Study Goals

“Develop a plan to transition ferry operations on San Francisco Bay to zero-emission vessels”

How much power do we need?
Where will it come from?
When do we need it?
How much will it cost?
How do we pay for it?

Emphasis on the use of electric propulsion systems and resolving the technical and regulatory barriers for the shore side infrastructure
Study Responsibilities

Management

WETA

Maritime
Vessel Analysis
Route Analysis

Shoreside
Infrastructure Analysis/Feasibility
Stakeholder Agreements

Study Funding

WETA
CALIFORNIA ENERGY COMMISSION

ARUP
Stakeholders Engaged
Workflow

Stage 1
Baselining
Collect and process data on operations, vessels and terminals to define their constraints and opportunities

Stage 2
Optioneering
Develop solutions and assess their attributes and drawbacks to select optimal direction

Stage 3
Blueprint & Strategy
Lay out an actionable path to progress to procurement, design and delivery of electrified ferry service
Study Schedule

Vessel Side

Baselining & data collection
Preliminary Analysis
Optioneering

Project Start
CEC Funds Released
Technology Assessment Memos
Energy Demand Memo

Infrastrucure Memo
Workforce Impacts Memo
Emissions Impacts Memo

Blueprint

Draft Blueprint, Draft Project Fact Sheet
Draft Final Report
Final Report, Final Project Fact Sheet

Shoreside

Stakeholder Outreach
Preliminary Capacity Analysis
Optioneering
Blueprint

Optioneering

Workforce Impacts Memo
Emissions Impacts Memo

Final Blueprint
Draft Blueprint, Draft Project Fact Sheet
Draft Final Report
Final Report, Final Project Fact Sheet

ARUP
Aurora – Vessel Analysis
Fleet Electrification Schedule

**Optimal Implementation**

- Diesel Vessel
- Battery Electric Vessel

**Conservative Implementation**

- Diesel Vessel
- Battery Electric Vessel
- TBD (Future Technology, Alternative Fuel, Hydrogen)

Optimal Timeline is the basis for our analysis.
Stage 2 - Key Factors

**Constraints (established in Stage 1)**

- Ridership demand is based on existing data and growth projections
- Attempt to mimic current service profiles to the extent possible
- Peak hourly (i.e. commute times) ridership demand drives the vessel sizing and power requirements
- SFFB is the common hub for most routes and will require the most attention

**Charging Assumptions**

- Two Charge Levels - Small Vessel (~1-1.5 MW) and Large Vessel (~4-5 MW)
- Charging occurs at all locations possible during onloading/offloading
Stage 2 - Optioneering Workflow

Develop Specifications for Vessels & Routes

Vessel & Route Optimization

Terminal Energy Demand

Terminal Electrical Requirements

Terminal Electrification Design

Can the Grid Provide the required power?

YES

Proceed to Stage 3

Developing the Blueprint

NO

Using the Vessel Rapid Analysis Tools developed in Stage 1

Electrical Grid Capacity

WETA Ridership Demand
Stage 2 - Optioneering Workflow

CONVERTING THE FLEET TO ZERO EMISSIONS IS A MULTI-YEAR PROJECT

VESSEL AND TERMINAL POWER DEMAND MUST BE BALANCED EACH YEAR THROUGHOUT THE TRANSITION

- Develop Specifications for Vessels & Routes
- Vessel & Route Optimization
- Terminal Energy Demand
- Terminal Electrical Requirements
- Terminal Electrification Design
- Can the Grid Provide the required power?

NO

YES

Proceed to Stage 3
Developing the Blueprint
Vessel Feasibility

**Phase 1 - Inner Central Bay**
- Treasure Island
- Mission Bay

**Phase 2 – Central Bay**
- Oakland/Alameda
- Seaplane
- Berkeley

**Phase 3 – Long Run Central Bay**
- Richmond
- Harbor Bay
- South SF

**Phase 4 – Long Runs**
- Vallejo
- Redwood City
- Carquinez

Legend:
- Feasible with Current Vessel Technology
- Feasible with Current Vessel Technology - Operational Changes Required
- Feasible with Current Vessel Technology - Significant Operational Changes Required
- Not Currently Feasible – TBD Future Technology Required
Energy Demand Projections

- **SF General Hospital**: 374 MWh/day
- **SF Central Library**: 22 MWh/day
- **Typical House**: 0.03 MWh/day
Current Analysis Work

- Charging
- Mooring and Docking
- Float Modifications
- Vessel Configurations
Arup – Shoreside Analysis
Part 1: Baselining phase
- Analyzed the local grid context using publicly available data
- Identified potential constraints
Part 1: Baselining Phase

Predicted ZEV Electrical Peak Demand & Batteries at Each Terminal vs Grid Capacities

*Alameda Main Street does not have predicted peak demands because there is no anticipated charging at this terminal*
Part 1: Baselining Phase

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Part 1: Baselining Phase

Predicted ZEV Electrical Peak Demand & Batteries at Each Terminal vs Grid Capacities

*Alameda Main Street does not have predicted peak demands because there is no anticipated charging at this terminal*
Phase 1 Shoreside Feasibility

*Ferry building – minimal upgrades suffice in this first phase while only the highlighted routes are electrified
Phase 2 Shoreside Feasibility

- Planned Grid Upgrades: Planned or existing grid capacity that is sufficient for electric ferries
- Requires Upgrades: Local feeders found to have sufficient grid capacity on PG&E ICA mapping tool
- Requires Significant Upgrades: New feeders or substation upgrade required with major cost and timeline implications

Locations:
- Ferry Building
- Berkeley
- Oakland
- Alameda
- Sea Plane
Phase 3 Shoreside Feasibility

- Planned Grid Upgrades: Planned or existing grid capacity that is sufficient for electric ferries
- Requires Upgrades: Local feeders found to have sufficient grid capacity on PG&E ICA mapping tool
- Requires Significant Upgrades: New feeders or substation upgrade required with major cost and timeline implications

Locations:
- Richmond
- Ferry Building
- Harbor Bay
- South SF
Part 2: Optioneering Phase

Grid Upgrades
With close coordination between the utilities and stakeholders, grid upgrades will provide the appropriate amount of capacity to meet the needs of an electrified ferry fleet.

LOAD MANAGEMENT
While the ferries have a schedule to maintain, charging the ferry can be prioritized at terminals that have more available capacity on the local grid.

SHORESIDE BATTERIES
Scenario modelling of battery energy storage solutions will determine the optimal solution for meeting the grid capacity needs.
Part 2: Optioneering Phase

**Current blocker:**
Grid Capacity uncertainty and optimized, balanced solution

**Team Solution (Options):**
1. Upgrade grid to meet capacity needs
2. Interconnect battery energy storage
3. Provide load management

**DEMAND COMPARISON:**
CURRENT CAPACITY v. FUTURE ELECTRICAL DEMAND

**SCENARIO 1:**
GRID UPGRADES

**SCENARIO 2:**
GRID + BATTERIES

**SCENARIO 3:**
GRID + BATTERIES + LOAD MGMT
Grid capacity meets electrical demand.

**Optioneering phase:** Arup is developing and evaluating solutions to meet increased electrical demand.
Grid capacity meets electrical demand.

Grid capacity does not meet increased electrical demand in most terminal locations.

**Scenario 1:** Meet increased demand entirely through grid upgrades in collaboration with utilities.
Scenario 2: Meet increased demand through grid upgrades and battery storage.
Grid capacity meets electrical demand.

Grid capacity does not meet increased electrical demand in most terminal locations.

Scenario 2: Meet increased demand through grid upgrades and battery storage.
Optioneering in Action

## SCENARIOS

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<thead>
<tr>
<th>SCENARIO 1: GRID UPGRADES</th>
<th>SCENARIO 2: GRID + BATTERIES</th>
<th>SCENARIO 3: GRID + BATTERIES + LOAD MGMT</th>
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<tr>
<td>CURRENT CAPACITY</td>
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### METRICS

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<th>Cost</th>
<th>Timeline</th>
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<tr>
<td>SCENARIO 1</td>
<td>$$$$$</td>
<td>Pending ongoing discussions with utilities</td>
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<td>SCENARIO 2</td>
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<td>SCENARIO 3</td>
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WETA – Progress Update
WETA Implementation Progress

- 2020 WETA was awarded a grant through TIRCP (Transit and Intercity Rail Capital Program) to build (1) 99-149 passenger all electric vessel and infrastructure.

- 2022 WETA applied for an additional grant through TIRCP to build (1) 99-149 passenger all electric vessel and related infrastructure.

- 2022 WETA applied for FTA funds to build (1) 99-149 passenger all electric vessel.

- If awarded, this would provide WETA with (3) 99-149 passenger vessels to serve phase 1 of implementation.

- There is also discussion of finding funding for a possible 4th vessel.
WETA Implementation Progress

- Engaged with SFPUC and the Port of San Francisco to analyze grid upgrades to serve the Downtown San Francisco Terminal and other charging opportunities along the waterfront
  - Includes examination of potential near term (temporary) upgrades while more complex solutions develop

- Engaged with San Francisco County Transportation Authority (SFCTA) for implementation of zero emission Treasure Island Ferry Service
  - Defining roles and responsibilities
  - Service planning and fare analysis
  - Coordination with SFPUC for electrification of Treasure Island Terminal

- Coordinating with Alameda Municipal Power to develop preliminary plans and cost estimates to electrify Alameda ferry facilities
  - Includes pre-engineering studies
  - Including Central Bay Operations and Maintenance Facility Expansion - preliminary work in FY23 capital budget
Questions