
Aftertreatment	TWC	TWC

### PHEV

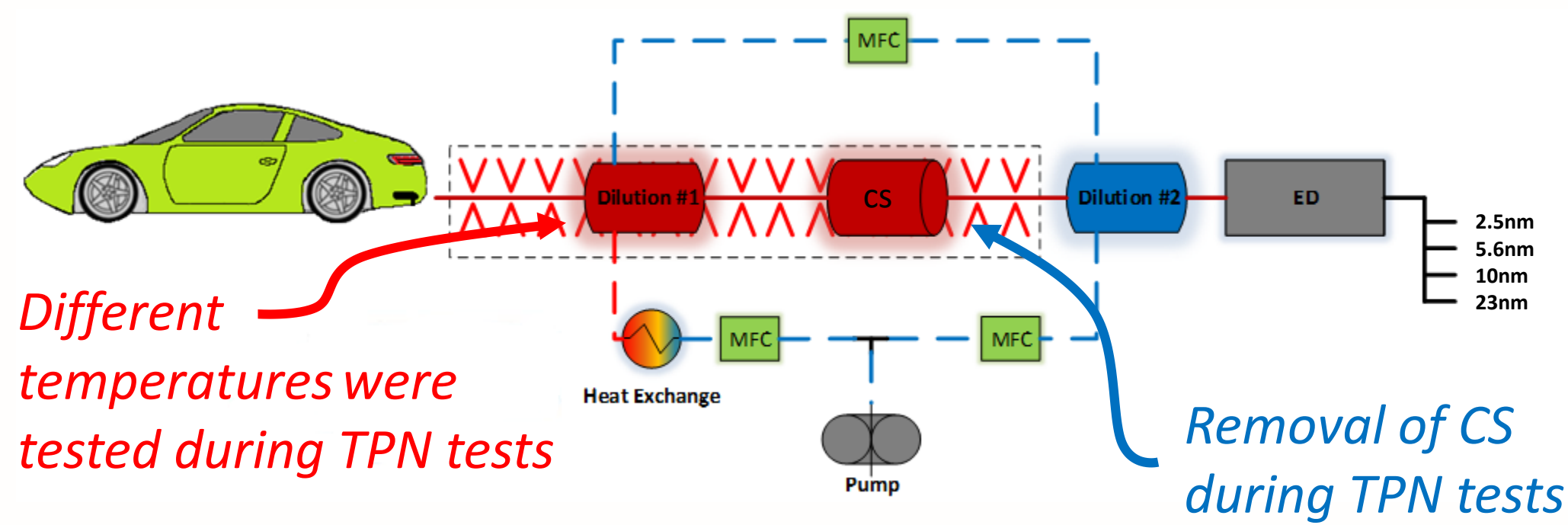


### Bi-fuel vehicle



Prototype particle filters were installed at bi-fuel vehicle tailpipe.

Particle filters specifications		
Filters	Wall thickness [mils] / Cell density [cpsi]	Mean pore size / Porosity
PF 1	8 / 300	Large / High
PF 2	10 / 300	

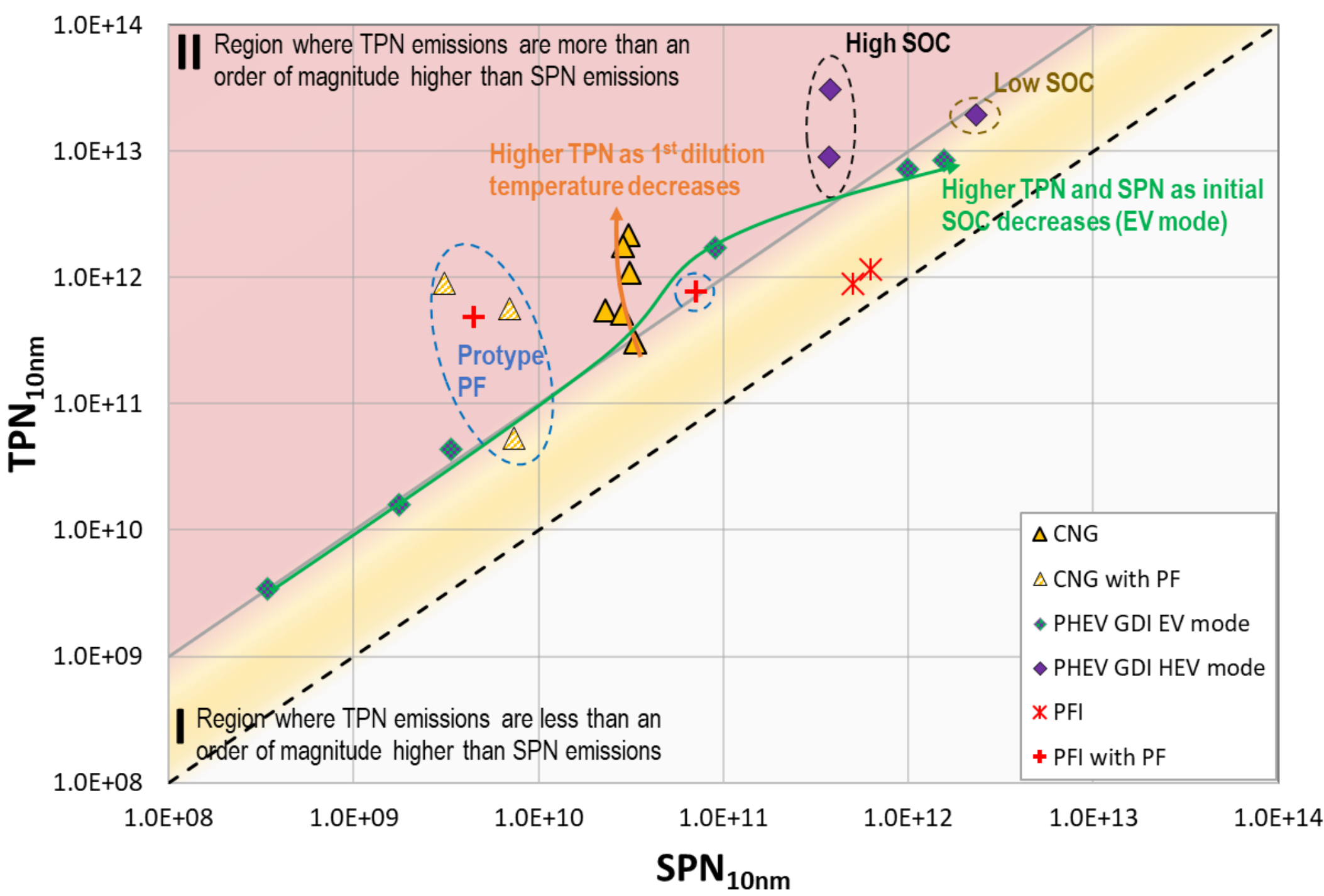


## Results

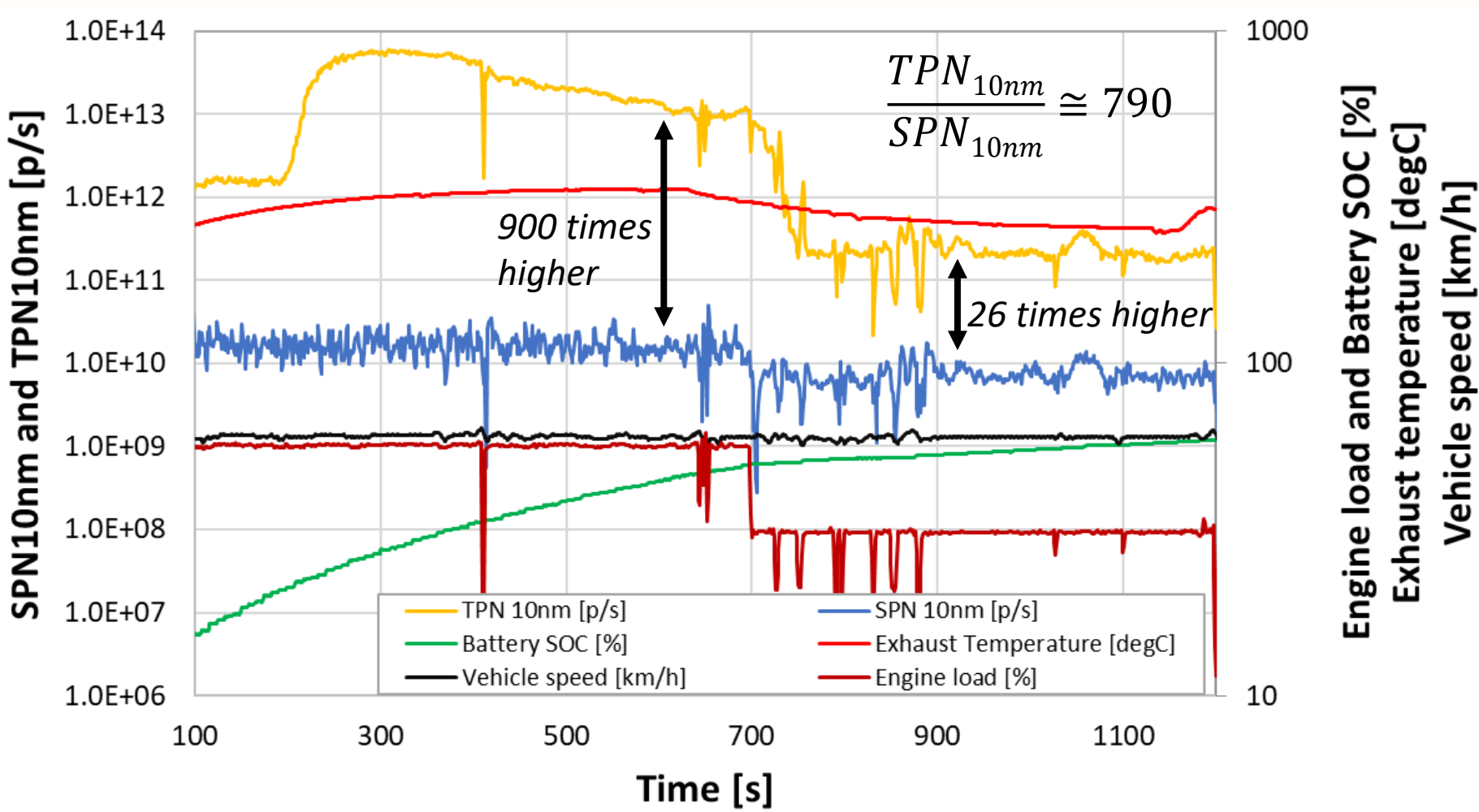
Evolution of TPN and SPN emissions for the different:

- Engine and powertrain technologies (PFI/GDI, PHEV)
- Fuels (CNG/Gasoline)
- Driving modes and SOC levels of the PHEV
- DTT 1<sup>st</sup> Dilution temperature (150°C, 50°C and 35°C)

Results for WLTC (both cold and hot). TPN and SPN emissions were corrected for particle losses and dilution ratio.



### Steady-state point with PHEV



## Conclusions

- Lower 1<sup>st</sup> dilution temperature results to higher TPN emissions.
- Higher initial SOC in PHEV (EV mode) results to significantly lower TPN and SPN emissions.
- Prototype PFs reduce significantly SPN emissions, while in TPN, the current configuration (PF installed at tailpipe) has a smaller impact.
- The effect of engine load change in PHEV under steady-state is much higher in TPN compared to SPN emissions.

### PROJECT PARTNERS



In collaboration with:



Call: H2020-GV-2016-2017  
Technologies for low emission light duty powertrains

Action:  
“Measuring automotive exhaust particles down to 10 nanometres – DownToTen”