A Bottom up Cost Assessment of Alkaline & PEM Stack
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Introduction
We present a bottom up assessment of AE and PEM state of the art and advanced stack direct cost with an aim to assess their feasibility for a GW/year production by 2030.

Methods
The direct cost encompasses materials, labor, manufacturing cost, overhead and profit margin. The materials prices are based on spot prices + a processing fee. The manufacturing and labor cost are based on the accounting method employed by Mayyas et al. (2019) where manufacturing cost accounts for capital, buildings, labor, production, building operation and energy cost. The labor cost is based on the number of laborers per production line with a fixed hourly rate working for 1600 hours/year. Overhead and profit margin are based on cost structures reported in annual financial statement of PV and electrolyzer manufacturers.

Price sensitivities:
Materials: based on ten year historical prices where the peak and trough are chosen as the high and low prices respectively. Manufacturing and labor: results for the bottom up assessment were compared to PV manufacturers at a GW scale, cost structures reported in annual financial statements of electrolyzer manufacturers and public statement for ITM’s GW factory.

Results:

Materials
The main cost drivers for materials cost is moving to advanced “larger” stacks with higher capacity coupled with reducing the loading of PGMs and replacing expensive materials like sintered porous titanium and gold with stainless steel powder and niobium respectively (Fig 1 a & b).

Manufacturing and Labor
Figure 2 a & b illustrates a schematic of the processes and production line required to produce AE and PEM stacks (1). The methodology employed my Mayyas et al. (2019) results in highly underestimated manufacturing and labor cost (~5% of stack cost) when compared to cost ratios seen in PV industry and electrolyzer manufacturers (materials: labor : manufacturing ~ 4:2:1; 8:4:1 respectively) (2,3). The assessment used is based on available information regarding manufacture of state of the art stacks.

Total Direct Stack Cost (including overhead & profit margin)
The manufacturing and labor cost were adjusted in accordance with the cost ratios seen in electrolyzer manufacturers’ annual financial statements and the public statement from ITM’s GW facility to arrive at a more realistic cost estimate for electrolyzer stacks. Figure 3 illustrates the adjusted manufacturing and labor cost, coupled with material cost sensitivities and overhead-profit margin (100% + (-50%) of stack cost for business in infancy: 25% + 10% for mature business) (4).

References

Figure 1: Material cost structure of the AE and PEM stacks including material cost sensitivities. AE Stack cost by PEM stack(1).

Figure 2: a) AE Stack Manufacturing Process

Figure 3: Total direct stack cost and including overhead & profit margin of state of the art and advanced stacks.