



SPENT FUEL CELL WASTE MANAGEMENT AND CHALLENGES IN THE MATERIAL RECYCLING

INTRODUCTION

Spent fuel cell waste management involves properly processing and disposing of end-of-life fuel cell components. Efficient waste management systems are critical for reducing environmental impact and recovering resources. Recycling presents difficulties since it involves complicated components incorporating rare metals. Sophisticated methods are required for element separation. Flexibility cost-effectiveness, and sustainability issues constrain successful recycling systems. To address these problems, business, academics, and government must work together to create unique recycling technologies and regulatory frameworks that promotes recycling in the fuel cell market.

AIM

The aim of the project is to study the current situation of material recycling in the field of Fuel cell Industry and to look into what process are involved in the process of recycling and understand what could be improved so that the material can be reused which can lead to less of an Environmental Impact.

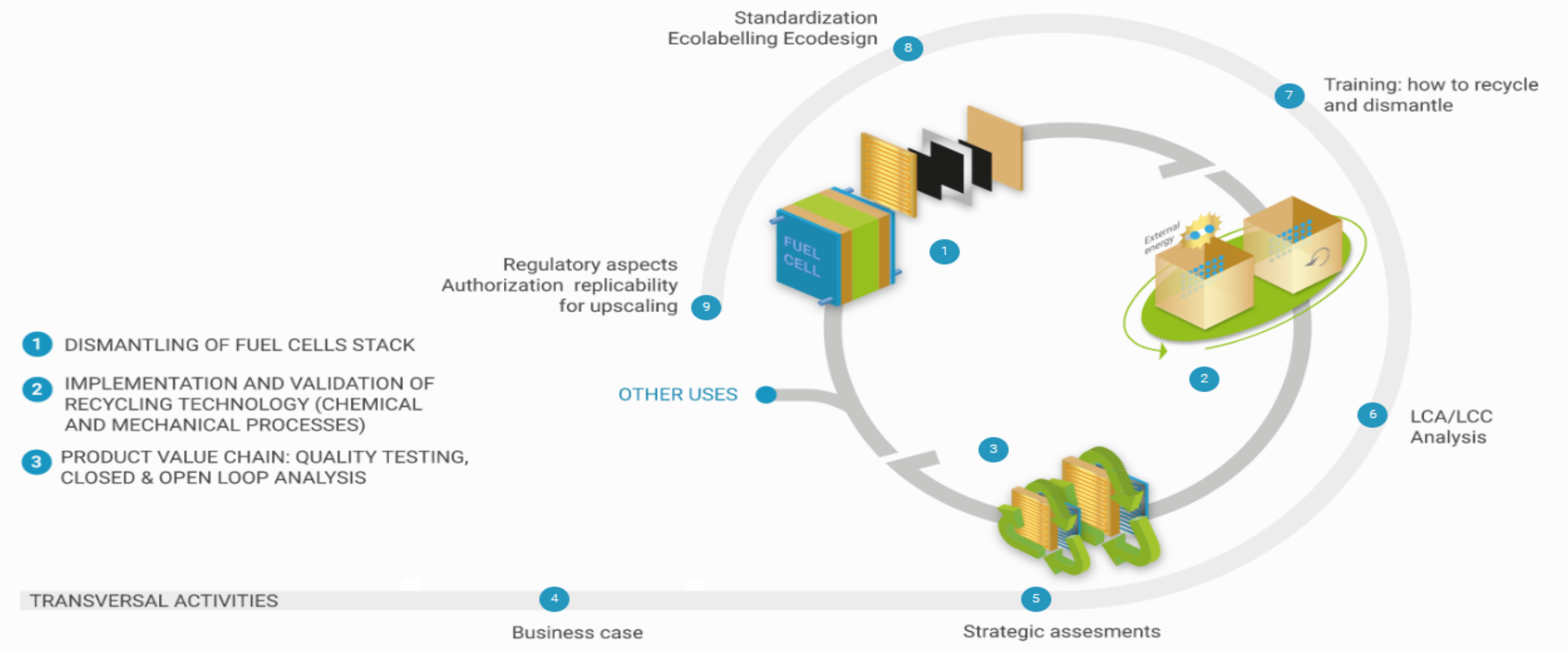


Figure 1: Recycling Process of A Spent Fuel Cell System.

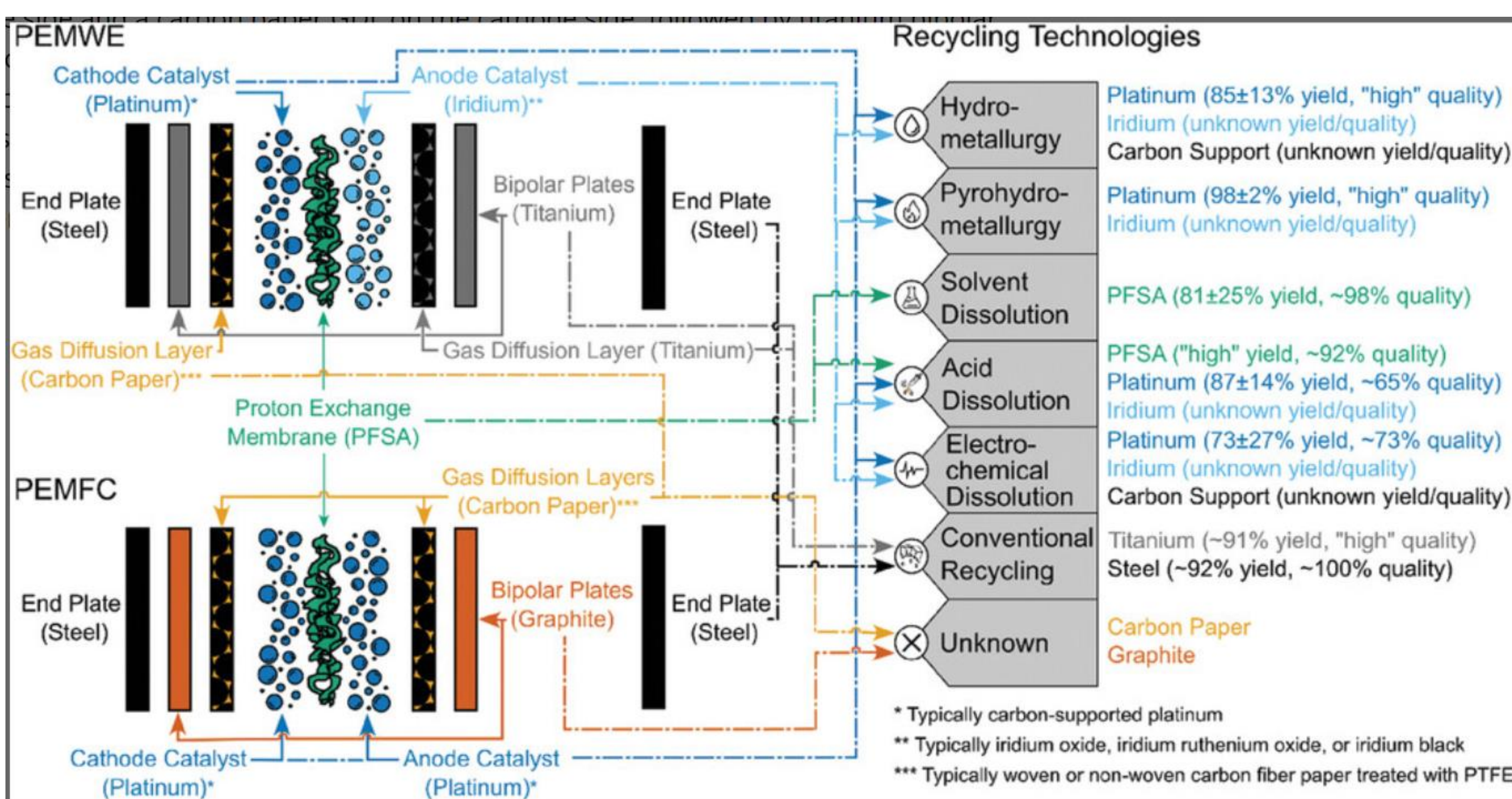


Figure 2: Different recycling technologies for various parts of the PEM fuel cell

Fuel cell disassembly mechanically entails taking apart individual parts in order to salvage precious materials and make recycling easier. The fuel cell stack must be divided into separate modules, catalyst-coated membranes must be removed, and important parts like electrodes and bipolar plates must be isolated throughout this procedure. The effective recovery of materials from wasted fuel cells, such as platinum catalysts and graphite, is made possible by mechanical dismantling, which promotes resource conservation and the creation of sustainable energy.

PLATINUM RECOVERY IN FUEL CELL

Platinum Grade Metals (PGM) recovery is pivotal for sustainable fuel cell energy production. As a crucial catalyst in fuel cells, platinum accelerates electrochemical reactions for energy generation. Maximizing recovery from spent fuel cell components is vital for environmental and financial reasons. This process minimizes the environmental impact of mining, conserves precious platinum resources, and supports the development of cost-effective and eco-friendly fuel cell technologies, ensuring long-term viability and a circular economy.

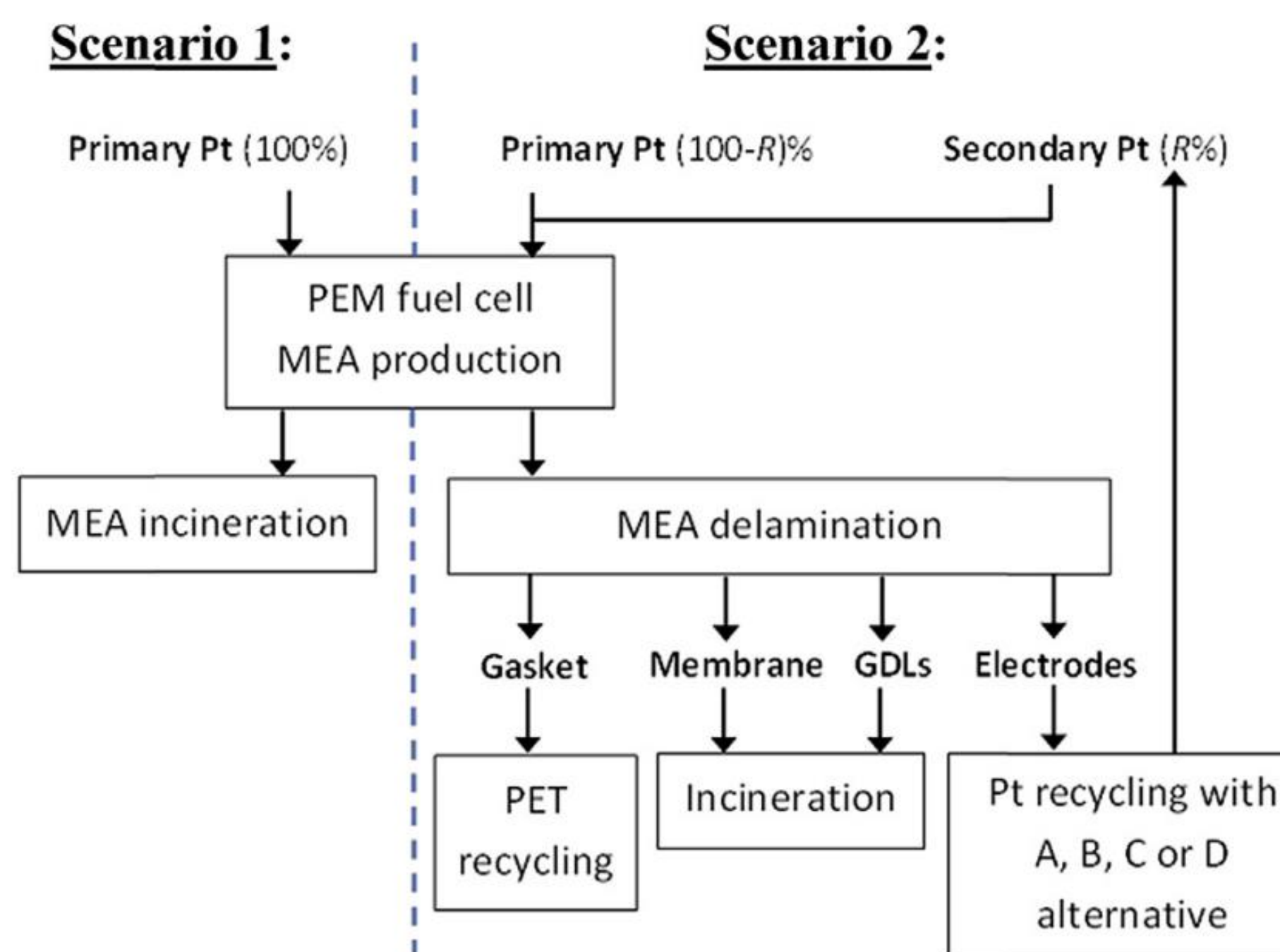


Figure 3: Different scenarios of dismantle of PEM fuel cell.

DISCUSSION

Pyro-hydrometallurgy suits as the best option for Platinum grade metals recovery. The major cost reduction needs to be done in catalyst loading and salvage fees. Improving PGM yields can save 10-50% of the recycling costs. This can reduce the procurement of raw Pt by 30% in 2050.

CONCLUSION

Proper processing of fuel cell and disposing of EOL fuel cell components is observed and noted that management of spent fuel cell is a crucial aspect for sustainable nature. Fuel cell's complexity, especially with rare metals and its challenges are noted. Elaborate steps are taken to develop sustainable recycling methods within regulations.

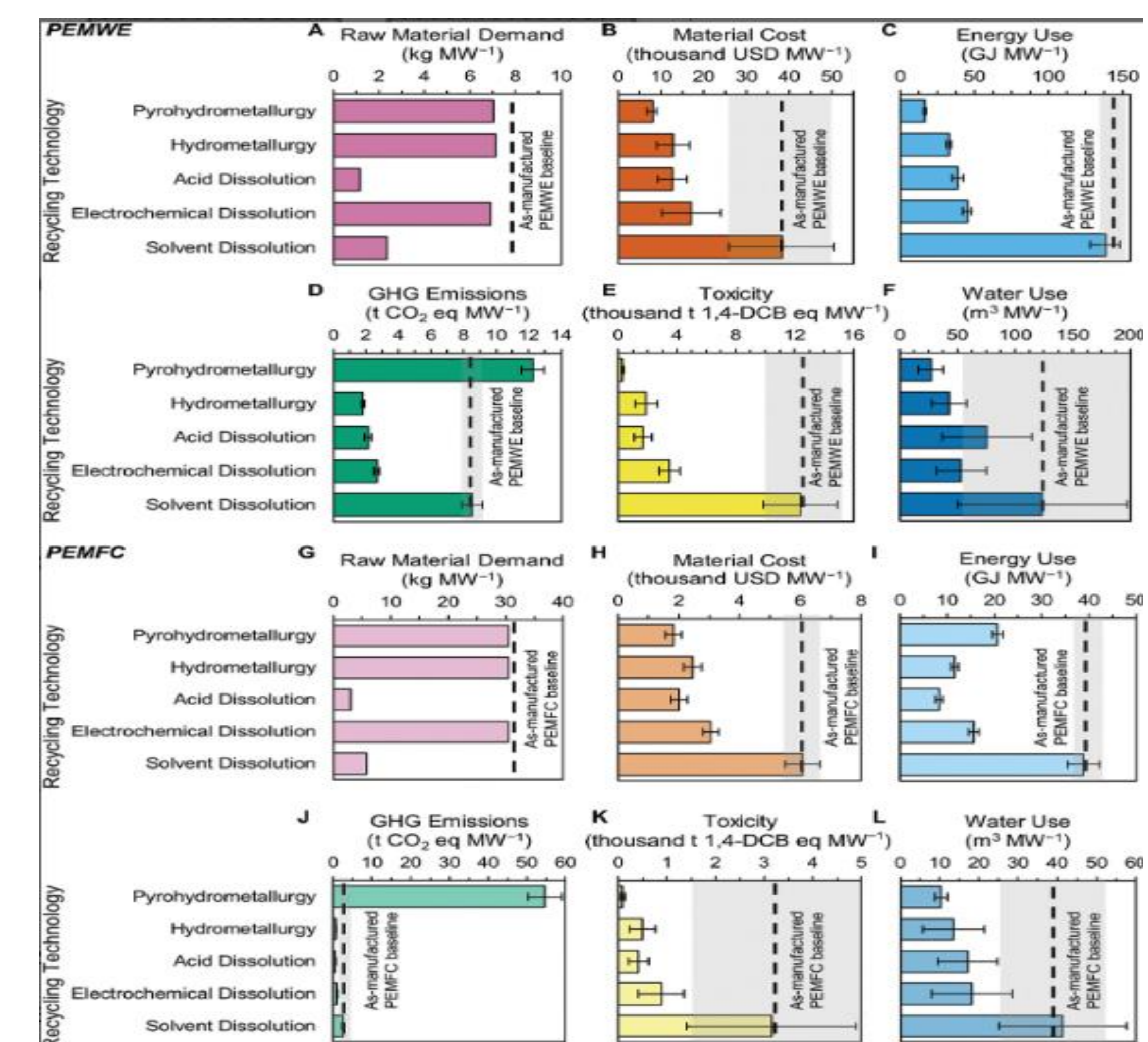


Figure 4 :Different scenarios of energy consumption of PEM fuel cell in different recycling purposes.

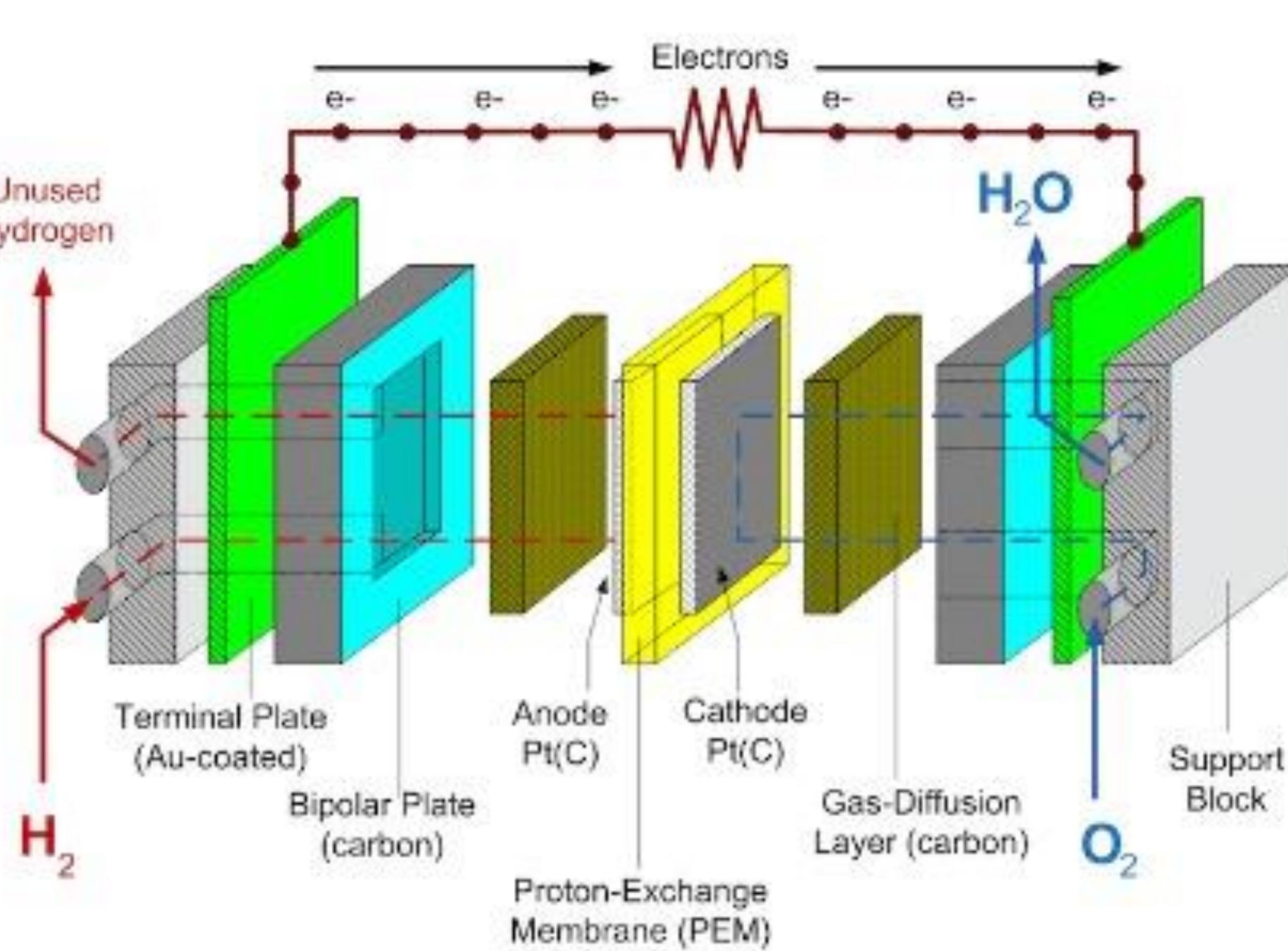


Figure 6: General composition of Fuel cell.

>95% of the precious metals in the MEA are reclaimed during recycling of fuel cell.



Figure 5: Companies working on recycling of fuel cell.

References

- Lucien Duclos, Maria Lupsea, Guillaume Mandil, Lenka Svecova, Pierre-Xavier Thivel, Valérie Laforest, (2017)Environmental assessment of proton exchange membrane fuel cell platinum catalyst recycling,Journal of Cleaner Production,Volume 142, Part 4.
Taylor Uekert, Hope M. Wikoff & Alex Badgett, (2023), Electrolyzer and Fuel Cell Recycling for a Circular Hydrogen Economy.