USMC Hybrid Power Efforts

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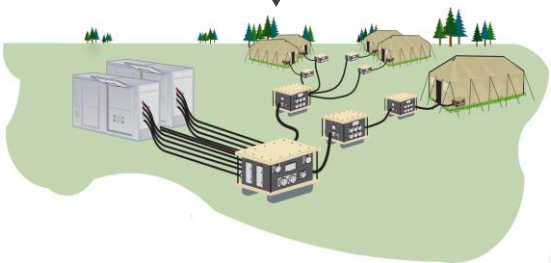
Introduction

- EPS overview
- Background on hybrid systems
- Key development areas
- USMC requirements in hybrid systems
- Current hybrid efforts
- Future opportunities
- Conclusion

U.S. Marine Corps Expeditionary Power Systems

Mobile Power
Water and Fuels



Advanced Power Team

Radio Power Adaptors

Power Supplies

Renewable Energy

Hybrid Systems

Battery Management / Sustainment Systems

Problem

During Operation Enduring Freedom, fuel and water accounted for seventy percent of the logistics required to sustain Marine Corps expeditionary forces ashore.

Solution

Hybridize existing generators to provide:

- **Increased Energy Efficiency**
  (33-60% fuel reduction over fielded generators)
- **Extend time between required generator maintenance**
  - **Generator run time will be reduced approximately 40%**
- **Reduced fuel consumption, resupply and total mission weight for the MAGTF, extending the Commander's reach by ~ 73%**

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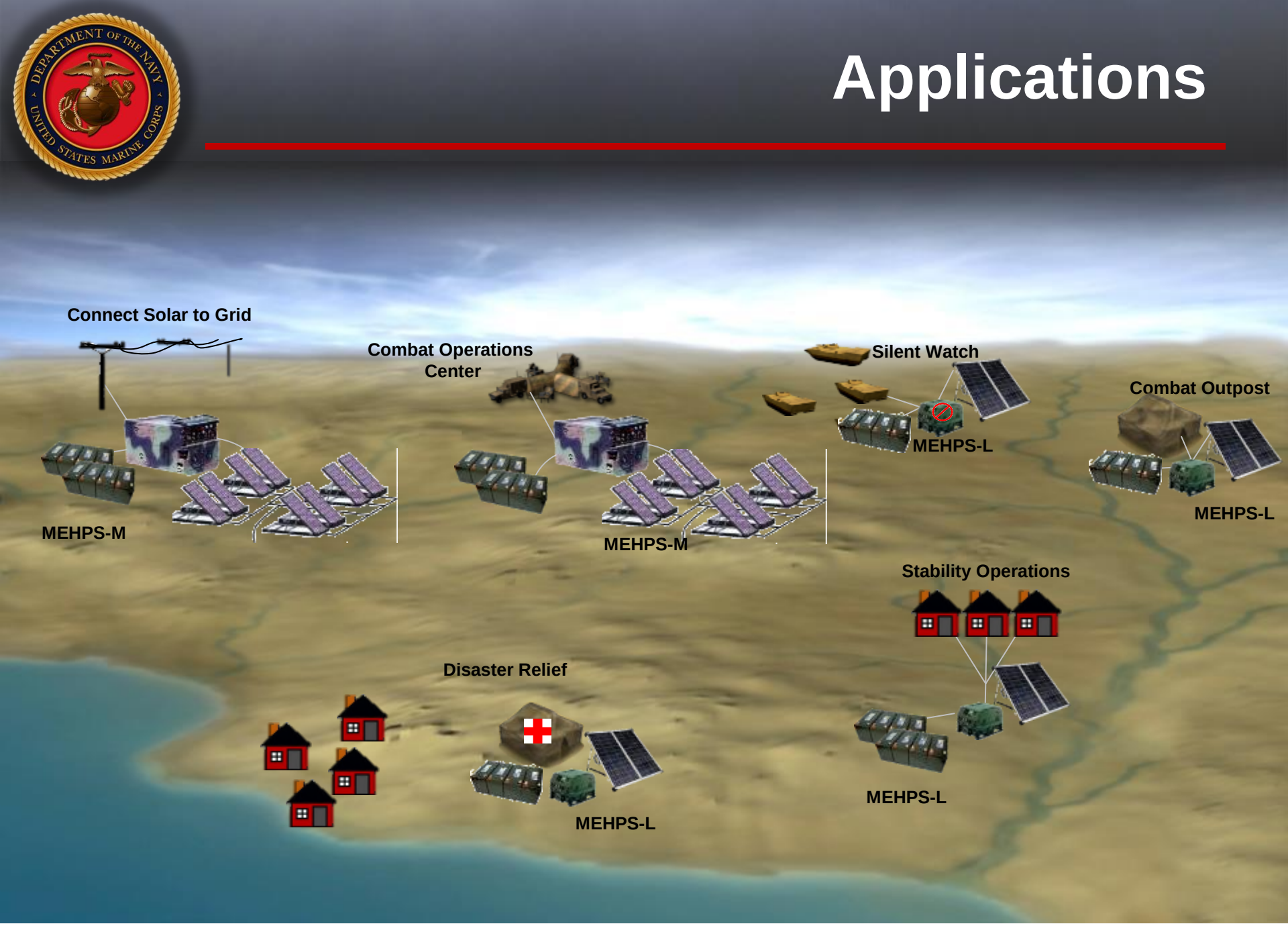
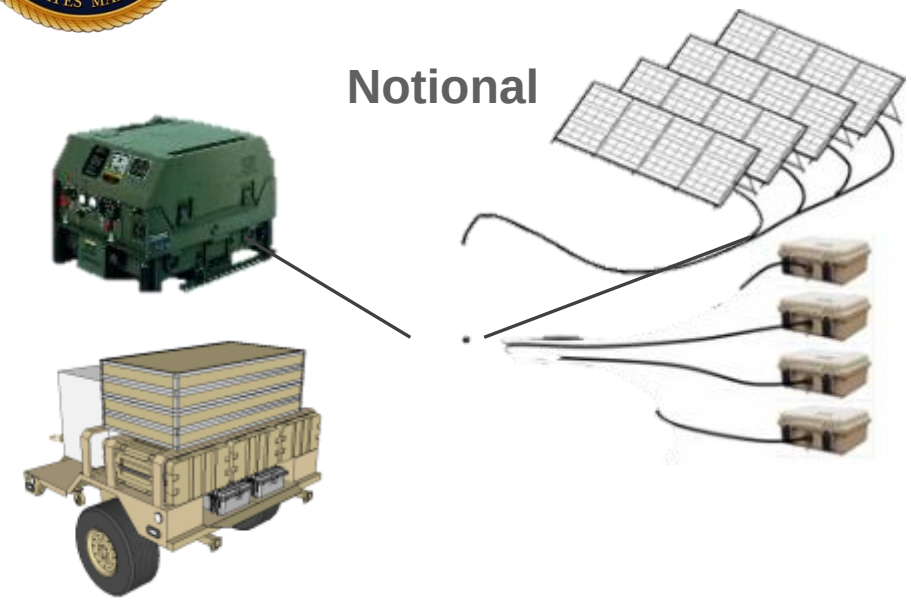
MEHPS AOA

	10W	300W	5kW	60kW	800kW	MW
Power Range	Man Portable	Small	Medium	Large	Prime
Employment Time	Hours-Days	Days-Weeks	Weeks-Months	Months- 1 Year	Years
Employment Vignettes	➢Dismounted ➢Observation Point (OP)	➢Observation Point (OP) ➢Patrol Base (PB) ➢Vehicle Based	➢Patrol Base (PB) ➢Combat Outpost (COP) ➢Village Stability Platform (VSP) ➢Forward Operating Base (FOB) ➢Vehicle Based	➢Combat Outpost (COP) ➢Forward Operating Base (FOB) ➢Vehicle Based	➢CAMP
Unit Size	Fireteam - Squad	Squad-Platoon	Company - Regiment	Division and Above	Division and Above
Logistics Support	➢Warfighter carried/ delivered	➢Warfighter carried/ delivered ➢Sling Loaded ➢HMMWV / MATV Delivered	➢Sling Loaded ➢HMMWV / MATV Delivered ➢MTVR Delivered ➢Forklift 4K and more	➢MTVR Delivered ➢LVSR Delivered ➢Air delivery C-130/ C-17	➢Air delivery C-130/ C-17
Hybrid System Type	➢Wearable distributed power	➢Small genset/ battery/solar	➢Trailer mounted ➢Containerized ➢Vehicle Based	➢Containerized / Microgrid ➢Vehicle Based	➢Containerized ➢Microgrid
Priority	N/A	Moderate	High	Low	N/A

Applications



MEHPS



USMC System to be used to augment existing generators in order to reduce fuel consumption in expeditionary environments

Technical Description

MEHPS is a hybrid power system that will consist of:

- **Controller/Power Inverter**
- **Generator**
- **Battery**
- **Solar Array**

The program will produce Light systems operating in the 5kw range and Medium systems operating in the 10kw range

Current Status

- **Data gathering from Technology Development (early Research and Development) Contracts**
- **Developing the System Performance Specification for EMD contract RPF.**

Key System Parameters

- **4 hour silent watch**
- **4/6 man lift components**
- **Reduction of fuel between 30-66%**
- **High reliability**

Program Timeline

- **Current Program Phase: Technology Evaluation**
- **RPF Release: with 3 months**

System Component Technology

Generator

- Militarized generator
- Flexible Fuel
- Universal Generator Control Technology (Remote start/stop)

Power Inverter

- High Efficiency Inverter
- Fully Ruggedized
- 3-Phase Power
- 2-Way DC/DC Converter

Trailer

- Military HMMWV Trailer
- Trailer Mounting & Integration Hardware

Cables

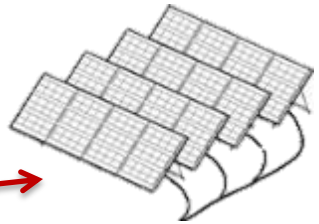
- Power and Data Cables
- Environmentally Rugged
- Quick Connect Tech.

Battery

- High Energy Density
- Modular & Expandable
- Broad Operating Temperature Range

Intelligent Controller

- Software Controls
- Human Interface
- Compact Electronics



Expeditionary Solar Array

- Lightweight, Compact Composite Panels
- Rugged and rapidly deployable

Development effort focuses on smaller, lighter, more efficient, easily maintainable systems.

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MEHPS Requirement

Light Hybrid

- 2/4 man lift components
- 3 kW (T); 5kW (O)
- Uses 5kW AMMPS (T); and 3kW TQG (O)
- Movable by multiple vehicles
- 3 Hours silent watch; 8 hours (O)
- 3 (T); 2.1 (O) gal/day fuel
- Reliability of 500 hour EFF

Medium Hybrid

- 4/6 man lift components
- 10kW (T); 15kW (O)
- Uses 10kW AMMPS (T); 15kW AMMPS (O)
- MCC-LTT Mountable
- 3 hours silent watch (T); 8 hours (O)
- 7.2 (T); 5.8 (O) gal/day fuel
- Reliability of 750 EFF (T); 1250 EFF (O)

MEHPS S&T Roadmap

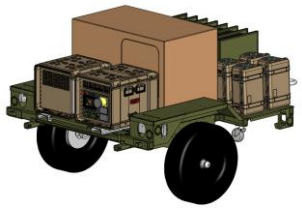
MHEES (MCSC)
10 kW Systems

Phase II SBIR
(ONR)
10kW Systems

Improved Solar
Panels (IPS)

AMMPS &
TQG
Generators

MEHPS-M (10-15kW System)



FY14 RIF (ONR)
Modularity between 3kW
and 10kW System

Energy Storage FNC (ONR)
3kW and 10kW Systems
Battery Focus

HESM (ASD R&E)
3kW System

MEHPS-L (3-5kW System)

FY11 RIF (ONR)
3kW System

RSEP FNC (ONR)
3kW System
Fuel Cell Focus

Lab Development
NSWC Carderock
MIT Lincoln Labs

FY	14	15	16	17	18	19	20	21
	Technology Development			Engineering & Manufacturing Development			Production & Deployment	

Renewable Sustainable Expeditionary Power

Objective

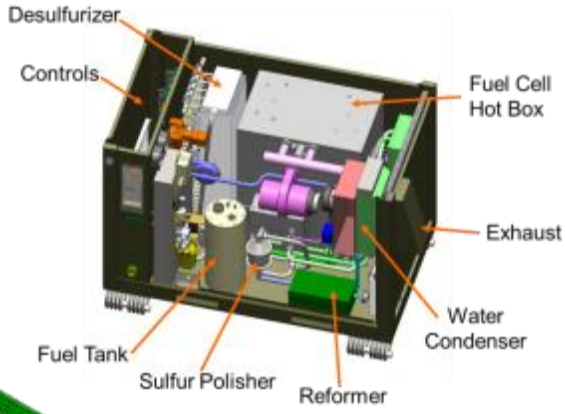
Develop a tactically deployable power system employing both renewable and sustainable sources, targeted for forward-deployed enhanced company operation needs.

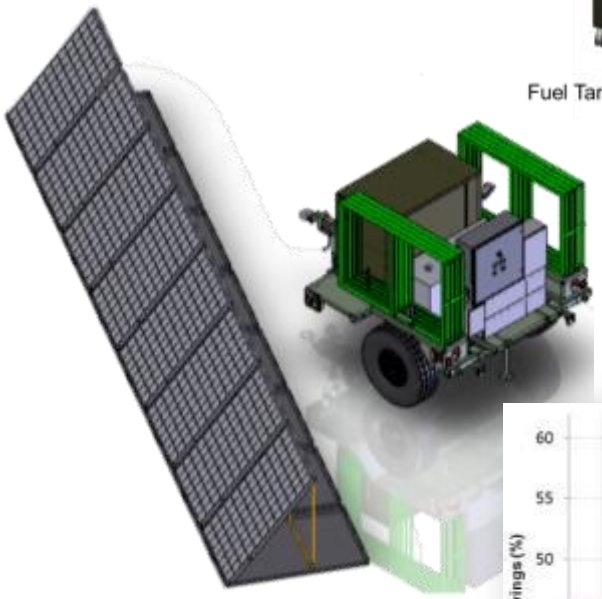
Approach

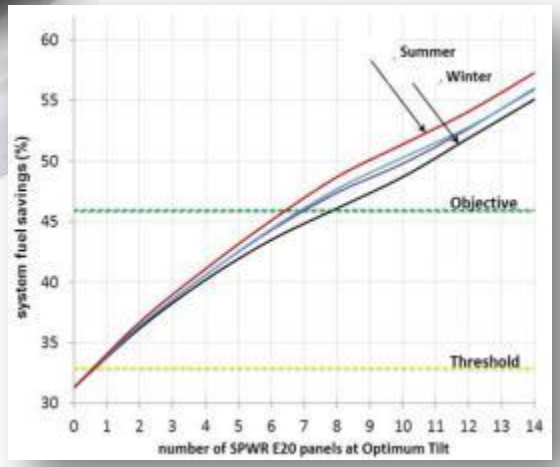
3 kW JP8-fueled Solid Oxide Fuel Cell
Quick deployable PV solar panels
Automated hybrid power control
Trailer mounted system (LTT-MCC)

What it means to the warfighter

33-60% fuel savings
24/7 silent watch operation
15-day operation without resupply
Continuous generation of 3-5 kW of power
Single Light Tactical Trailer deployable
MIL-STD-1332 Class 2B power quality

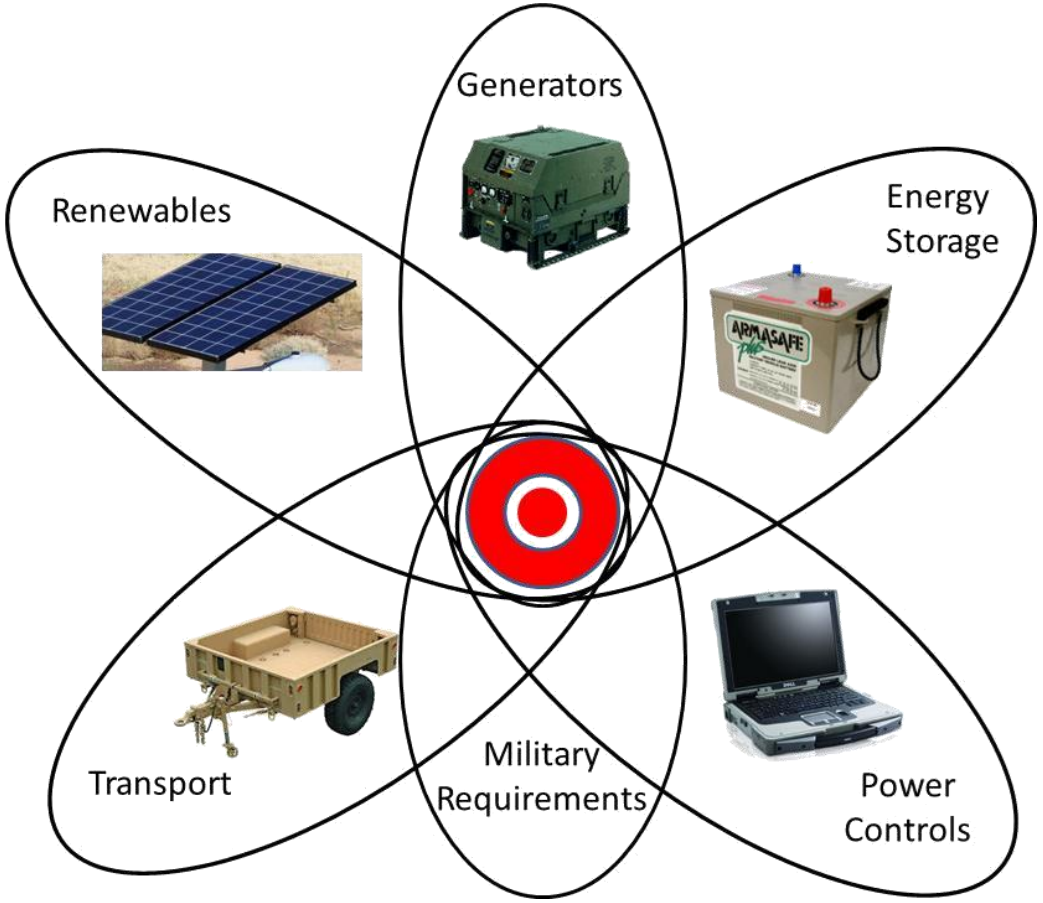






Future Naval Capability (FNC) P&E-FY12-01, FY-12 to FY-16 Effort

Tactical Hybrid Power Modeling



Hybrid Power Studies

Optimizing solutions for load profiles is a balance between power controls, energy storage and renewables.

Models

Detailed component and system level models, mission based organizational level models

Return on Investment (ROI)

Both weight, fuel efficiency and cost-based ROIs important for Navy.

Consortium for Optimally Resource Secure Outposts (CORSO)

Goal: Support development and validation of modeling and simulation framework to optimize energy consumption in military outposts

Key Areas of Focus:

- Energy efficient heating/cooling for shelter structures
- Micorgrid based control of heating and cooling
- Environmental control units
- Batteries

Engagement with Non-Traditionals: CORSO seeks to build collaborative relationships with innovative organizations in areas of focus. The collaboration partner will work closely with Georgia Tech researchers in the evaluation and application of technologies in these domains that could be implemented in cutting-edge military applications. Collaboration grants upto $25,000 are available to selected participants.

Additional Information/Application:

http://www.corso.gatech.edu/

Professor Yogendra Joshi, yogendra.joshi@me.gatech.edu

Timing: Now

- An DTTI was signed with the Country of India. MEHPS was one program selected as a pathfinder program.
- A Program Agreement has been signed with India for MEHPS
- Phase I – Technology information exchange program
- Phase II – TBD
- Impact to MEHPS program unknown at this time

Further Information

Email questions to:
PM_EPS@usmc.mil

Find more programmatic information:
http://www.marcorsyscom.marines.mil/ProgramOffices/EPSHome.aspx
www.onr.navy.mil
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QUESTIONS