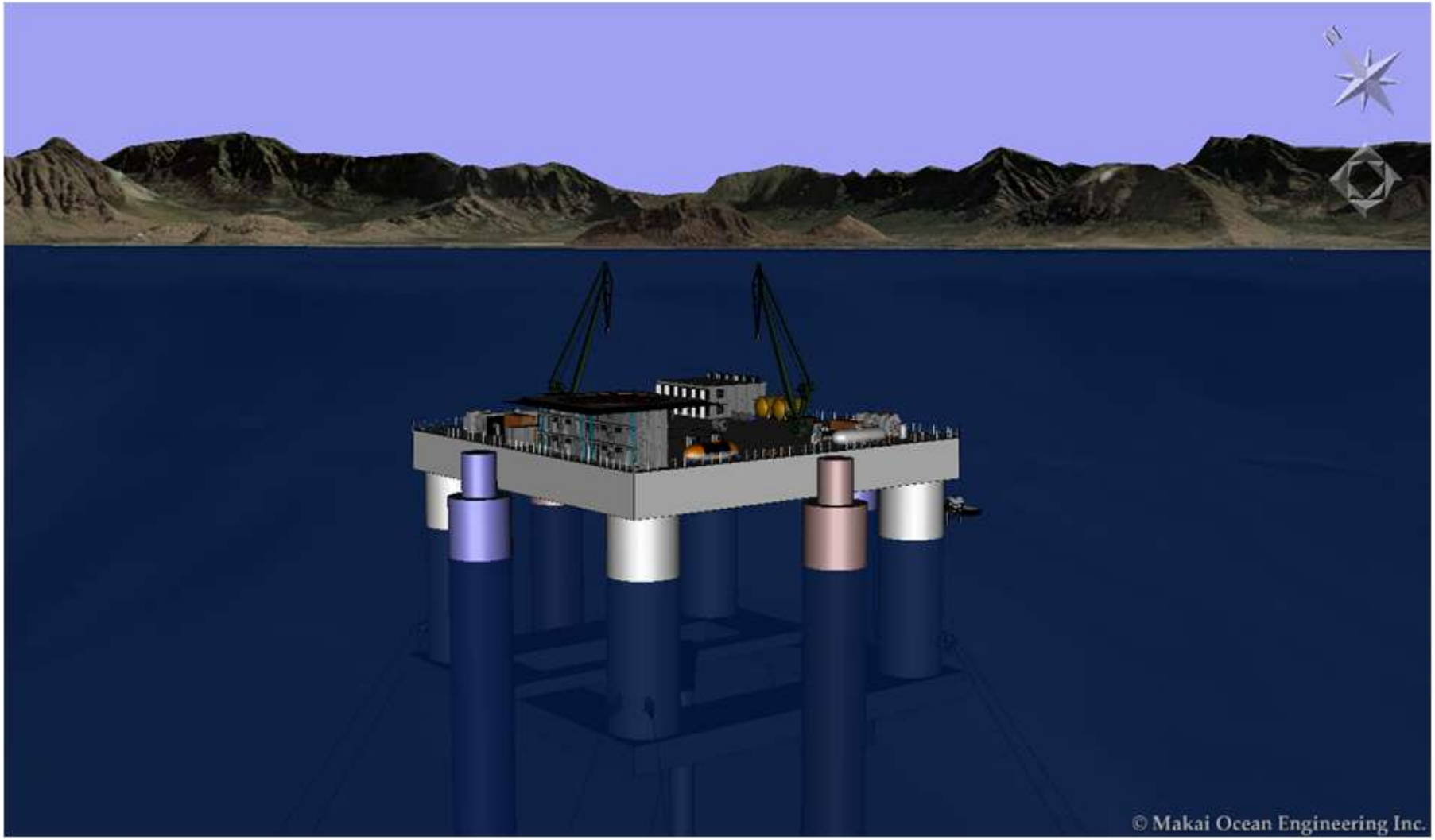
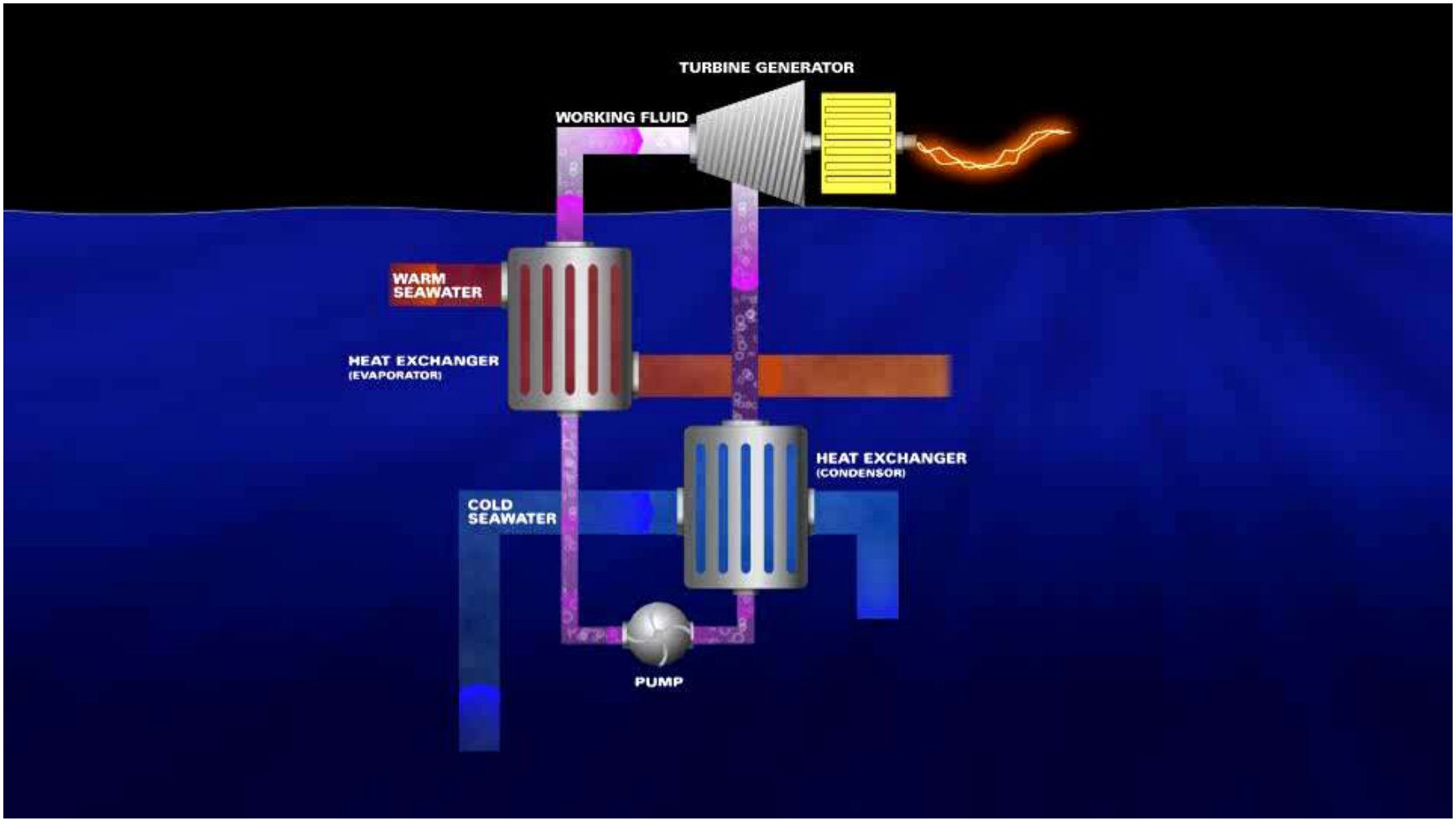
Potential Environmental Effects of Ocean Thermal Energy Conversion

Notional OTEC Plant off Oahu



OTEC Cycle


TURBINE GENERATOR
WORKING FLUID
WARM SEAWATER
HEAT EXCHANGER (EVAPORATOR)
HEAT EXCHANGER (CONDENSOR)
COLD SEAWATER
PUMP

Oahu OTEC Site Properties

- Water depth = 1100-1300 meters
- Very steep slopes
  - Limited sediment thickness for anchoring
  - Potential for submarine slumps/slides
- Relatively benign wind/wave conditions
- Proximity to shore-based infrastructure

Context and Intensity

- OTEC plants are highly visible and likely will attract wide interest
- Effects may be “regionally” measurable, but of “national” or even “global” interest
- Information is limited
  - Effects are not well quantified
  - Observations are limited
  - Effect predictions may be hypothetical and abstract until pilot studies can be monitored
- Effects will be site- and configuration-specific
  - Ocean or shore plant location
  - Discharge location and depth

Typical Ocean Industry Effects

- Possible bottom habitat disturbance from cabling and anchoring
- Biological displacement and attraction from the physical presence of industrial activity
- Potential for water quality degradation from accidental industrial release of fuel, oils and lubricants during installation phase

Direct OTEC Biological Effects

- Potential for fish and other swimming animals (nekton) to be physically damaged on striking protective screens (impingement)
- Smaller drifting plants and animals (plankton) physically damaged on passing through heat exchange system (primary entrainment)
- Plankton and Nekton subject to temperature and pressure changes in discharge plumes (secondary entrainment)
- All organisms subject to
  - Operational noise
  - Antifouling and biocide toxicity
  - Accidental release of working fluid, petroleum products or lubricants

Direct OTEC Water Quality Effects

- Level of effects are unclear given limited studies conducted to date
- Changing ocean water chemistry in water discharge mixing zones
  - Nutrients and carbon dioxide concentrations increase
  - Carbon dioxide released to atmosphere
  - pH decrease
  - Oxygen concentrations decrease

Indirect OTEC Biological Effects

- Changes in water chemistry may stimulate ocean productivity
  - Increasing productivity in warm, sunlit tropical waters
    - Phytoplankton and multicellular algae primary production
    - Zooplankton secondary production (consumer and decomposer)
  - Changing biological diversity and distribution
    - Increasing plankton consumers
    - Decreasing specialized tropical ocean producers and consumers (e.g. coral)
    - Cyclic variation affected by decomposition and oxygen demand

Conclusions

- Substantial uncertainty in effects until measurements are made and performance of pilot plant monitored
- Experience base with other offshore platforms can be leveraged
- Primary unknowns are effects of water intake and exit streams