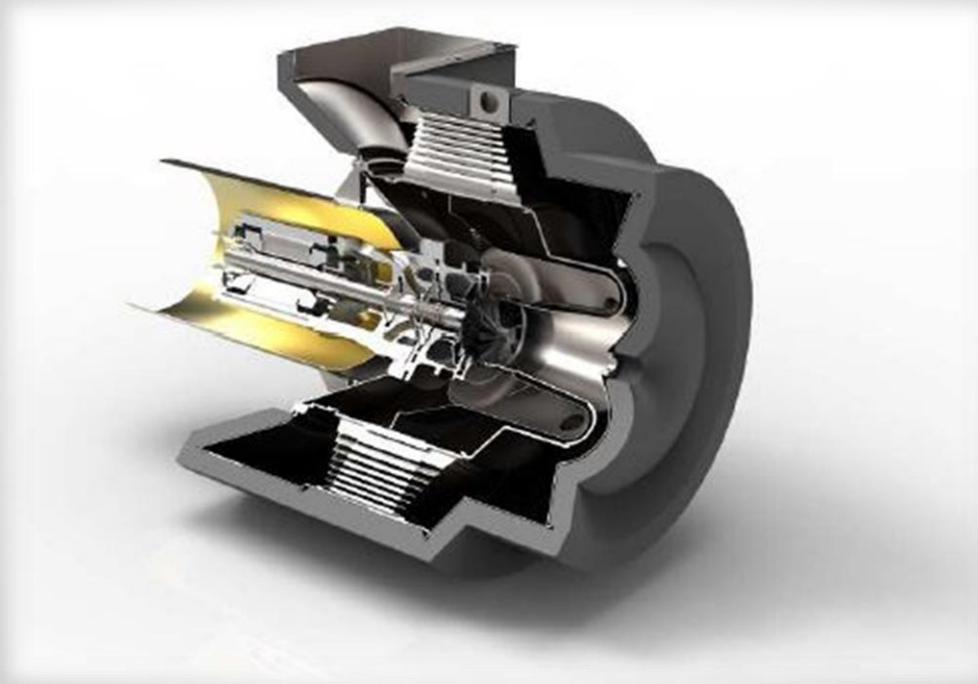


# MICRO GAS TURBINES ON MEGA YACHTS



Rostock University  
February 2, 2016

# What is a micro gas turbine (MGT)



# Motivation

- IMO Tier III Regulations on NO<sub>x</sub> emissions
  - New constructions from January 2016
  - Selective Catalytic Reduction (SCR) for GenSets
  - No adaptation needed for MGT
- Comfort
  - Low vibration and noise levels
  - No Lube Oil
  - High maintenance intervals/expected lifetime

# Drawbacks (comparison with GenSets)

- 230% Higher Air Demand

➤ Efficiency decrease with  $T > 23^{\circ}\text{C}$  → Inlet ducts+Air coolers

- 15% Higher Fuel Oil consumption

└──→ Use of waste heat

- 50% higher maintenance costs

└──→ Batteries

# Feasibility study on Mega Yacht BV80



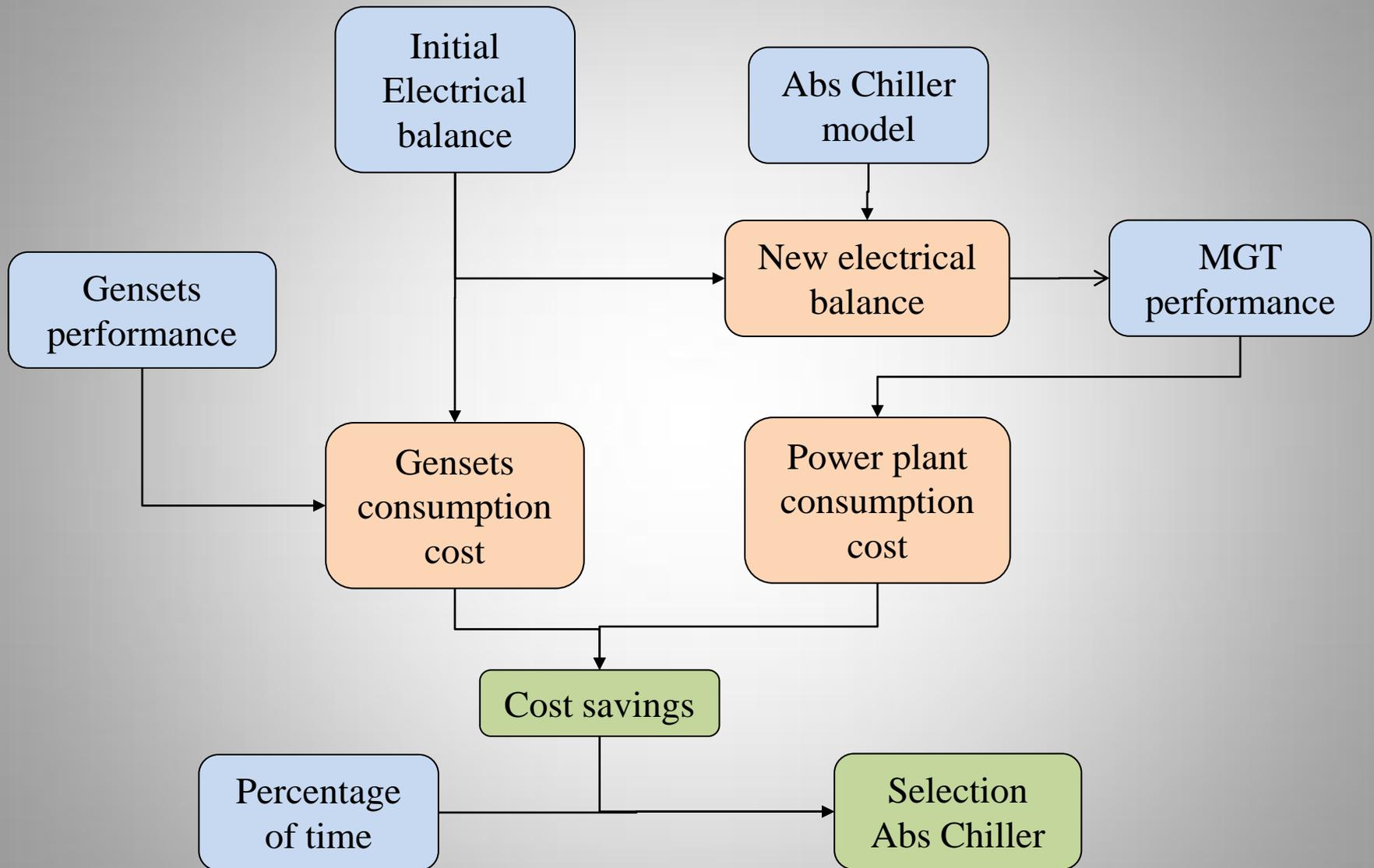
# Use of waste heat

- Mega yachts spend 90% of time in summer areas
- Up to 25% of total energy for chilled water
- Absorption chiller
  - Use of heat to produce chilled water
  - Electrical demand is reduced
  - Overall efficiency increase

# How big the absorption chiller must be

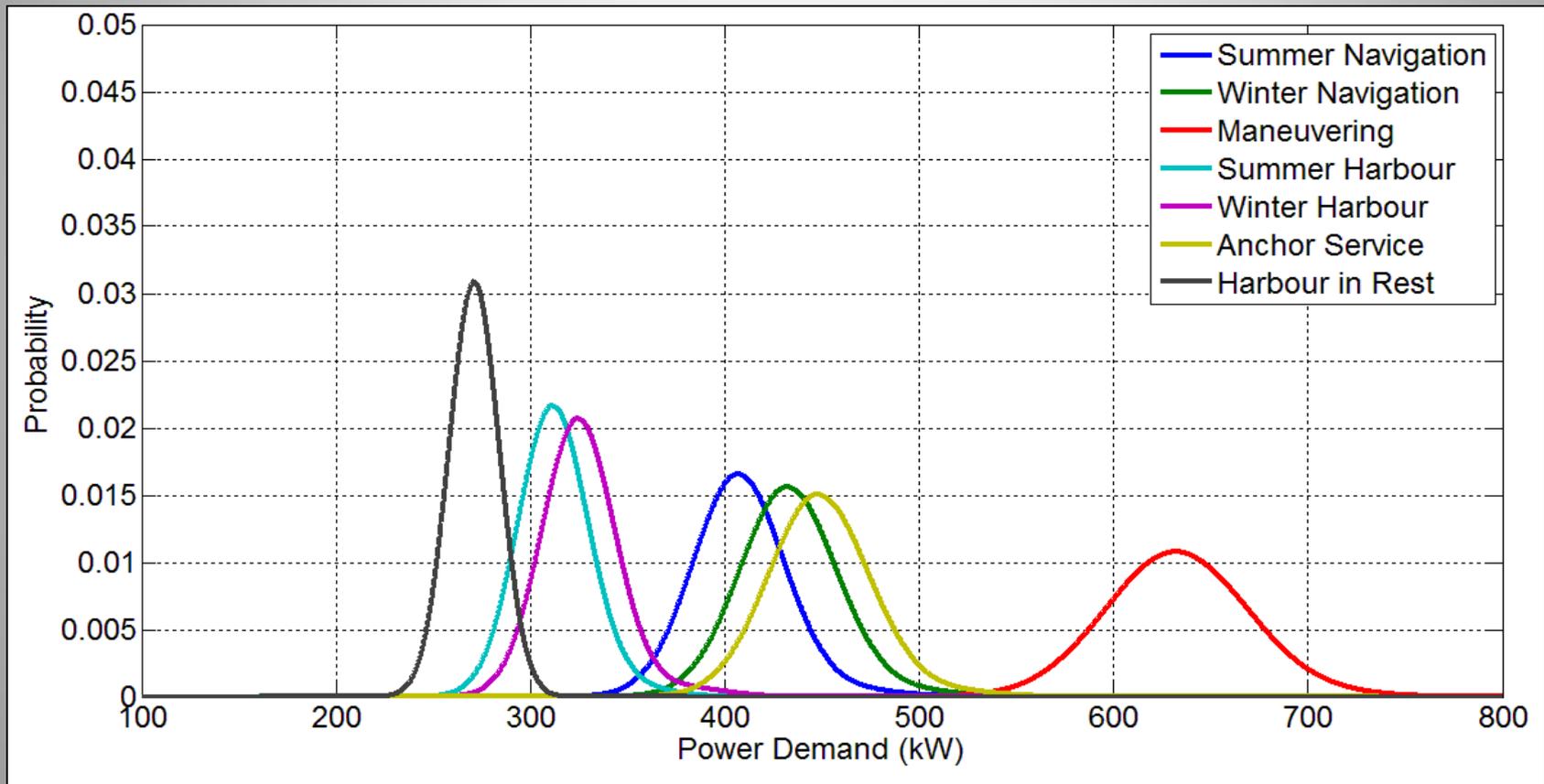
- Chilled water production depends on available heat
- Available heat depends on electrical demand
- Electrical demand varies:
  - Ship condition (navigation, anchoring, harbour service...)
  - Hour of the day
  - Owner/guests onboard
- Development of a code to take into account variables

# Code overview

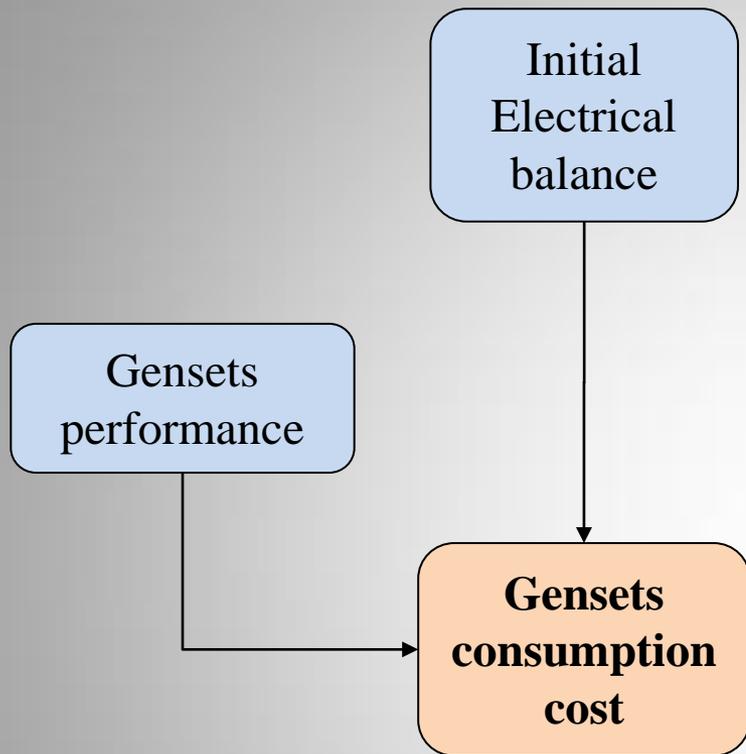


# Gaussian distribution of electrical demand

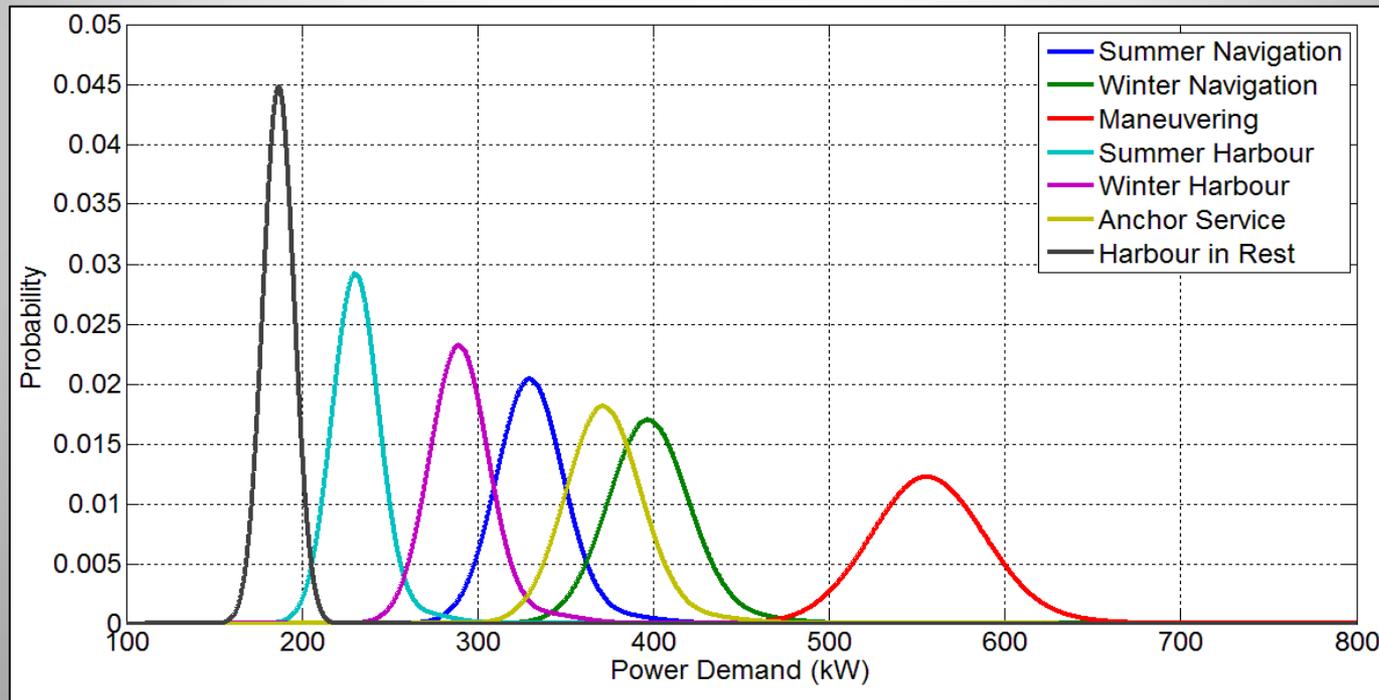
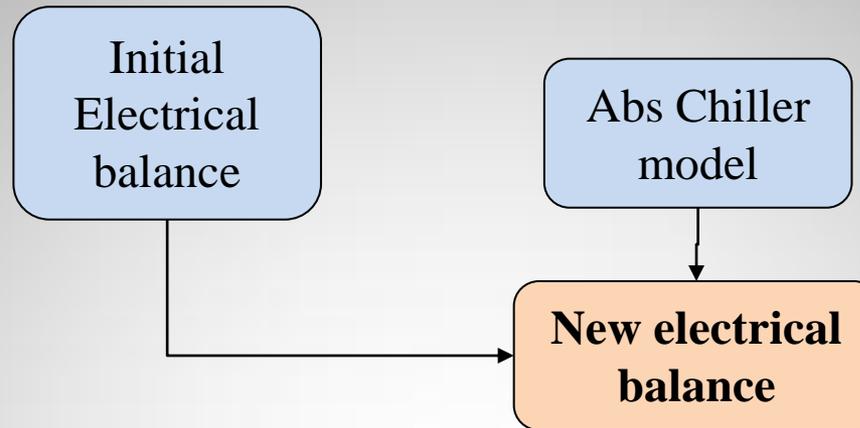
**Initial  
Electrical  
balance**



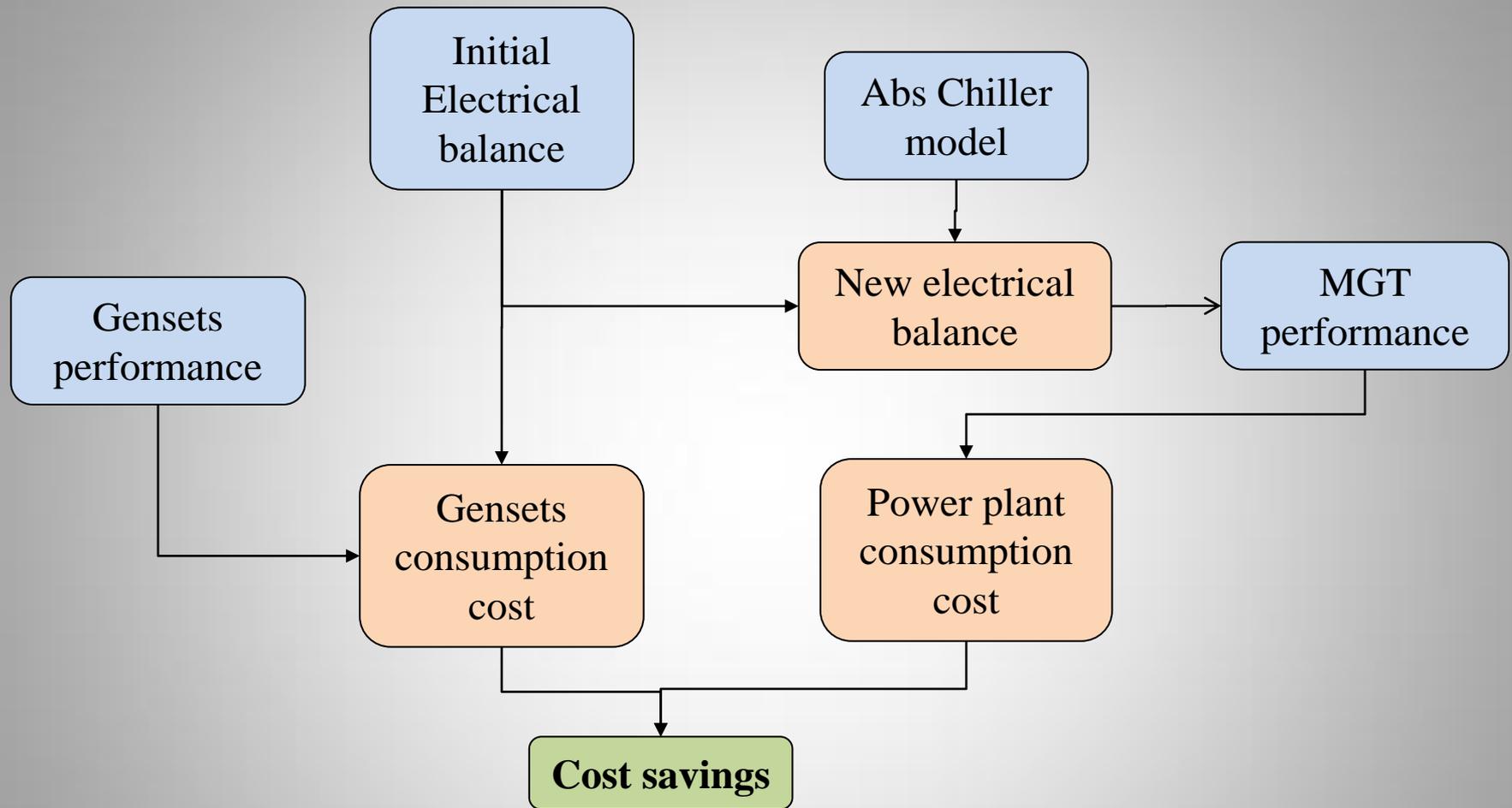
# Gensets consumption costs



# Reduction of electrical demand



# Comparison Gensets vs MGT+Absorption Chiller



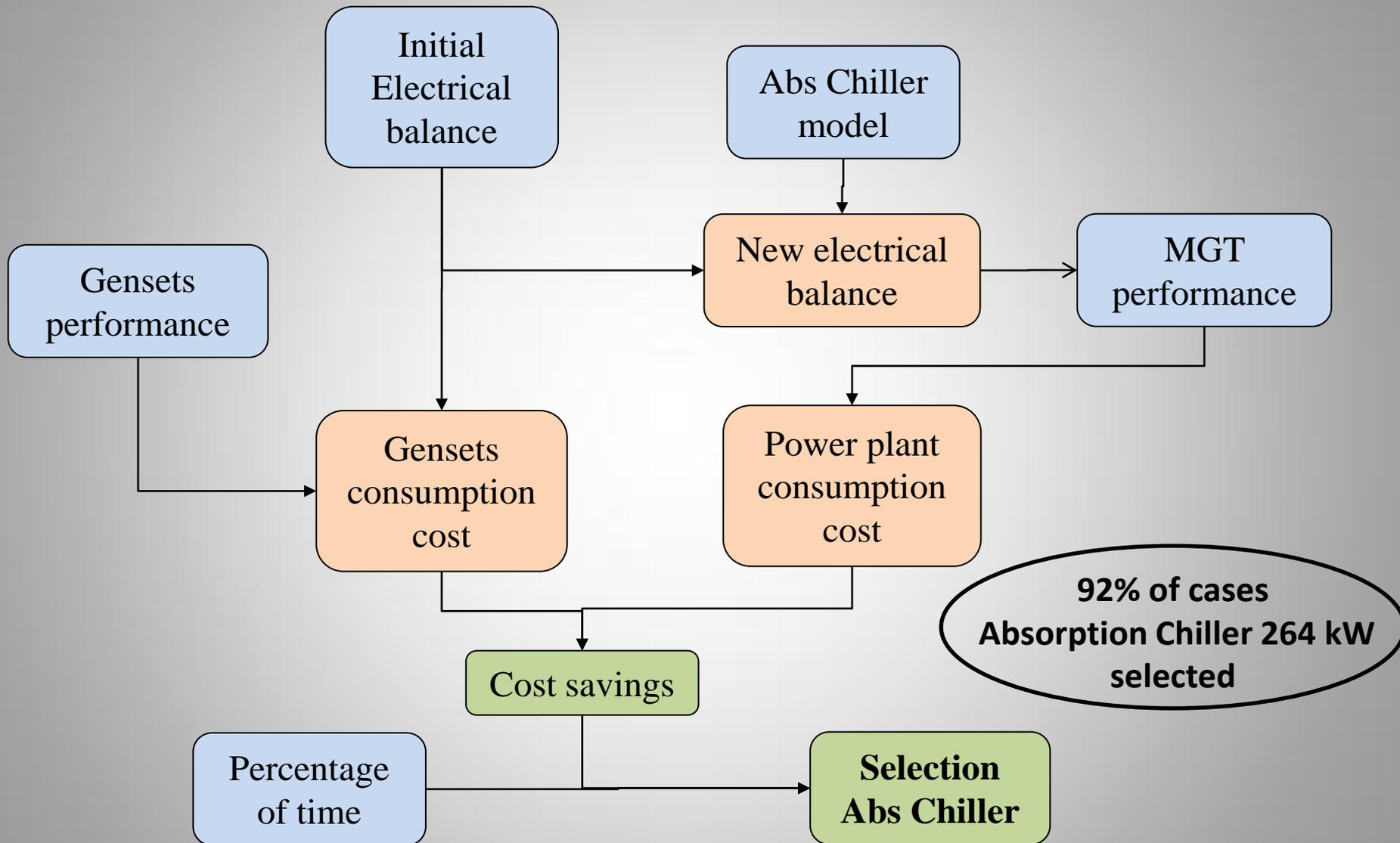
# Reasonable percentages of operation

Percentages of time			
		Minimum	Maximum
Navigation	%	0	30
Harbour service	%	0	30
Anchoring	%	0	40
Harbour in Rest	%	50	100

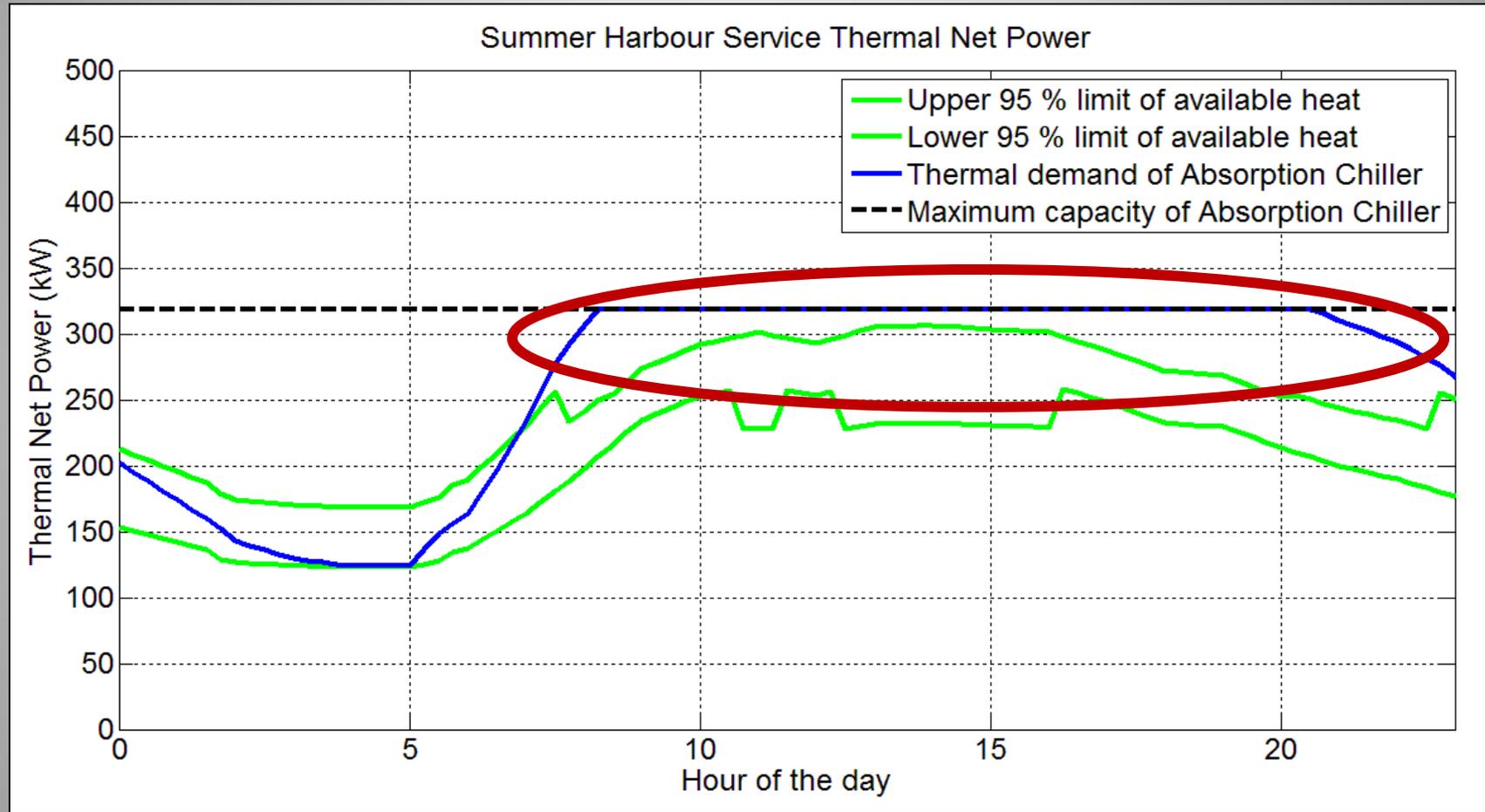
**242 Combinations**

**Percentage  
of time**

# Absorption chiller selection

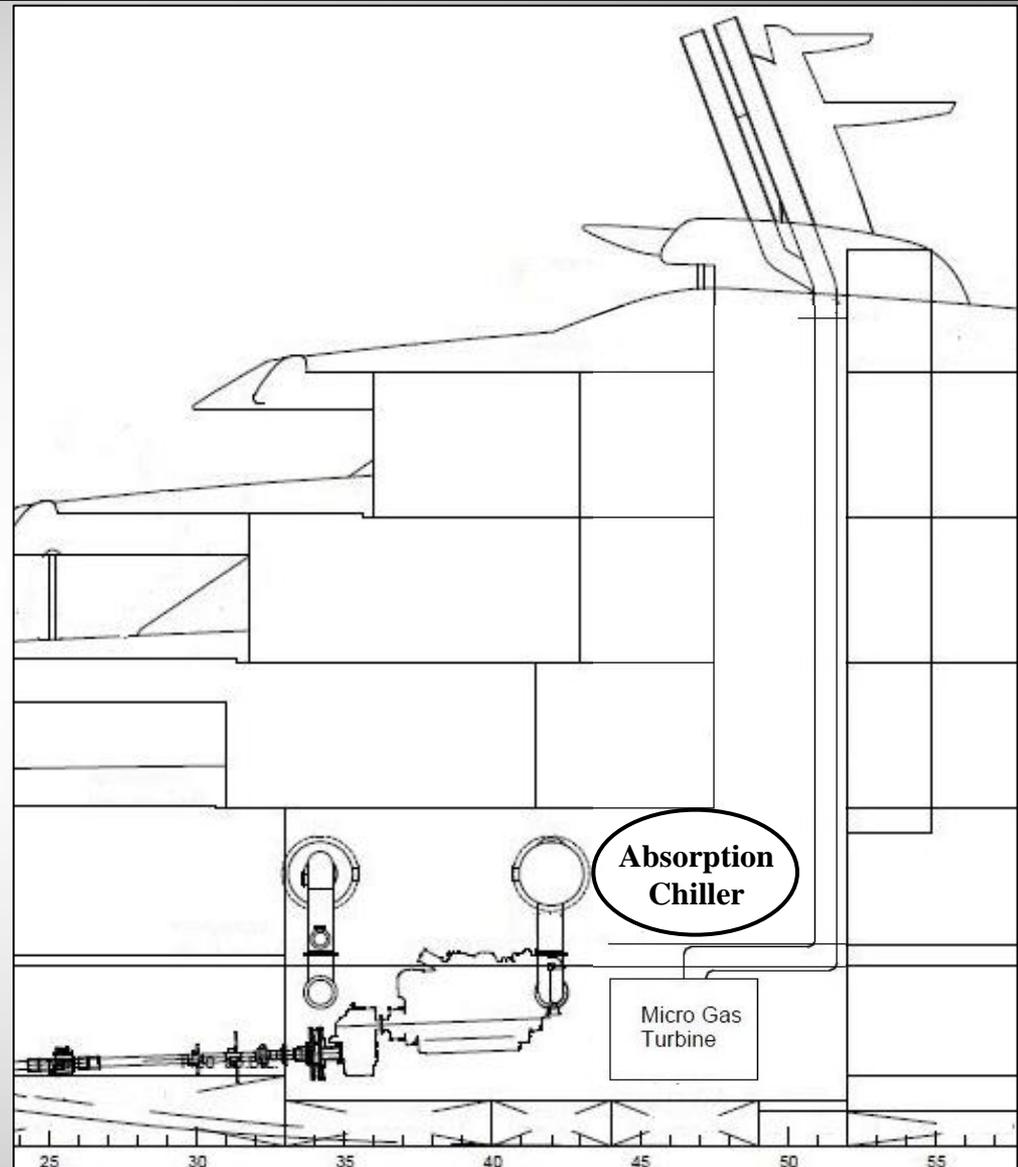


# Heat power profile for selected model



# Effect of the selected model

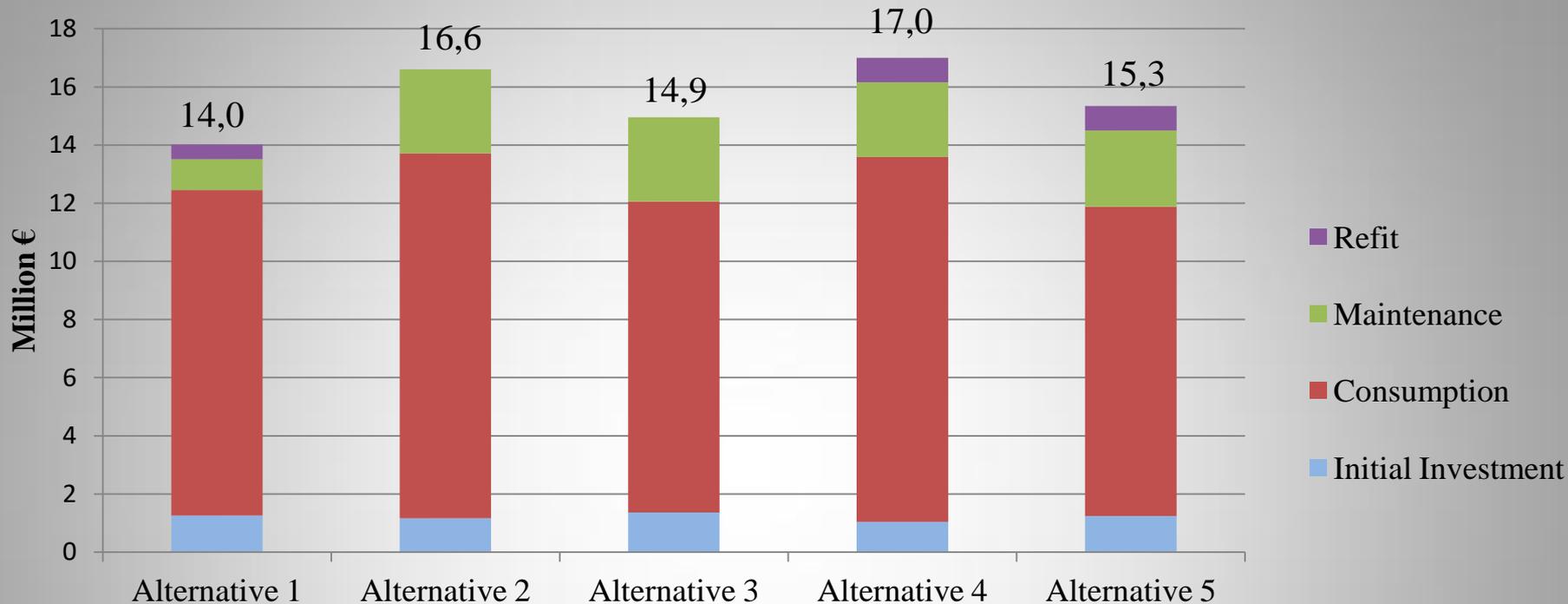
Overall efficiency 1%  
higher than GenSets



# Batteries for bow thruster

- One MGT could be removed if batteries are installed
  - Reduction of total air demand
- MGTs would work 33% more hours per year
  - Reduction in maintenance costs
  - Decrease of expected life of MGTs from 20 to 15 years

# Lifetime costs of alternatives over 20 years



- Alternative 1: GenSets
- Alternative 2: MGTs
- Alternative 3: MGTs + Absorption chiller
- Alternative 4: MGTs + Batteries
- Alternative 5: MGTs + Absorption chiller + Batteries

# Conclusions

- Efficiency of MGT+Absorption Chiller > GenSets
- Extra cost/year < 0.05% of total price of the ship
- Clean Image

