Electrode Optimization for Oxygen Evolution Reaction by Using an Environmentally-Friendly Synthesis.

Henao-Toro, H.[1], Cartagena-Ocampo, S.[2], Calderón J.A.[2], Chica, E.[1], Rubio-Clemente, A.[1,3]
Universidad de Antioquia, UdeA
[1]Grupo de Investigación Energía Alternativa – GEA, Calle 70, No. 52-21, Medellín, Colombia. Postal code: 050024.
[2]Centro de Investigación, Innovación y Desarrollo de Materiales, CIDEMAT. Calle 62 #52-59 Medellín, Colombia. Postal code: 050024.
[3]Escuela Ambiental, Facultad de Ingeniería, Calle 70, No. 52-21, Medellín, Colombia. Postal code: 050024.

Introduction

The report presented in 2022 by the Intergovernmental Panel on Climate Change (IPCC) forecasts devastating changes across the planet if current anthropogenic emissions continue. To mitigate this impact, it is necessary to reduce anthropogenic emissions by half by 2030 and achieve net-zero emissions by 2050 (IPCC, 2022) [1].

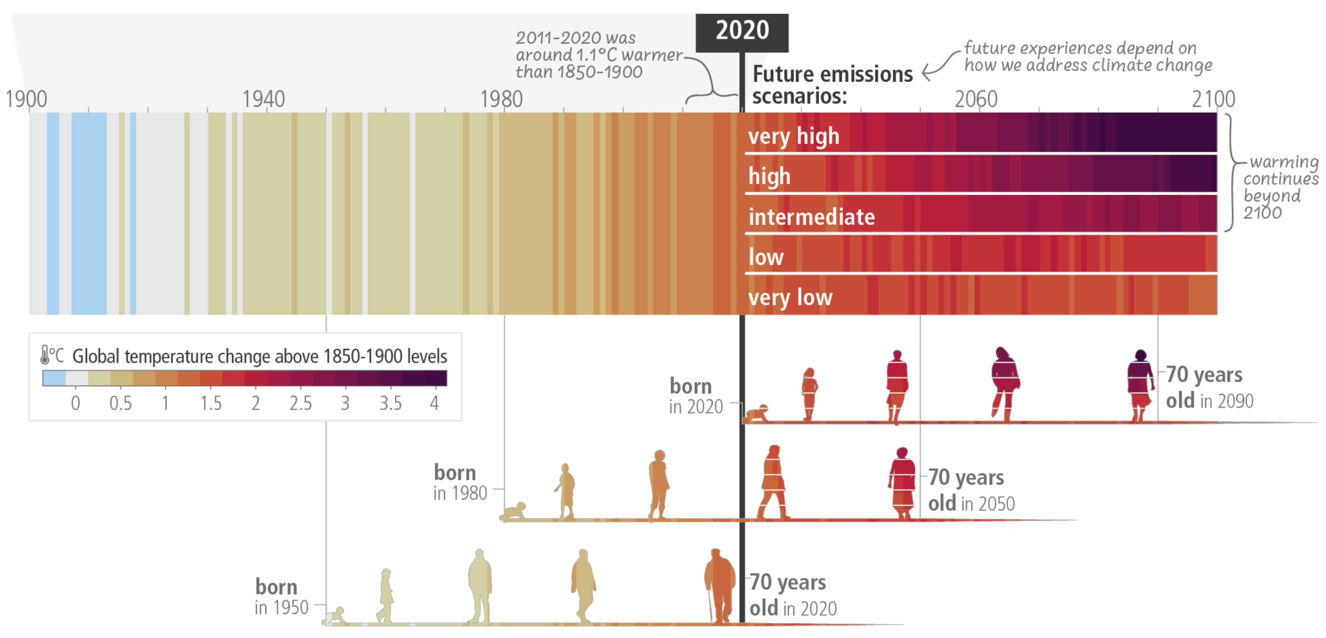

Fig 1. Observed (1900-2020) and projected (2021-2100) changes in global surface temperature

Energy transition

Use of hydrogen in the decarbonization of various industries

Electrodes made of noble metal oxides like Ru/Ir are commonly used for OER due to their high catalytic capacity. However, their scarcity and high cost make implementation difficult [2]. Therefore, research has focused on alternative materials, such as transition metals, which in some cases have demonstrated higher catalytic activity and stability for OER than noble metal oxides [3]

In this work, highly efficient electrodes for OER were developed through a simple and environmentally viable synthesis.

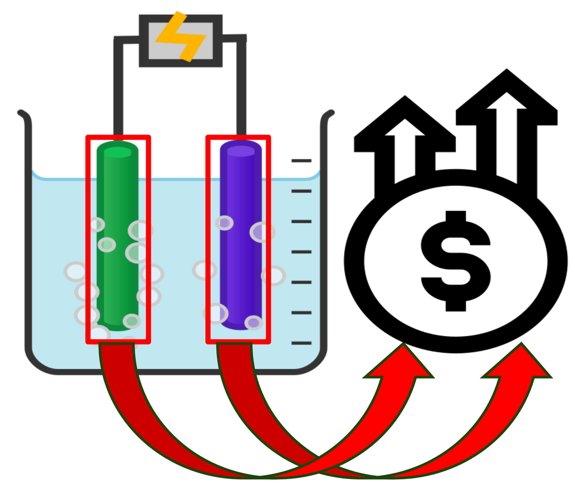

Fig 2. Price increases due to electrode materials

Methodology

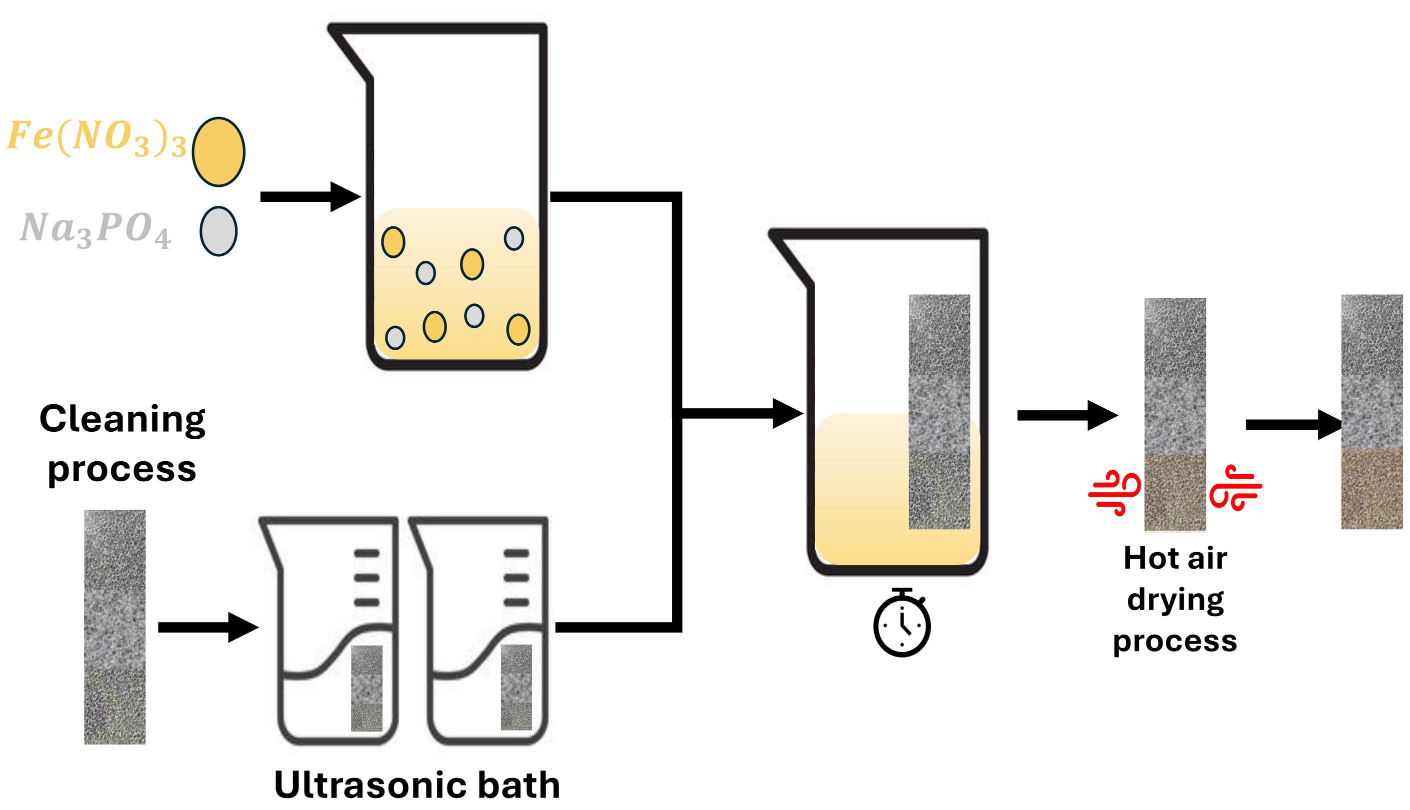

Fig 3. Diagram of the synthesis process

Table 1. Experimental Conditions

Electrode	$Fe(NO_3)_3$ (mg)	Na_3PO_4 (mg)	Contact time (min)
$Fe-NaP/_{opt}$	1,050	0,050	2
$Fe-NaP$	1,050	0,150	2

Fig 4. AUTOLAB Potentiostat Measurement Equipment

Results

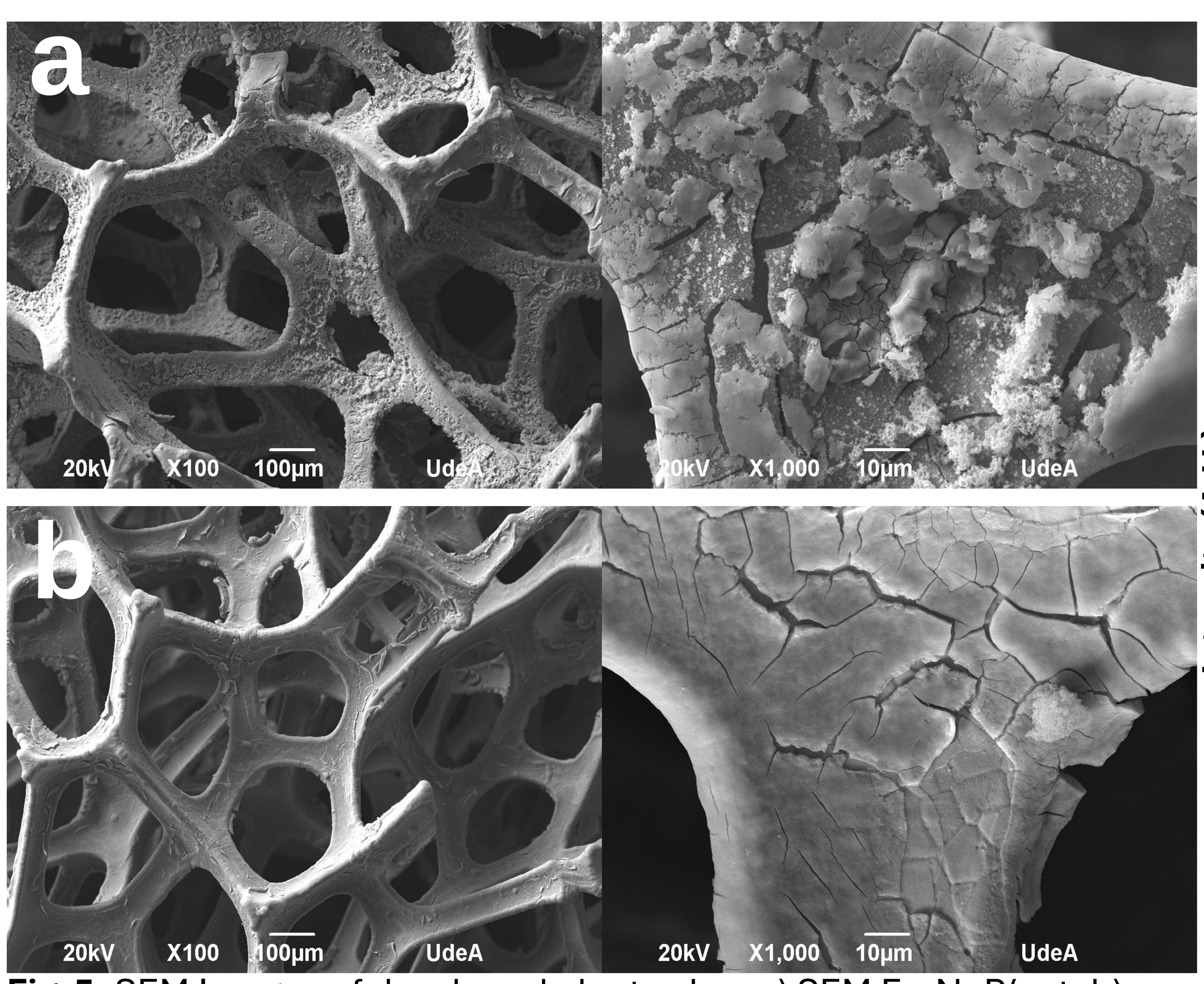

Fig 5. SEM Images of developed electrodes. a) SEM Fe-NaP/opt, b) SEM Fe-NaP

Characterization and electrochemical tests

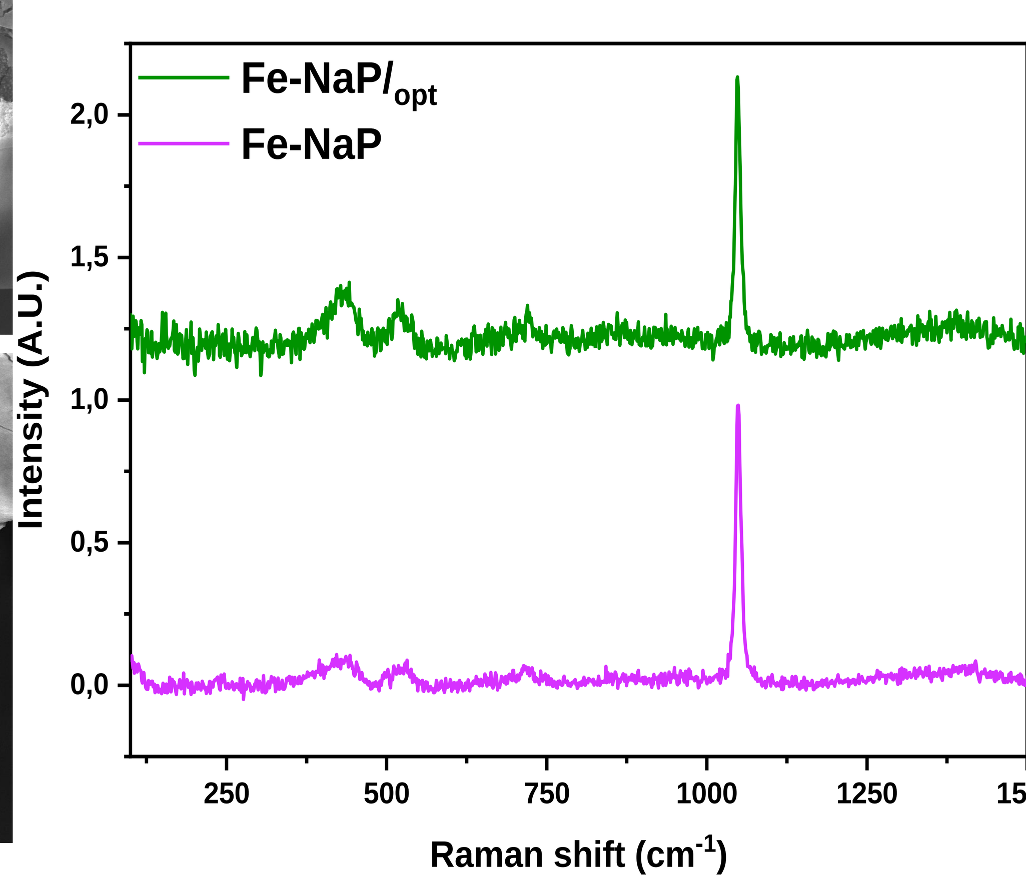

Fig 6. Raman spectra

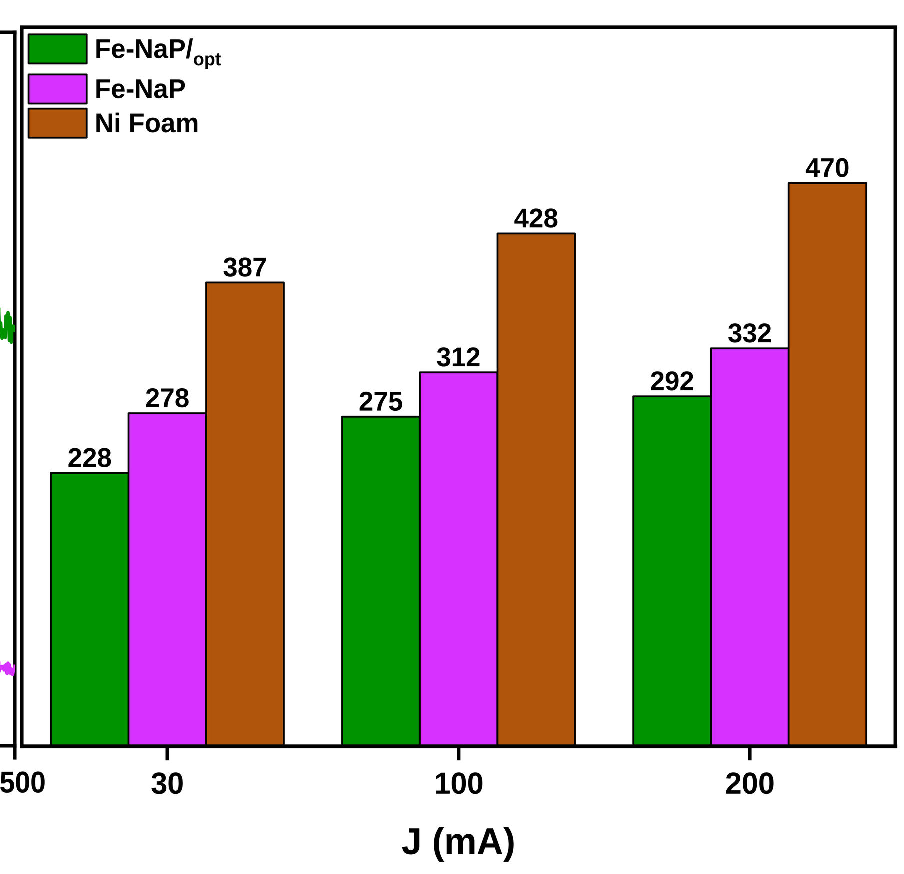

Fig 7. Overpotentials at 30 mA, 100 mA and 200 mA

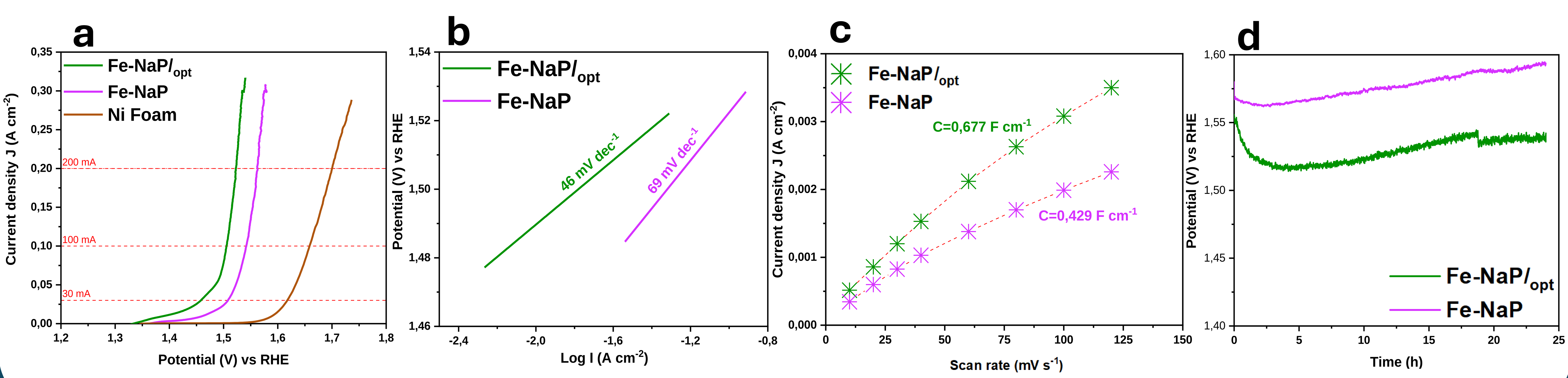

Fig 8. Electrochemical tests. a) LSV for OER, b) Tafel slopes, c) Capacitance measurements, d) Stability tests 400mA

Conclusions

Using a smaller amount of Na_3PO_4 yields better results, achieving overpotentials of 275 mV at 100 mA cm-2.

SEM images show a rough structure on the surface of Fe-NaP/opt, possibly indicating the presence of metallic (oxy)hydroxides.

Excellent results were achieved with a simple, versatile, and cost-effective synthesis, making the entire process more economical.

References

[1].Climate Change 2023 Synthesis Report. available in https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf
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