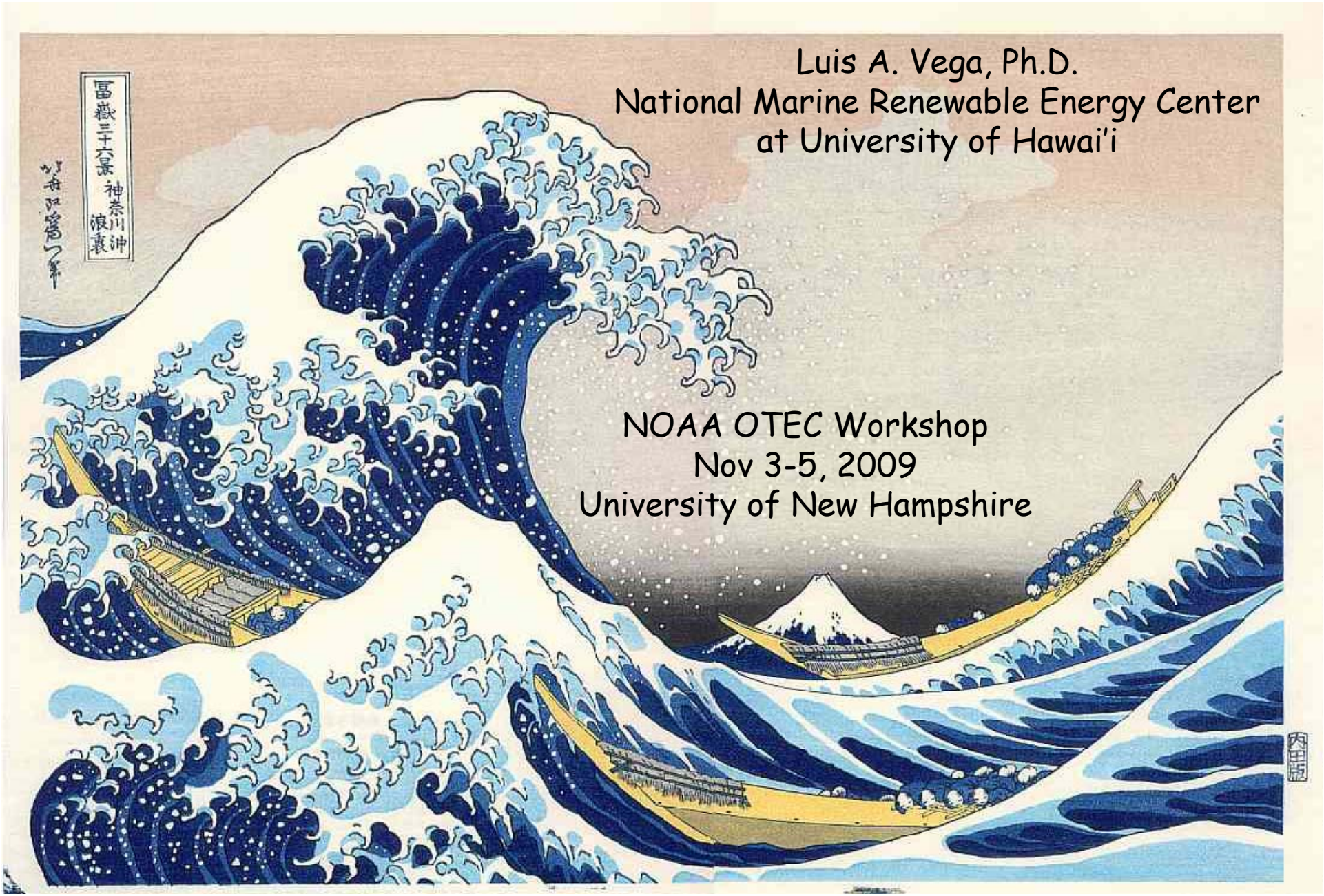

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NOAA OTEC Workshop
Nov 3-5, 2009
University of New Hampshire

Workshop Objectives

- Are commercialization challenges:
  - (i) Technical,
  - (ii) Engineering,
  - (iii) Development costs?
- OTEC Development Roadmap

USA OTEC: Development Schedule

(Assumption)

USA OTEC DEVELOPMENT		←	YEARS	→		
	1 to 5	6 to 10	11 to 15	16 to 20	21 to 25	26 to ∞
Pre-Commercial Plant (> 5 MW)		Ops				
Electricity (Desal Water) Plants in Hawaii and USA Territories: ~ 20 x 100 MW Plants	Prelim Design		Ops	Ops	→	→
NH3/H2 Plantships Supplying all States				Prelim Design		Ops →

OTEC: The Challenge

- **Major Challenge** is not technical but rather **financing of a capital intensive technology without an operational record;**
- If plant **> 50 MW, cost of electricity ($/kWh)** would be **cost competitive;**

  → *How do you get more than ¾ Billion Dollars for a 100 MW plant without a "track record" and without invoking national security, global warming, environmental credits, etc.?*

- **Without operational records** from a pre-commercial plant (~ 5 MW) **financing** of commercial sized plants (> 50 MW) is **highly doubtful;**

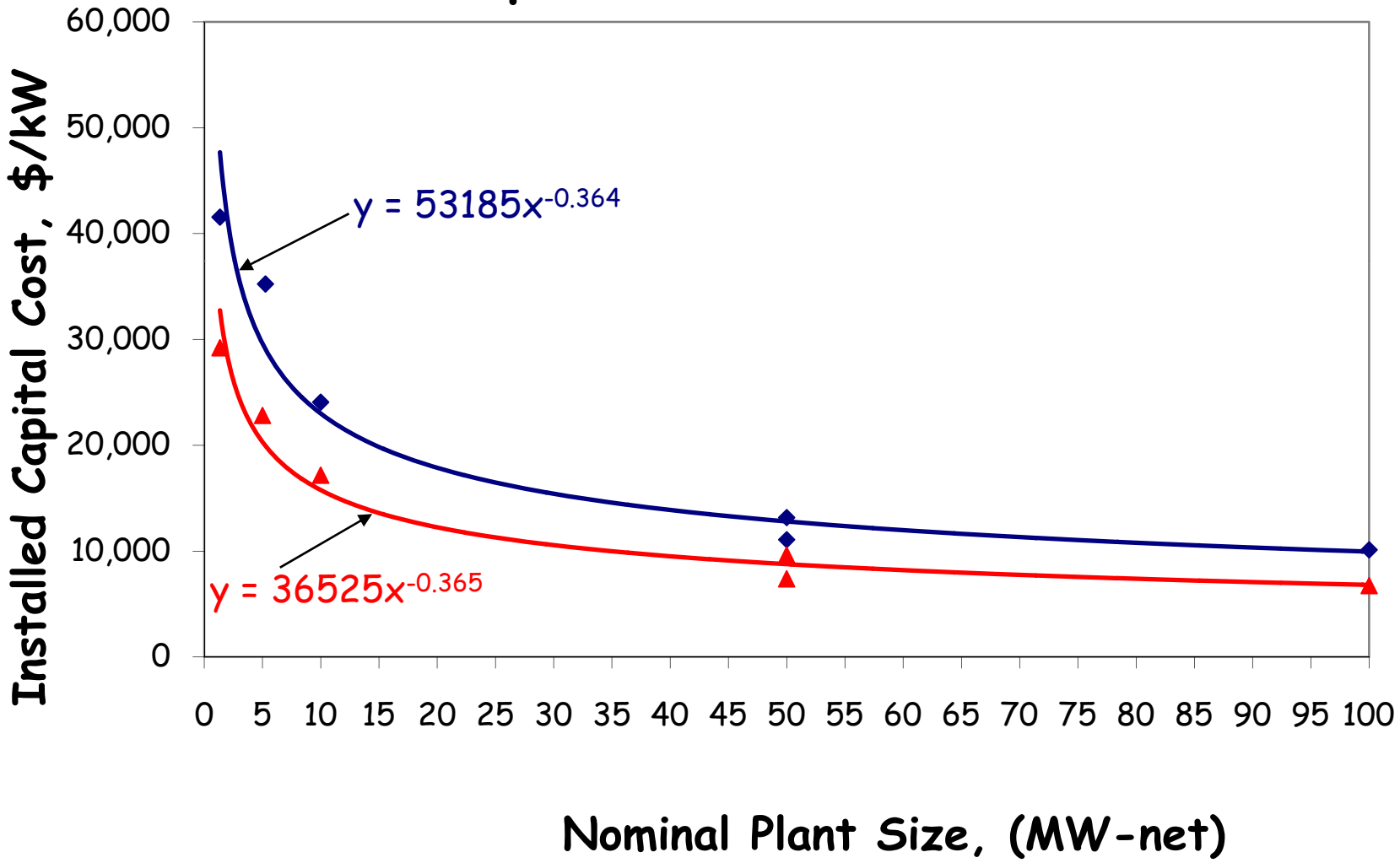
OTEC Pre-Commercial Plant

- **Federal funding required for pre-commercial plant** (~ $120M to $150M);
- **Pre-Commercial Plant** would take **5-years from the go-ahead** to deliver electricity to the grid;
- Pre-Commercial Plant must operate for at least one year **before finalizing engineering and environmental-impact mitigation design aspects** of the commercial size plant;
- The **Commercial Plant** would take **another 4 to 5-years** to deliver electricity to the grid;

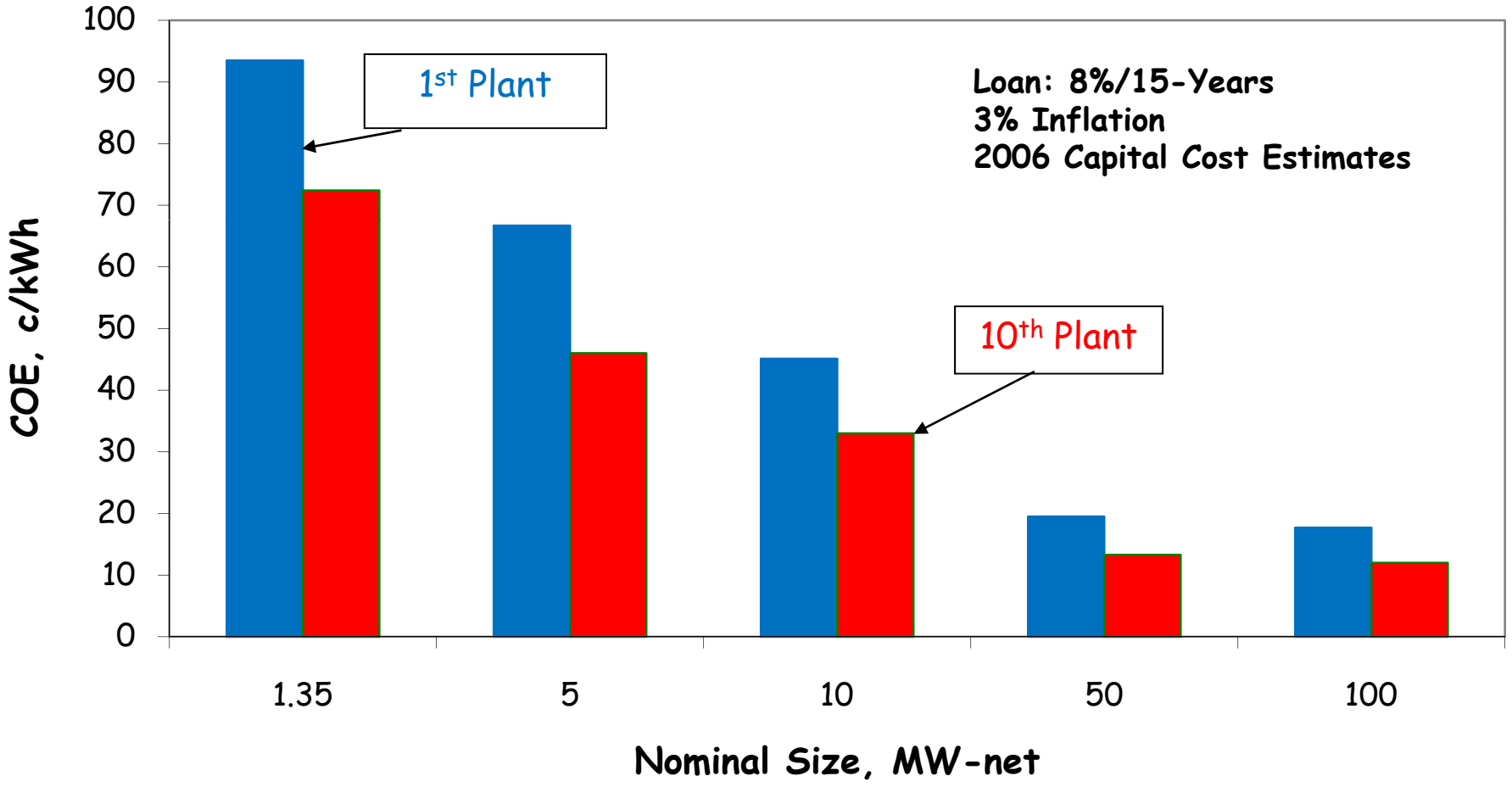
Economics Summary

Because **OTEC is capital intensive** electricity **cost-competitiveness** if Size **> 50 MW** & **> 15-year Life-Cycle.**

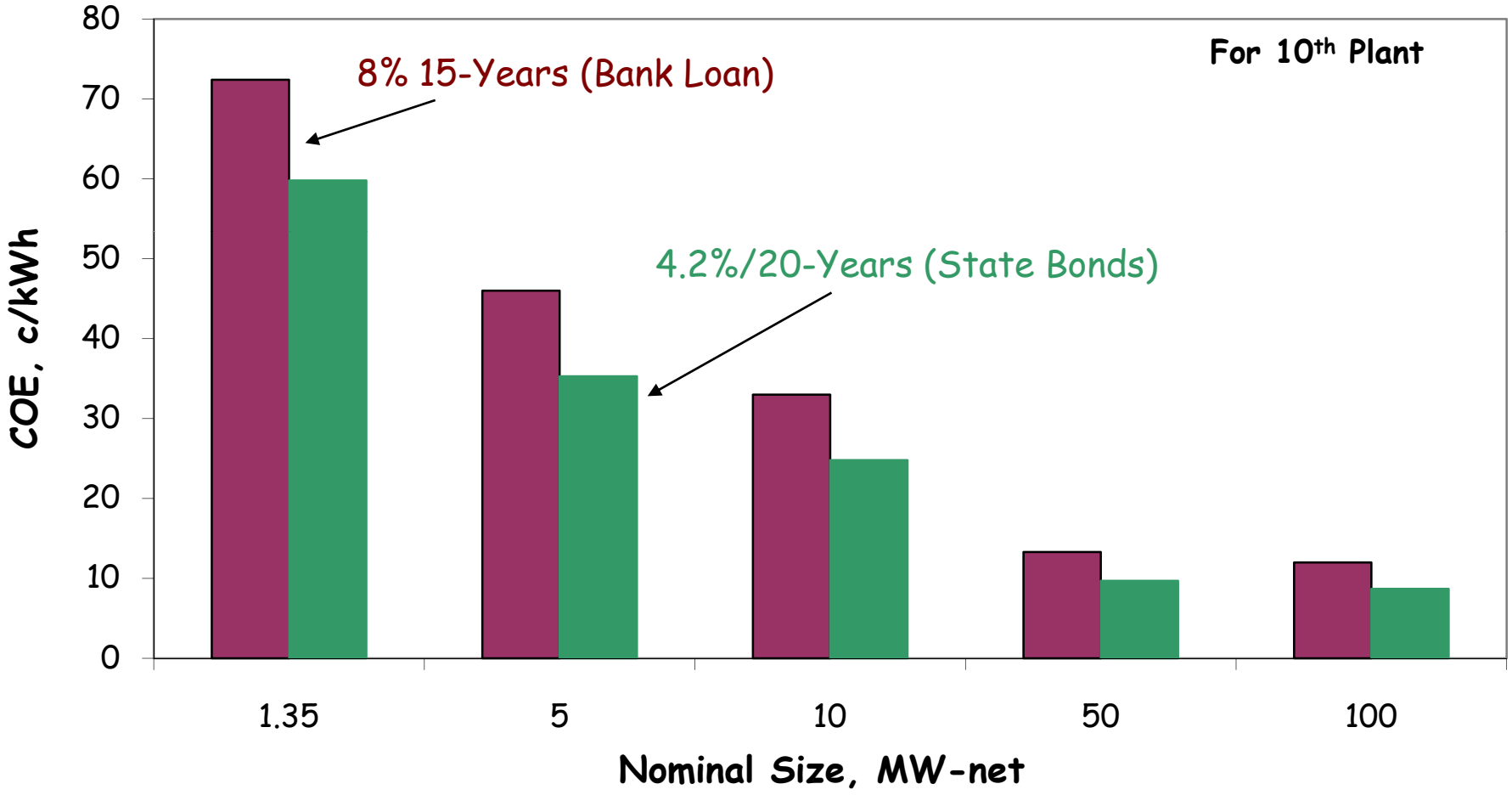
1st Plant and 10th Plant Capital Cost Estimates



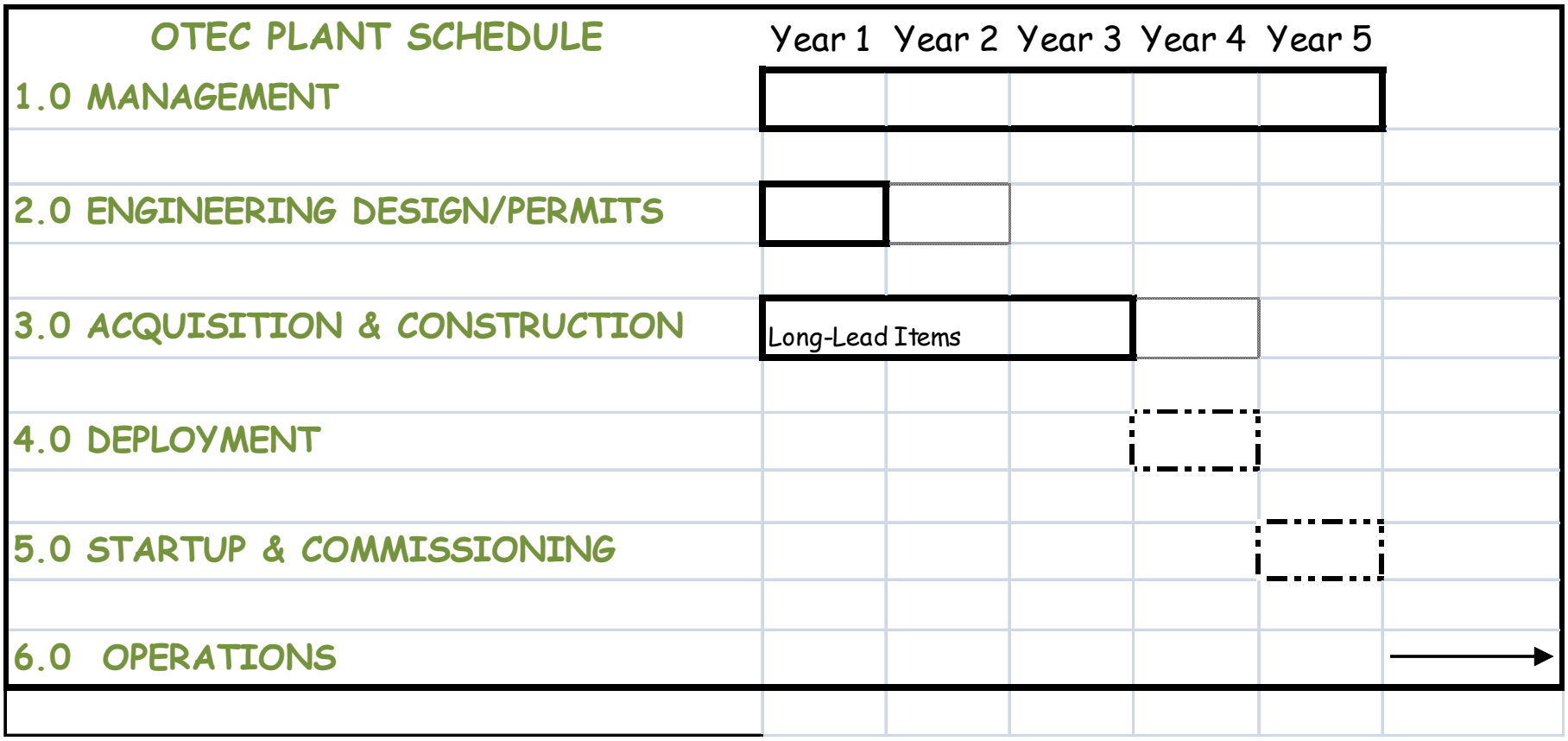
Cost of Electricity Production for 1st Plant and 10th Plant
[COE = CC + OMR&R]



OTEC Cost of Electricity Production as a Function of Loan Term



OTEC Plant Schedule



OTEC Plant Schedule

- Detailed-Engineering-Design ~ one-year; Permits ~ two-years;
- **Major components** are **long-lead-items**, requiring 12 to 24+ months for delivery, and are **available from established industry**;
- As much as **5-years** after-receipt-of-order (**ARO**) is required before delivering **electricity to grid**.

Workshop Objectives

- Are commercialization challenges:

  (i) ~~Technical,~~

  ~~(ii) Engineering,~~

  (iii) Development costs

- OTEC Development Roadmap (see p. 3)