H2-Readiness of Turbine Based Power Plants –

A Common Definition

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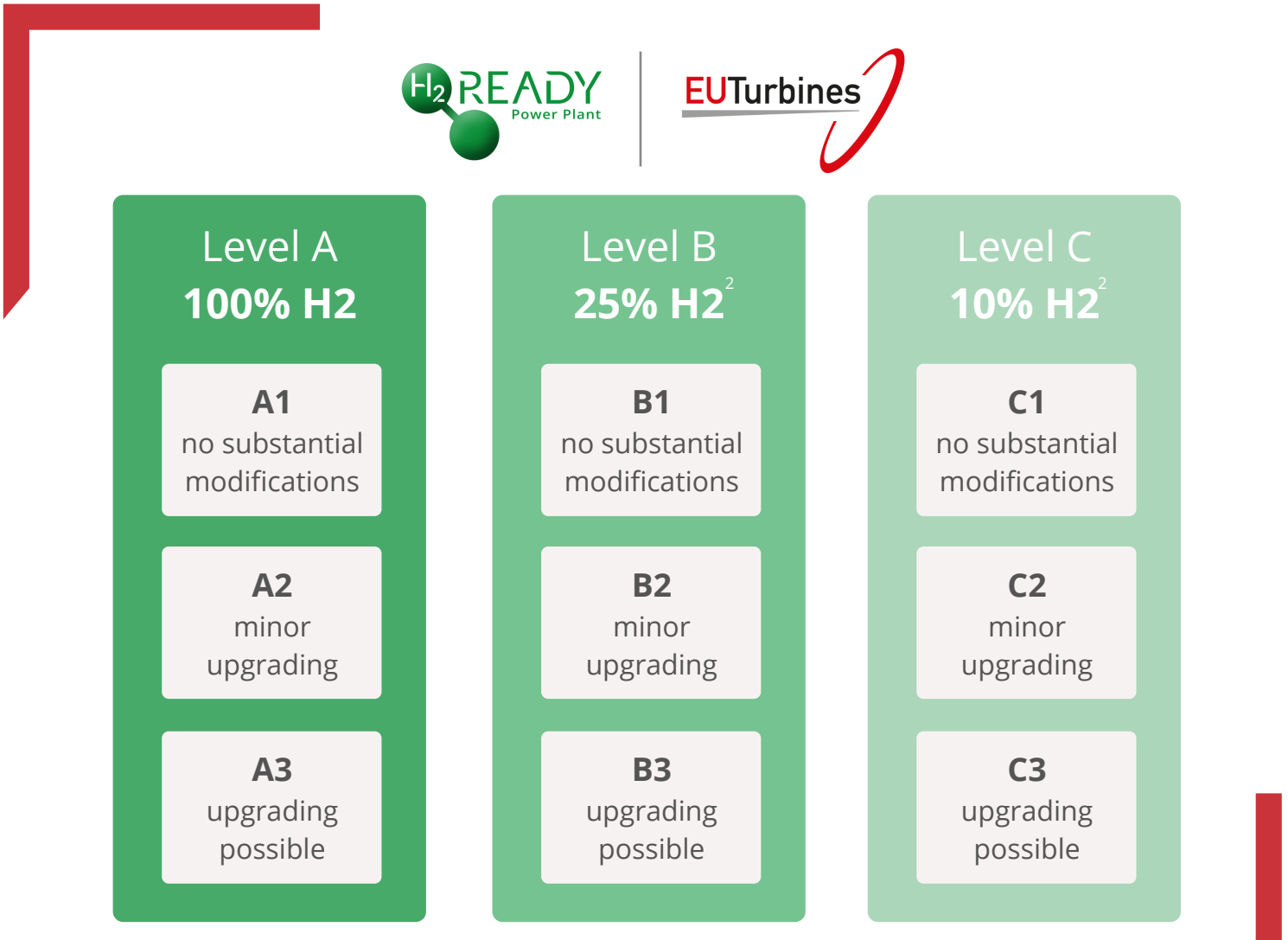
As the gas sector decarbonises, especially thanks to the introduction of hydrogen, it is important that end-users like gas turbine power plants are able to operate with gases other than natural gas. Outlining the H2-readiness of future power plants will ensure that investments are future-proof and do not lead to a carbon lock-in.

The purpose of this paper is to provide a common understanding of H2-readiness for new[1] gas power plants. H2-readiness is defined by:

- **Share (%) of hydrogen**[2]
- **Technical adaptions needed to reach the desired H2-readiness level in the future**



- **No substantial modifications:** Limited modifications may be needed with costs **up to 5%** of overall plant building costs.
- **Minor upgrading required:** Upgrade costs estimated to be **up to 10%** of overall plant building costs.
- **Upgrading technically and economically possible:** Technically suitable, with upgrade costs estimated to be **up to 20%** of overall plant building costs.

Share (%) of Hydrogen

Hydrogen will remain a scarce resource over the next decade. It is likely that hydrogen valleys and hydrogen-dedicated pipelines are built in Europe within the near future but, especially in the distribution grid, the blending of certain levels of hydrogen into the natural gas pipeline will be a valuable option in the transition. The maximum blending share is expected to remain limited to around 25% by volume – above that level there will most likely be a switch to pure hydrogen in one step. By 2050, that switch should be fully concluded.
Based on these assumptions, the gas turbine industry defines H2-readiness for new gas power plants[3] in three levels, according to the hydrogen content[2] of the gas used:

- **H2-Readiness Level A:** 100% hydrogen[4]
- **H2-Readiness Level B:** up to 25% hydrogen blended into natural gas[2]
- **H2-Readiness Level C:** up to 10% hydrogen blended into natural gas[2]

Technical Adaptations

New gas turbine power plants built today will typically start operating with natural gas for a number of years – until larger amounts of hydrogen become available. However, H2-readiness considerations are needed when planning and commissioning a new gas power plant – this will determine the level of modifications and related investments needed to operate a new gas power plant at the desired hydrogen level in the future. The gas turbine industry defines three categories[5] for each H2-readiness level:

- **Category 1: No substantial modifications**
  No substantial modification of the power plant's hardware is necessary to reach the relevant H2-readiness level. However, the plant may require adaptations in operation, service & maintenance, operating procedures, software etc. Modifications are estimated by the technology supplier to remain **up to 5%** of the overall costs of building a new power plant[6]. Also, there may be modifications necessary in the gas supply outside the plant.

- **Category 2: Minor upgrading necessary**
  The plant is technically suitable and retrofittable to operate with the hydrogen share of the category. Certain modifications of the hardware, software, etc. will be required before being able to operate. Many of the upgrading efforts can be done as part of planned regular inspection and maintenance activities. The technology suppliers estimate the costs for this upgrade **up to 10%** of the overall cost of building a new power plant[6].

- **Category 3: Upgrading technically and economically possible**
  The plant is technically suitable and retrofittable to operate with the hydrogen share of the category. Certain modifications of the hardware, software, etc. will be required before being able to practically operate with the mentioned hydrogen level. The technology suppliers estimate the costs for this upgrade **up to 20%** of the overall cost of building this power plant[6].

1 New power plants with requests for quotation after the publication date of this definition by EUTurbines.
2 % figures relating to the volume share of hydrogen blended into natural gas.
3 These definitions may not apply to existing gas power plants. Existing gas power plant owners should check with their technology supplier to determine applicability of these ratings to their sites.
4 This is a non-technical wording. As there are often fractions of other gases in the pipeline system, the technically more correct term would be hydrogen content >95%.
5 For cost shares in the identified categories, it is assumed that the basic plant layout and design already provides for necessary space requirements in connection with the upgrade. Furthermore, it is assumed that the stable supply with the defined gas composition is ensured outside the plant (no mixing equipment is included as part of the modifications). It is also assumed that the requirements of the current industrial emissions legislation apply and, as a consequence, no additional NOx reduction system will be needed.
6 Costs relating to the inflation-adjusted costs of building a state-of-the-art simple cycle gas power plant without the need for additional exhaust aftertreatment solutions. Subject to review when significant parameters change.

EUTurbines

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