



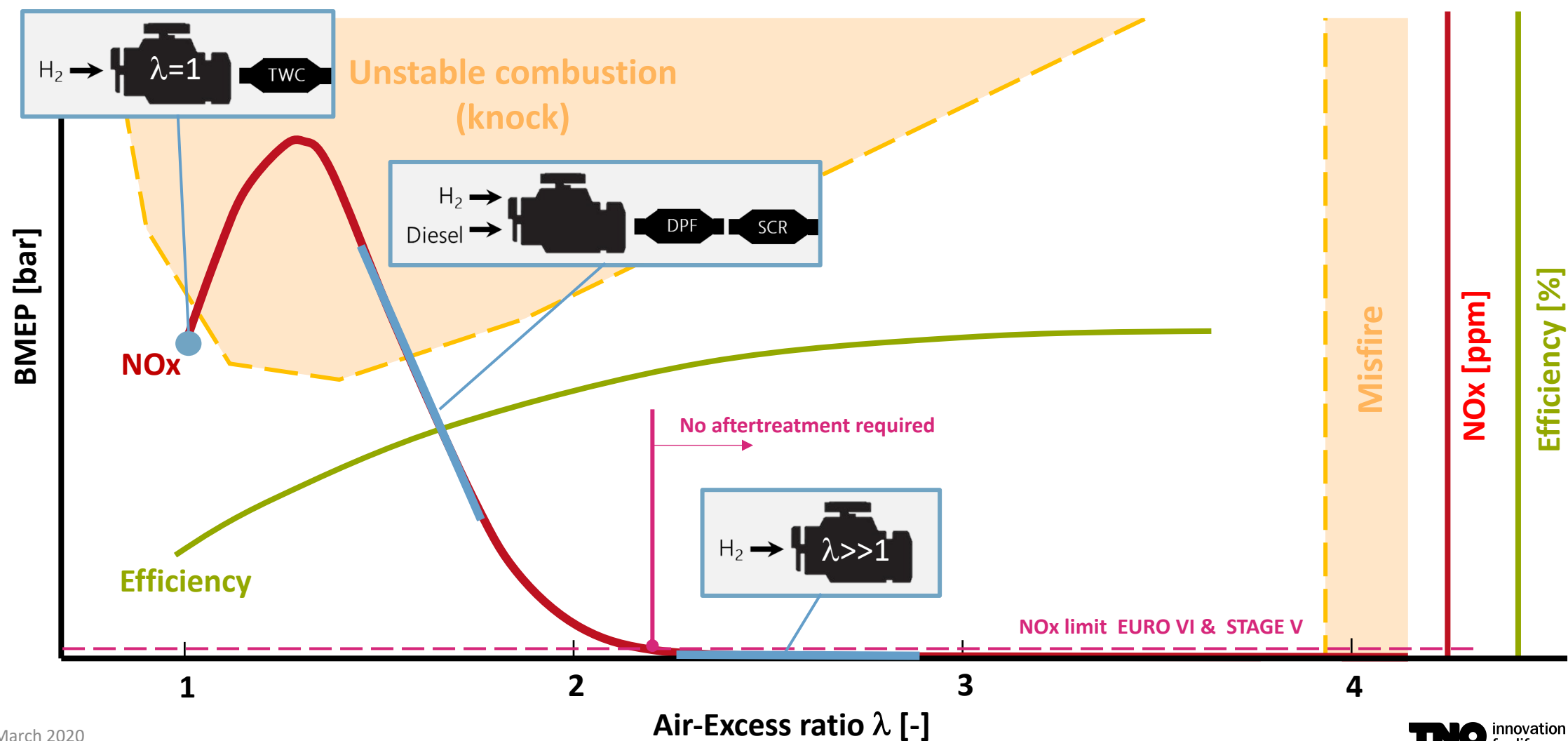
› FEASIBILITY HYDROGEN ICE COMBUSTION CONCEPTS PLATFORM DUURZAME BRANDSTOFFEN | DR. IR. X.L.J. SEYKENS

16 April 2020

› WHY USING H2 IN INTERNAL COMBUSTION ENGINES? ACCELERATING SUSTAINABILITY USING PROVEN TECHNOLOGY

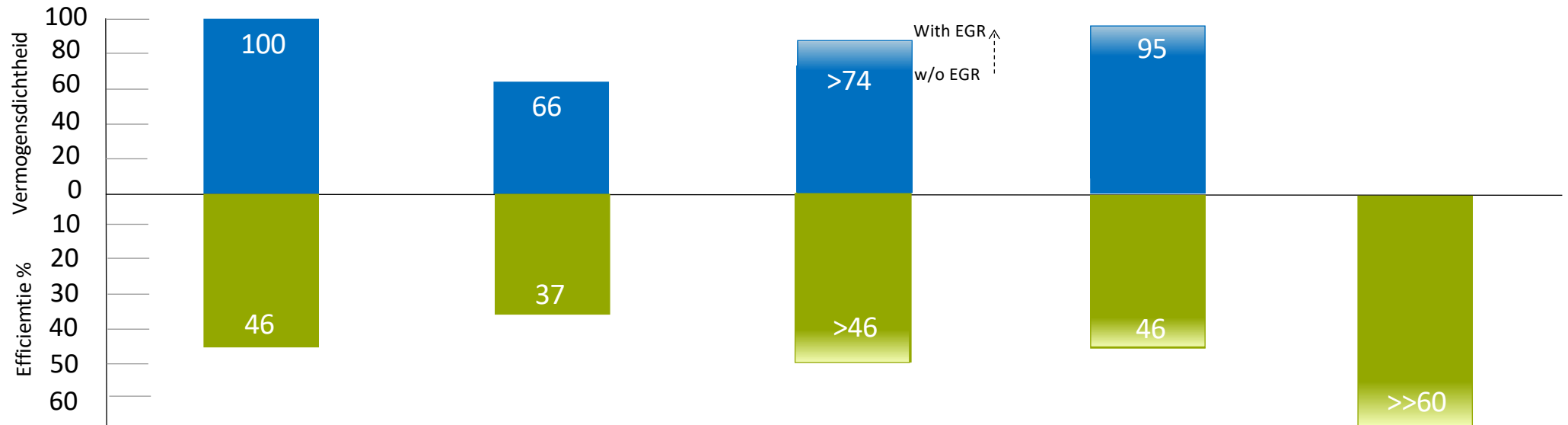
- › Internal combustion engines are **proven robust technology** in road and non-road applications
 - › **Established industry** (design & optimize, manufacture, service & maintenance, re-cycling)
 - › **Tolerant** on hydrogen **fuel quality**. Also in NG/H2 combinations.
 - › Internal combustion engine concepts without aftertreatment **don't need precious or rare metals**
-
- › Application of hydrogen in ICE enables **accelerating the transition towards a sustainable society** and provides an **interim solution for many applications** for as long as alternative (electrified) powertrains are not available or possible

WHY USING H₂ IN INTERNAL COMBUSTION ENGINES? POTENTIAL FOR HIGH EFFICIENCY & ULTRA-LOW EMISSIONS



FEASIBLE HYDROGEN COMBUSTION CONCEPTS

	Diesel	SI $\lambda=1$ + EAS	SI $\lambda \gg 1$ zonder EAS	Dual Fuel + EAS	H2/Argon
Limits		- knock - dp/dca	- pmax - knock	- pmax - dp/dca	- knock - dp/dca



CO2 reduction		100%	100%	30 – 60%	100%
Aftertreatment	DPF + SCR	TWC	None	DPF + SCR	None
Euro/kW					?
Thermal loading					

APPLICATION HYDROGEN INTERNAL COMBUSTION ENGINE

HIGH POTENTIAL FOR SUSTAINABLE HD APPLICATIONS

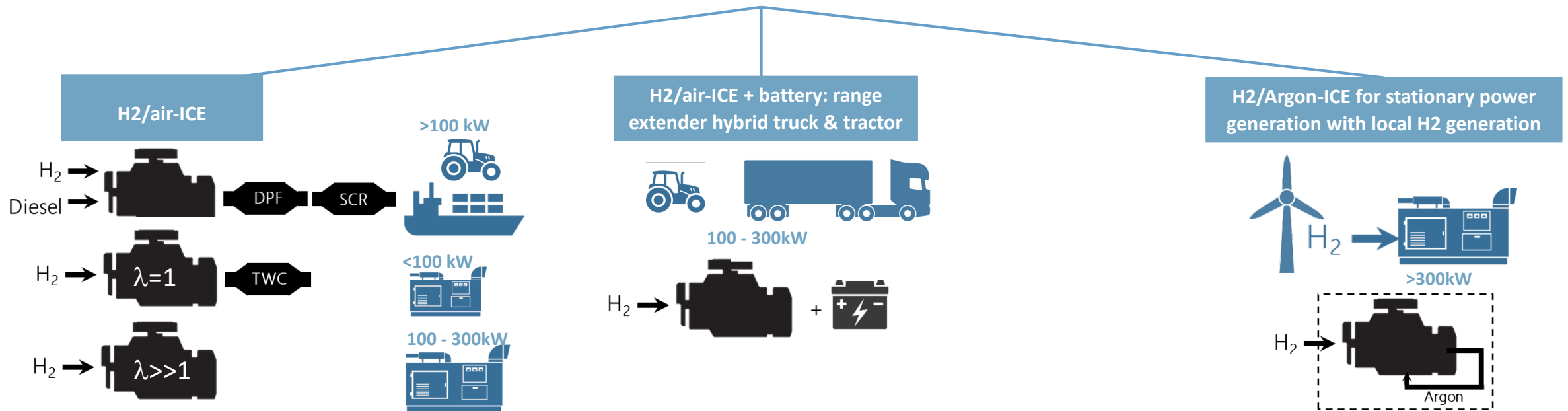
**High
efficiency**

**0
Emissions**

**Proven
technology**

**Reduced
power density**

H2-ICE



› THANK YOU FOR
YOUR TIME

CONTACT INFORMATION

Xander Seykens (PhD.)

Senior Research Scientist Powertrains



Automotive Campus 30

P.O. Box 756

5700 AT Helmond

The Netherlands

T +31 88 866 5738

Xander.Seykens@tno.nl



Onderweg naar duurzame mobiliteit

Mede mogelijk gemaakt door:



Ministerie van Infrastructuur
en Waterstaat

referentienummer DKTi519010