HIGH ENERGY REDOX ENGINE

Dr. Yet-Ming Chiang, Propel Aero

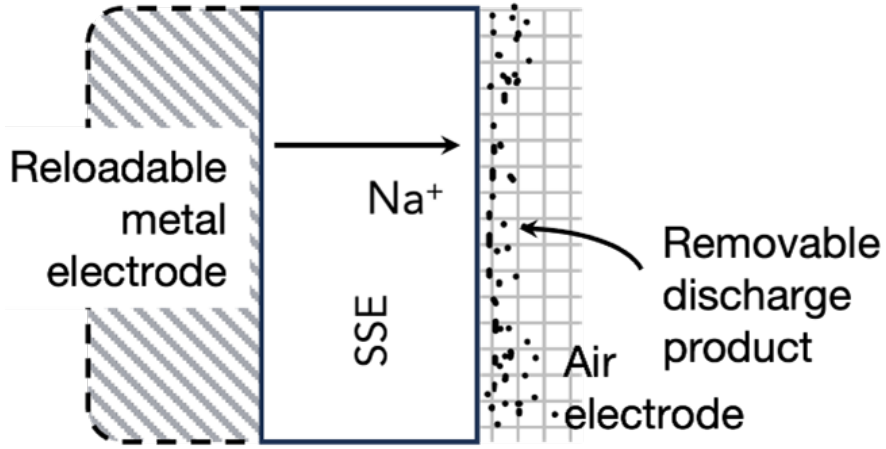
Massachusetts Institute of Technology
University of Michigan

Project Vision

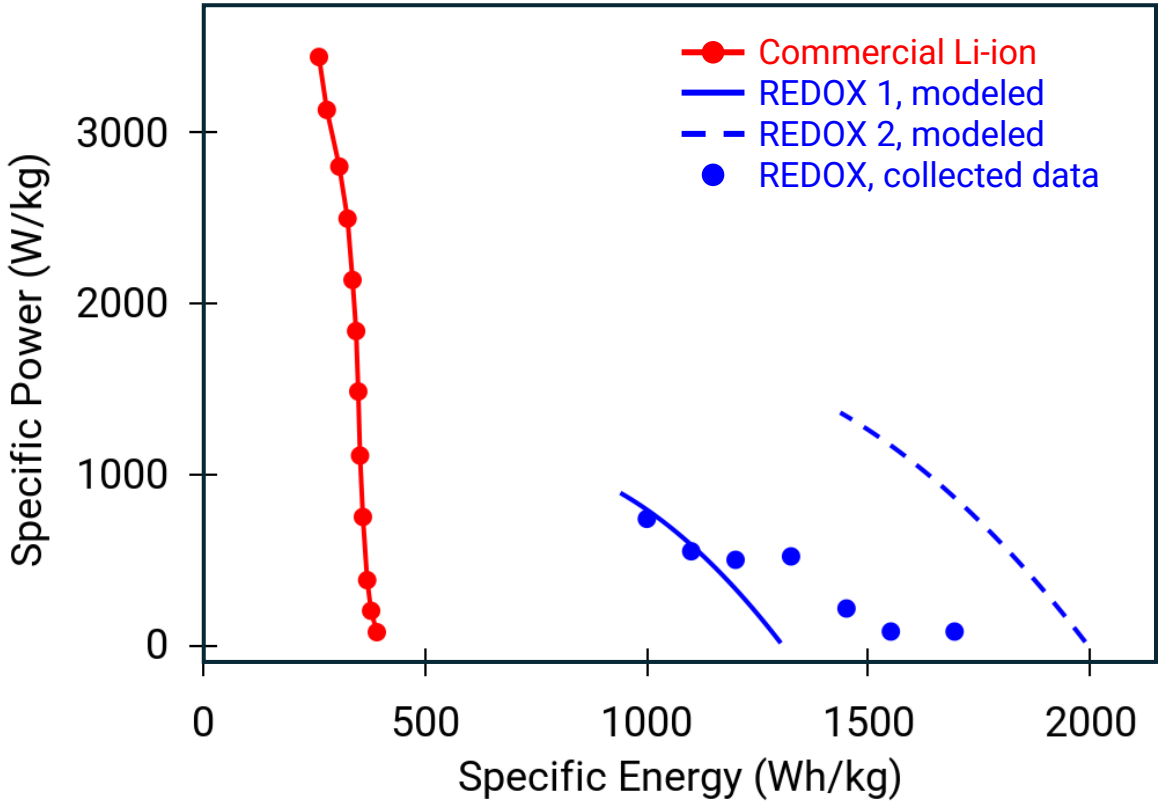
Unleashing the next age of electric mobility by delivering a REDOX engine that offers >1000 Wh/kg at cost parity with jet fuel

PROPEL-1K Program
Annual Meeting
July 15, 2025

Technology Concept and Design Space



Sodium-air fuel cell



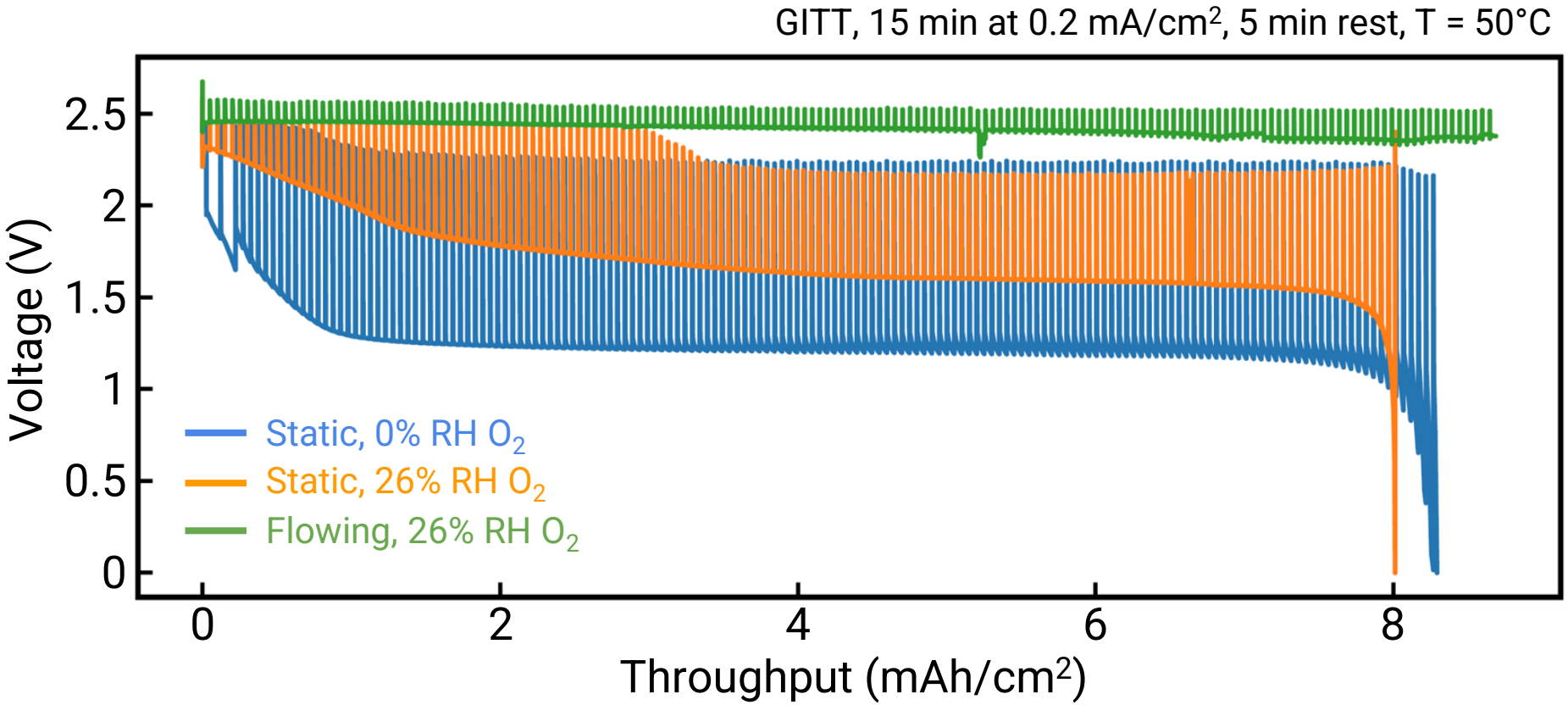
Technical Achievements

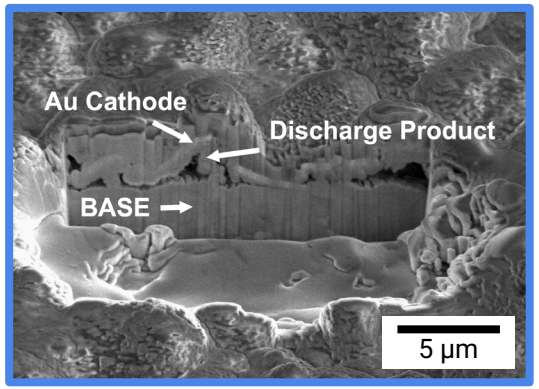
Demonstrated continuous operation consuming up to 2.5 cm Na metal

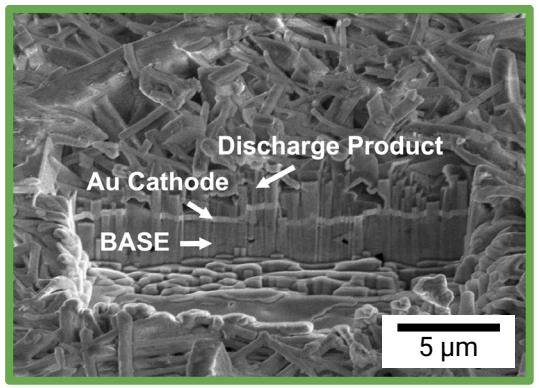
Exceeded maritime continuous and pulse power targets

Demonstrated 1700 Wh/kg stack specific energy

Continuous operation with low overpotential with humidified air

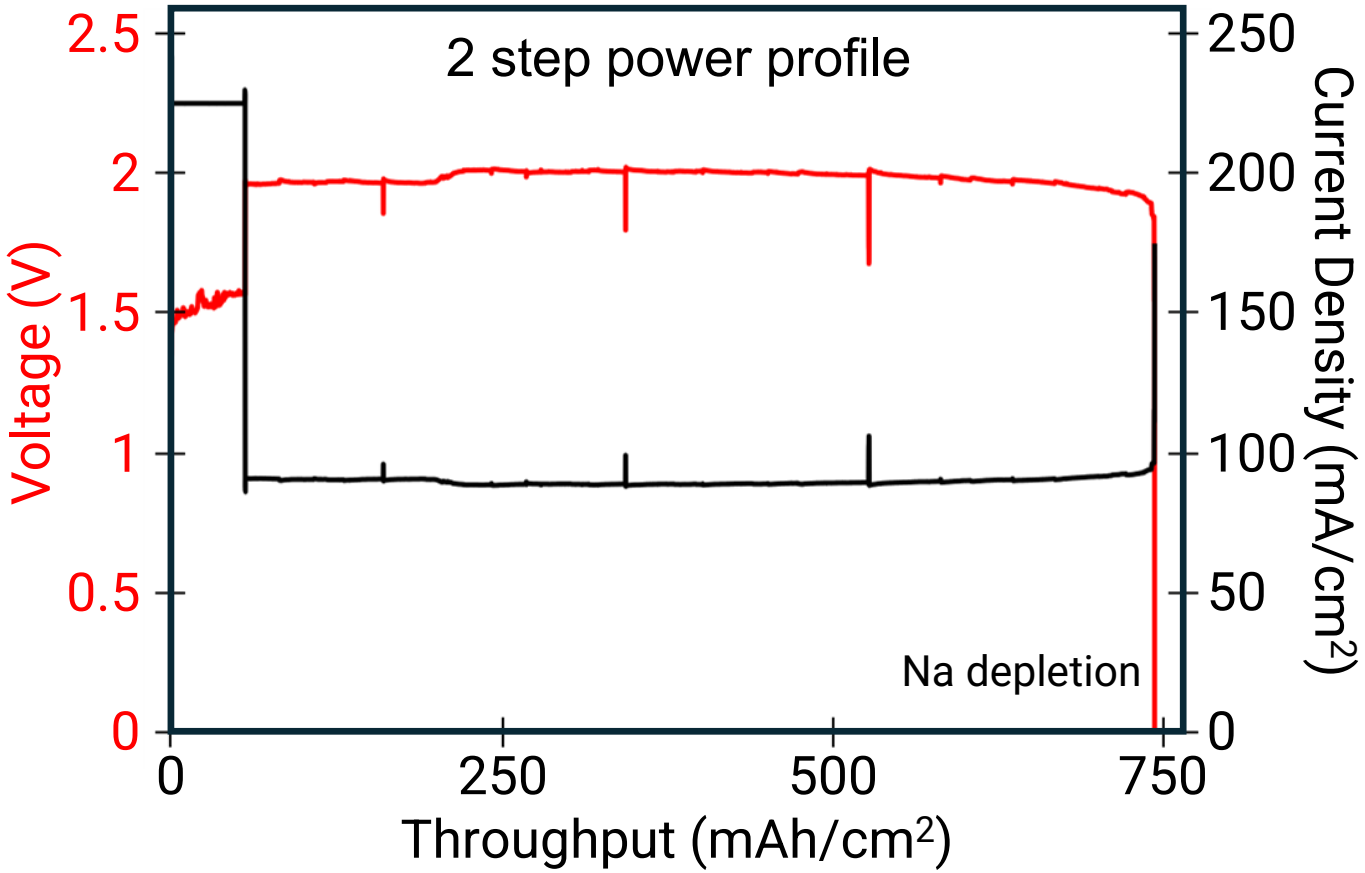


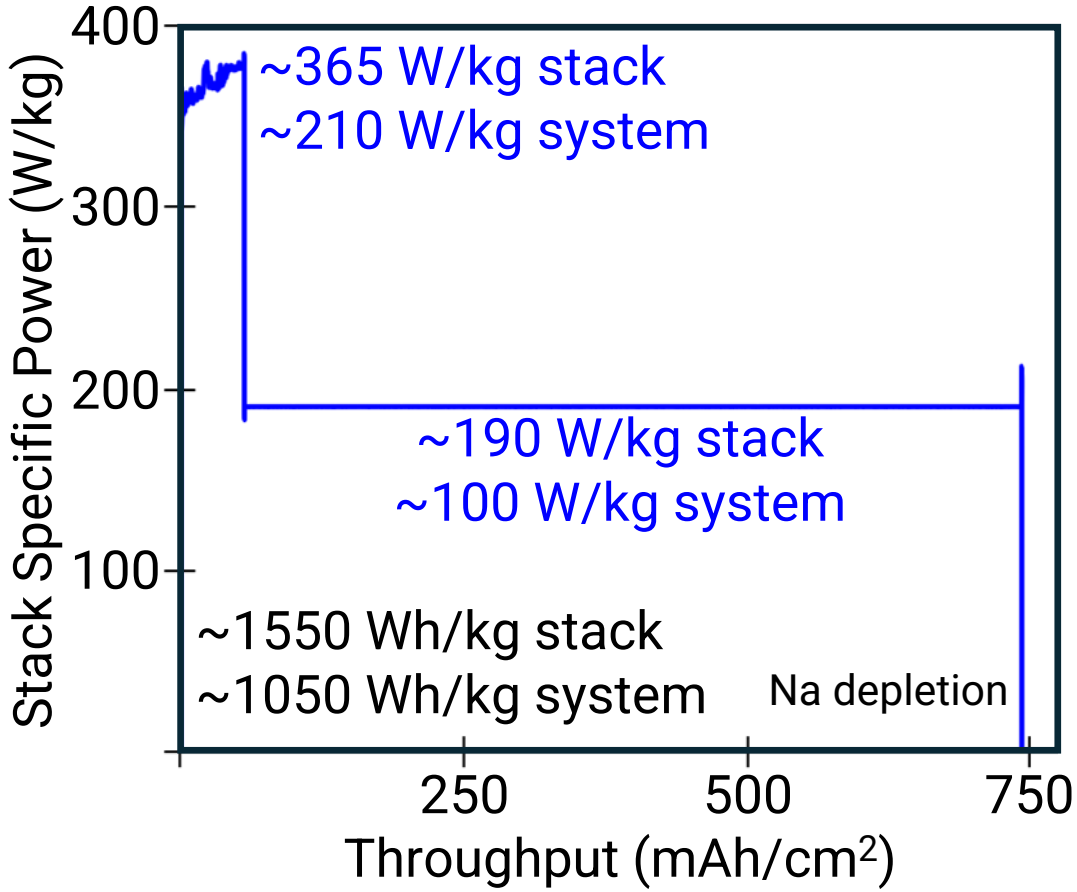




Introducing humidified air gas stream lowers overpotential and increases accessible capacity due to continuous discharge product removal

REDOX cells operating under maritime duty cycle in air

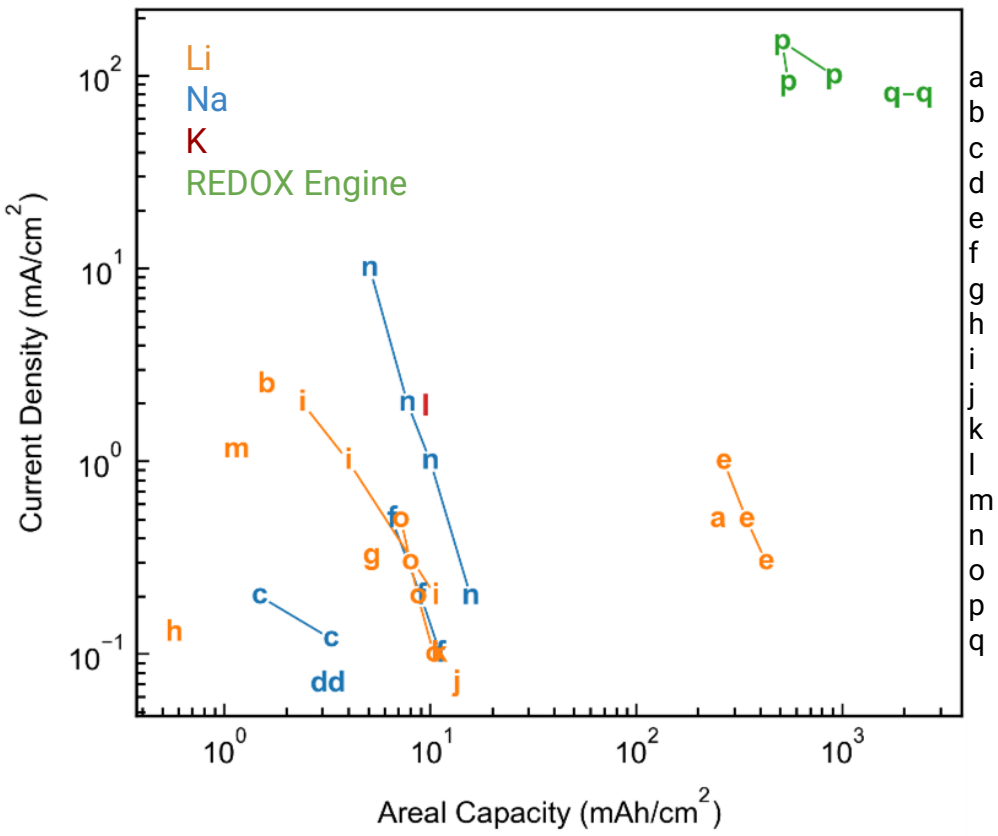




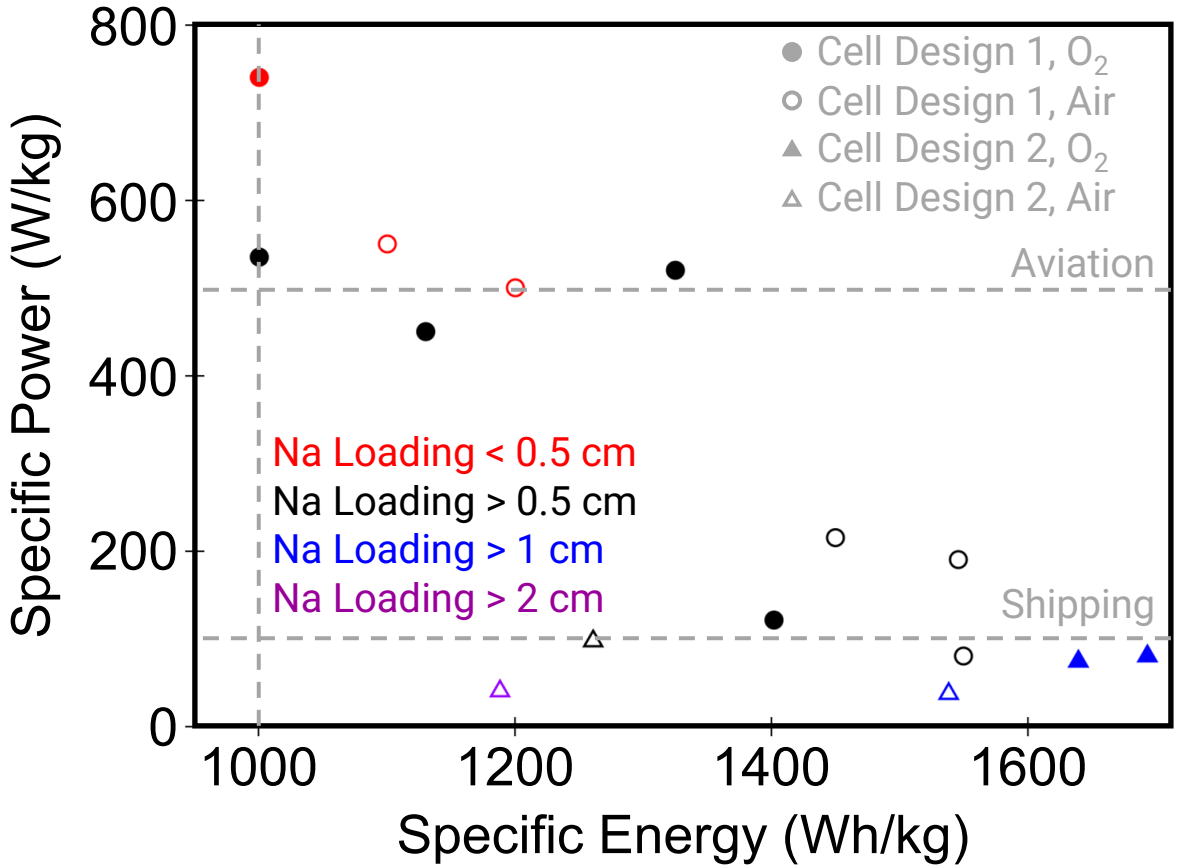
Measured stack performance + modeled system-level performance reaches >1 kWh/kg at continuous/pulse power targets for maritime applications

ARPA-E AWARDEE

REDOX Engine Performance Comparison and Progress



a Wang, Zhou, 2009
b Peng et al., 2012
c Hartmann et al., 2013
d Das et al., 2013
e Visco et al. 2014
f Yadegari et al., 2015
g Giordani et al., 2016
h Zhu, Z. et al., 2016
i Gao et al., 2016
j Kim et al., 2017
k Xia et al., 2018
l Baclig et al, 2018
m Qiao et al, 2019
n Zhu, Y.G. et al., 2022
o Kondori et al., 2023
p REDOX Engine, O_2
q REDOX Engine, air



Next steps

Air electrode and solid electrolyte development for higher power

Module and system design, build, test

REDOX Engine Team

