Hawaii Transportation Energy Analysis: Marine Efficiency Options

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Outline

- About the ICCT
- Project background
- Baseline marine energy consumption
- Unique characteristics of shipping energy use
- Energy-saving tactics evaluated

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ICCT mission and activities

The mission of ICCT is to dramatically improve the environmental performance and efficiency of cars, trucks, buses and transportation systems in order to protect and improve public health, the environment, and quality of life.

- Non-profit research institute
- Air pollution and climate impacts
- Focus on regulatory policies and fiscal incentives
- Activity across modes including aviation and marine
- Global outreach, with special focus on largest markets

Disclaimer

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The views and opinions expressed in this presentation are that of the ICCT, and may not necessarily represent the position of the DBEDT.

HCEI 2011 roadmap established an aggressive goal

Goal: Reduce the use of petroleum in ground transportation by 70% or ~ 385 MGY by 2030

Strategy with 2010 baseline	2015 target	2020 target	2030 target
Reduce vehicle miles traveled (VMT)	2% VMT reduction	4% VMT reduction	8% VMT reduction
Incorporate renewable fuels into transportation sector	E10 and biodiesel consumption at 2010 level (~45 million gallons)		150 million gallons
Improve standard vehicle efficiency of fleet	25 mpg cars 18 mpg LT	30 mpg cars 22 mpg LT	35 mpg cars 28 mpg LT
Accelerate the deployment of electric vehicles (EVs) and related infrastructure	4K EV sales (10K on road)	10K EV sales (40K on road)	30K EV sales

MGY: million gallons per year

Comparing 2015/2020 goals with 2013 status

Strategy with 2010 baseline	2015 target	2020 target	2013/2014 Actual
Reduce vehicle miles traveled (VMT)	2% VMT reduction	4% VMT reduction	19% increase in VMT
Incorporate renewable fuels into transportation sector	E10 and biodiesel consumption at 2010 level (~45 gallon)		52 million gallons
Improve standard vehicle efficiency of fleet	25 mpg cars 18 mpg LT	30 mpg cars 22 mpg LT	25 mpg for cars & LT combined
Accelerate the deployment of electric vehicles (EVs) and related infrastructure	4K EV sales (10K on road)	10K EV sales (40K on road)	1K EV sales (~3K on road)

On-road fuel use of 525 MGY in 2013 as compared with 496 MGY in 2010; a 6% increase.

Core strategies under consideration for transportation energy roadmap

- Light- as well as heavy-duty vehicle efficiency improvements
- Transition to electric drive vehicles (EVs and FCVs)
- Alternative fuels including biofuels and natural gas
- Vehicle demand management/promotion of transit and non-motorized transport
- Improving aviation efficiency
- **Improving marine efficiency**

Timeline for transportation energy analysis

- Stakeholder workshop: November 2014
  http://energy.hawaii.gov/wp-content/uploads/2011/09/TransWorkshop_Summary.pdf
- Vehicle Efficiency Options, January 8, 2015 (webinar)
  - http://energy.hawaii.gov/wp-content/uploads/2011/09/VehicleOptionsWebinar_1.08.15.pdf
- Continued stakeholder engagement
  - Workshop on Electric drive vehicles: January 13-14, 2014
  - Web-meetings on aviation and marine tactics: early February 2015
- Qualitative and quantitative evaluation of tactics (January/February 2015)
- Assess complementarity with existing Hawaii policies/plans and budgets (February/March 2015)
- Seek broad agreement on plan and implementation steps (April/May 2015)
- Final report (June 2015)

- Late 2015: Actual work begins on implementing an integrated transportation energy strategy with shared roles and responsibilities

Baseline marine energy consumption

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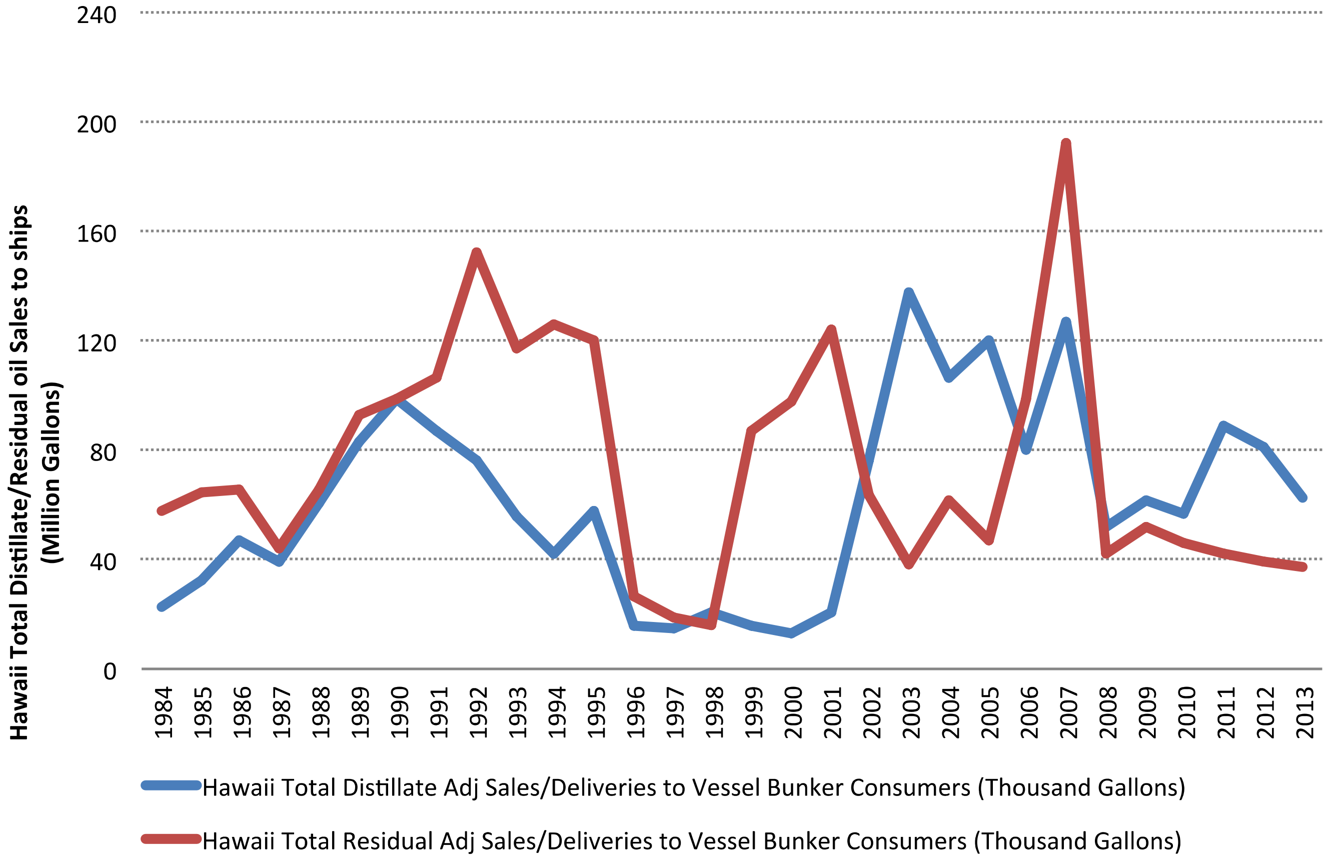
Fuel sales to ocean-going vessels in Hawaii

- Bunker sales to ocean-going vessels (OGVs) fluctuate widely around 110 million gallons per year, 2.5% of total U.S. bunker sales, 10% of total liquid fuel sales in Hawaii



Data Source: EIA (2014), Bunker sales to ships in Hawaii

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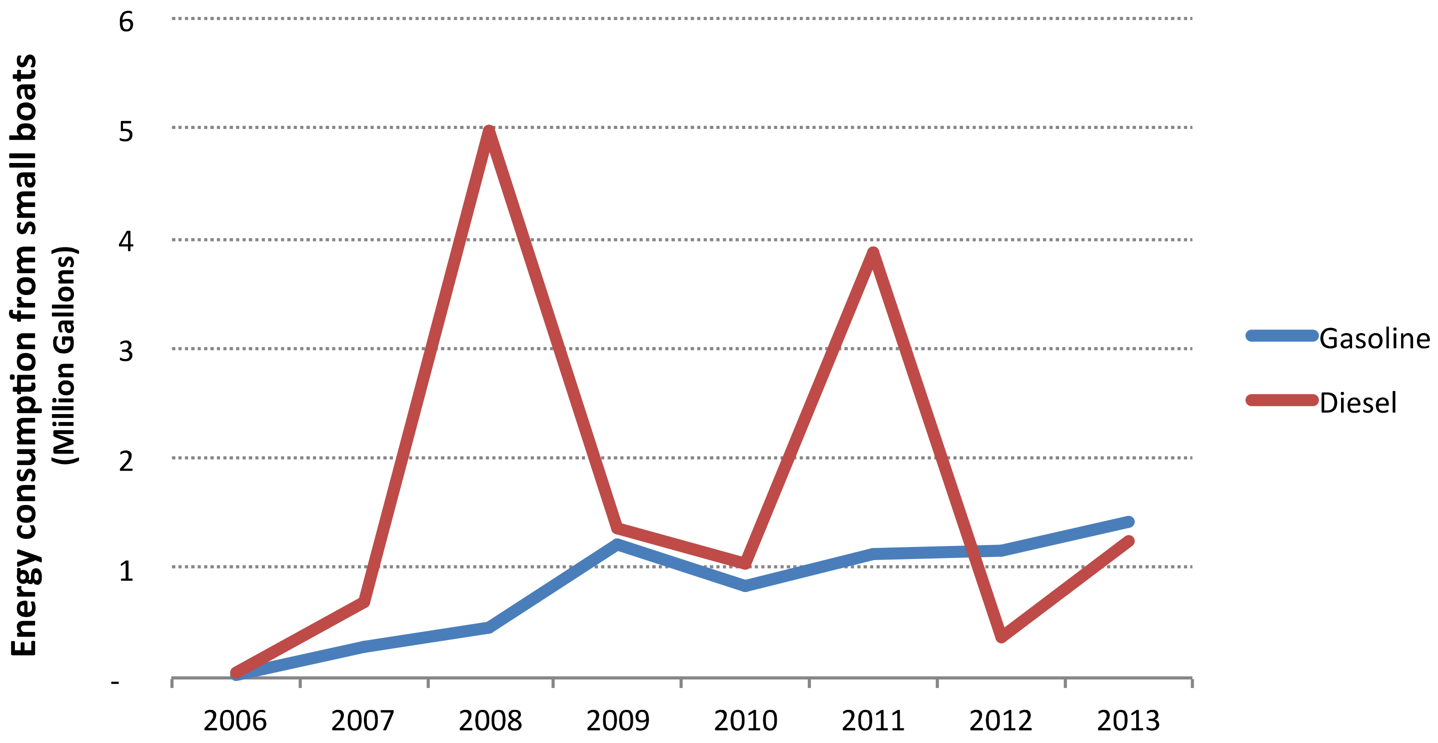
Fuel sales to small boats in Hawaii

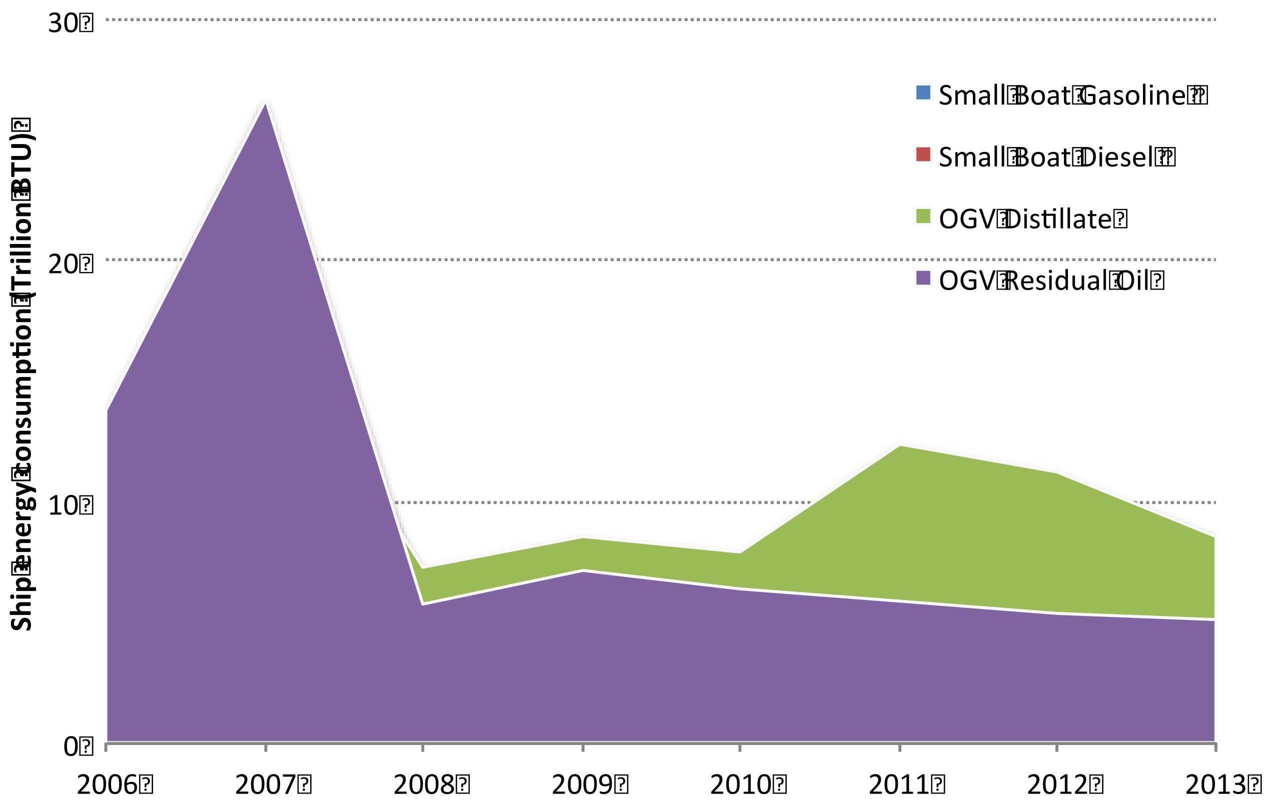
- Fuel sales to small boats vary even more over time, with increasing gasoline sales



Data provided by Hawaii DBEDT

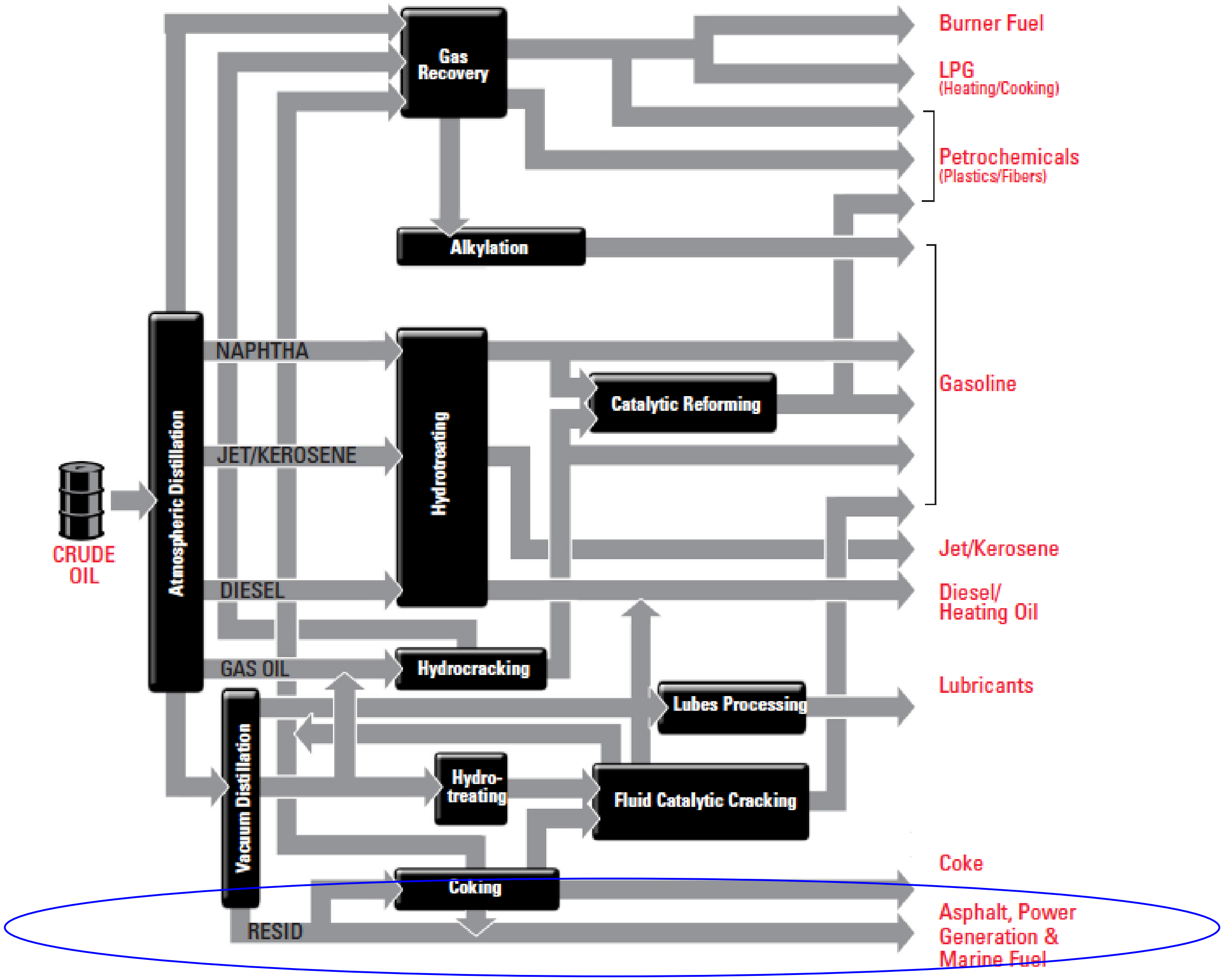
Combined fuel sales to shipping in Hawaii

- Bunker sales to ocean-going vessels (OGVs) dominate total energy use
- Baseline in 2020: 122 MGY (OGVs) and 3 MGY (small boats)



Unique characteristics of shipping energy use

Not all oil is the same



ExxonMobile: A simple guide to oil refining

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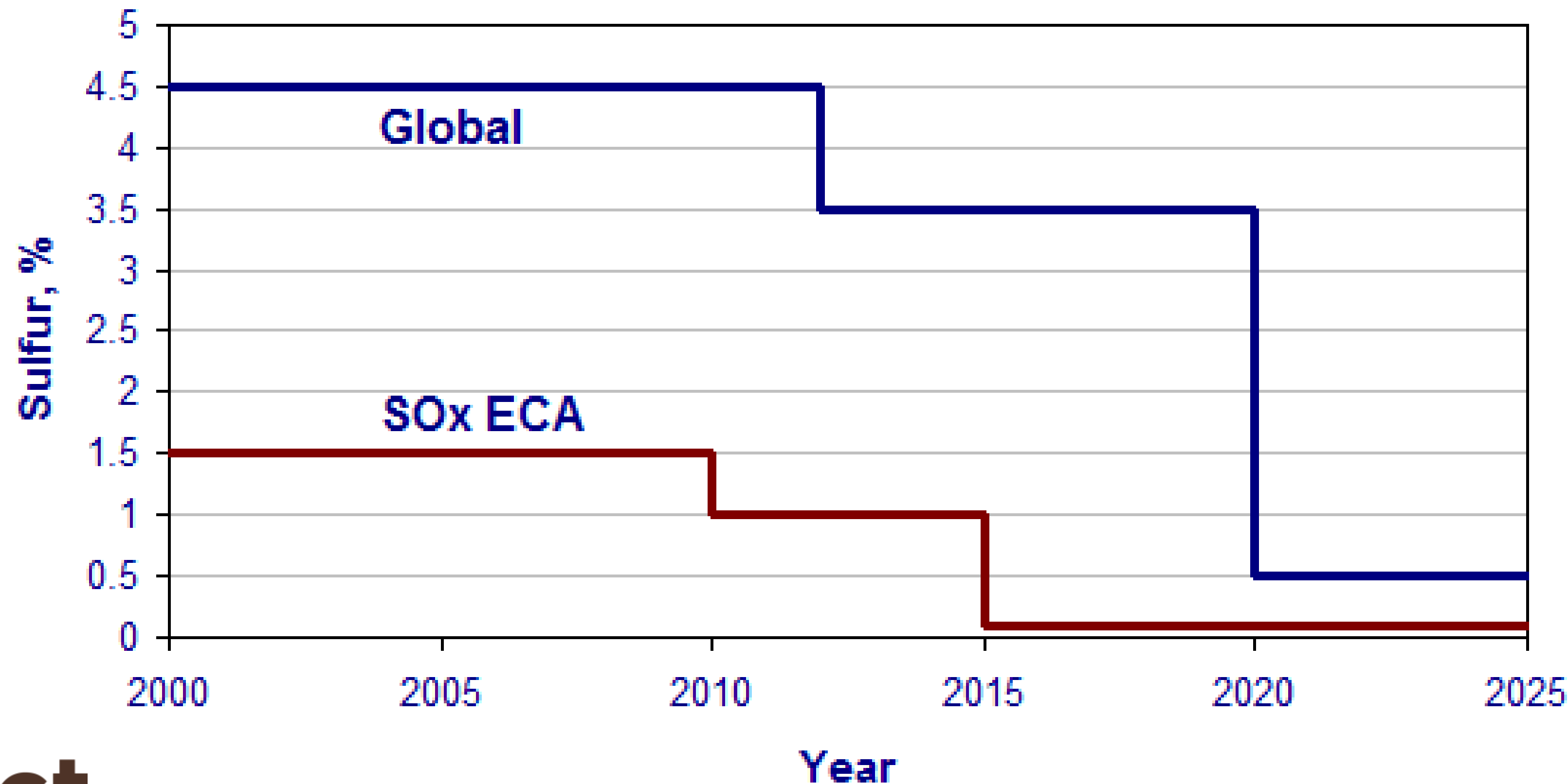
Regulatory changes in the coming years

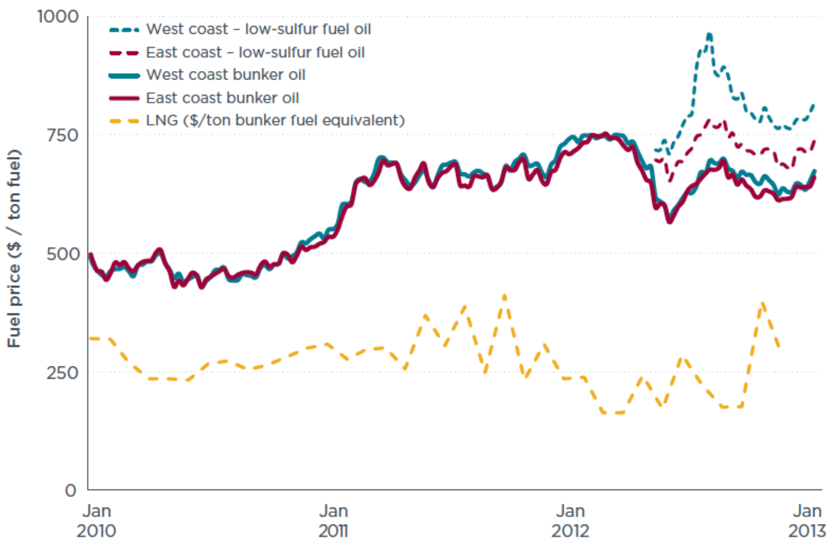
- Global bunker demand will undergo a sea change in the next few years
- Ship operators have to store multiple fuels in tanks, leading to changes in demand for different marine fuels in Hawaii



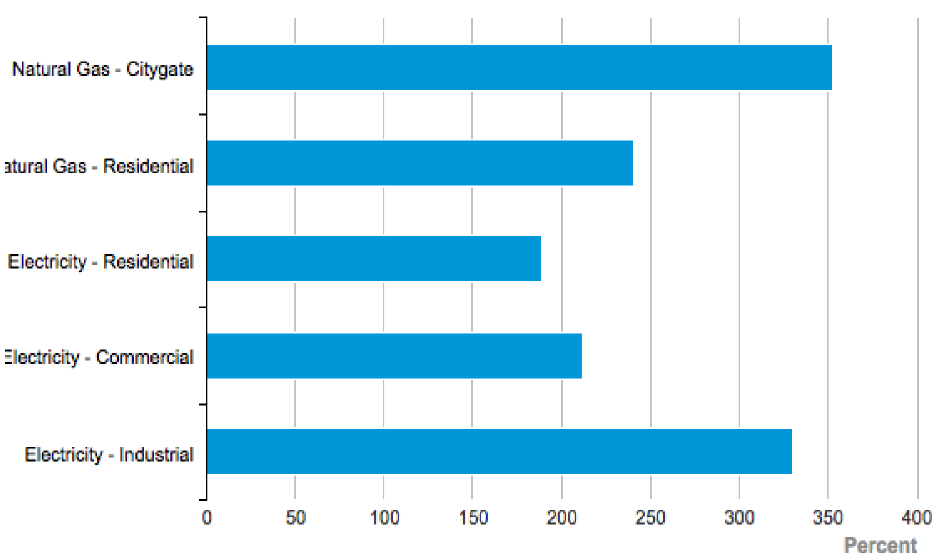
Source: Dieselnet https://www.dieselnet.com/standards/inter/imo.php
http://transportpolicy.net/index.php?title=International:_Fuels:_ISO_Petroleum_Marine_Fuels

Marine fuel is much cheaper

- Cheap fuel may damp the implementation of alternative fuels (i.e. LNG)



ICCT (2013) "Assessment of the fuel cycle impact of LNG as used in international shipping



EIA (2013) Hawaii price differences from U.S. average http://www.eia.gov/state/?sid=HI#tabs-5

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Market situation in shipping market

- Unlike aircraft, OGVs usually purchase fuels in markets where they are cheaper and carry them during other voyages
- Consequently, raising the energy efficiency of OGVs does necessarily mean reduced demand for marine fuels at a given port
  - For analysis purpose, we assume energy savings will translate to lower energy demand in shipping in Hawaii

Energy-saving tactics evaluated

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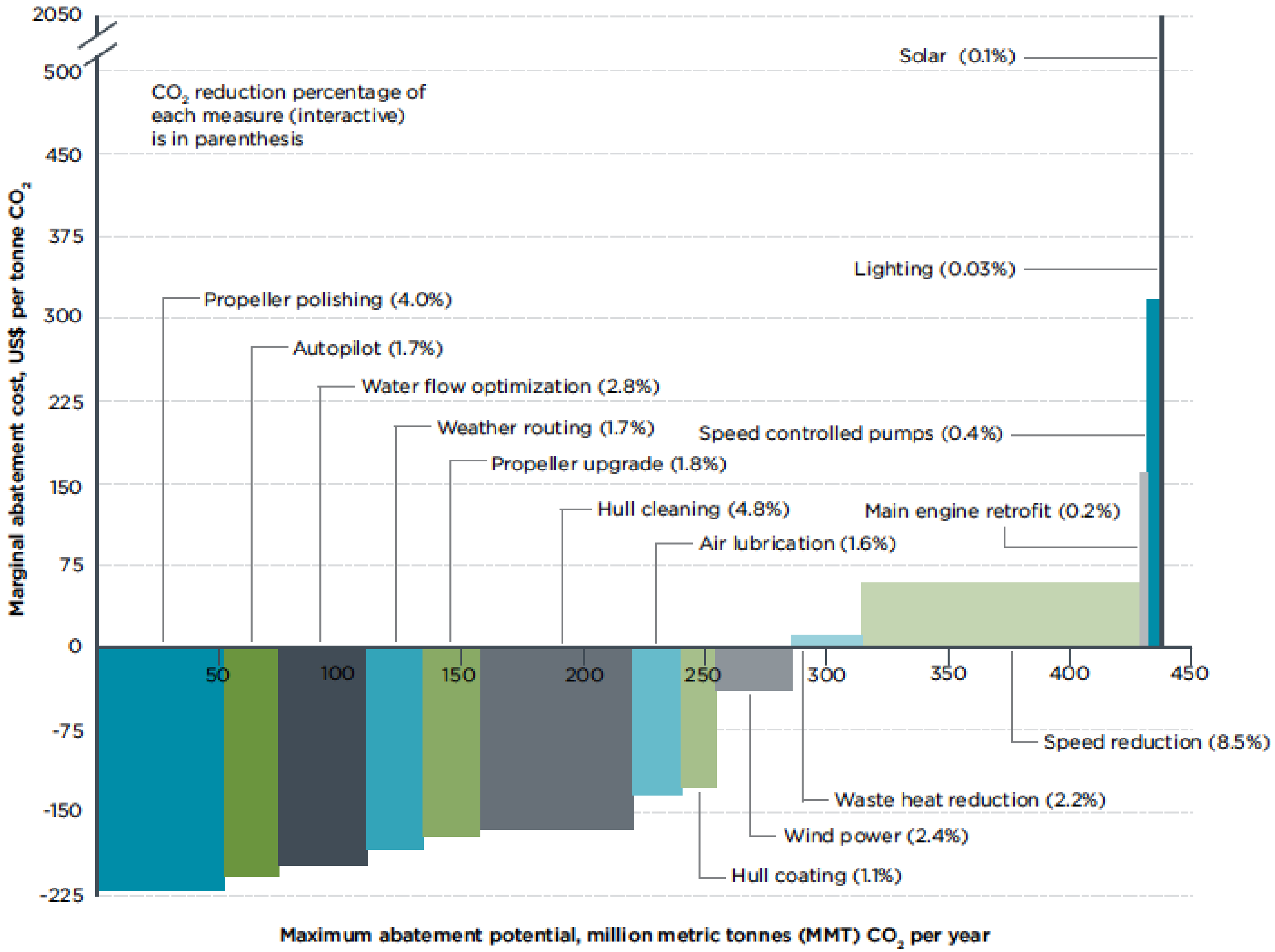
Marginal abatement cost curve

- A marginal abatement cost curve was applied to assess tactics to reduce energy consumption from shipping in Hawaii



ICCT (2011) Reducing Greenhouse Gas from shipping

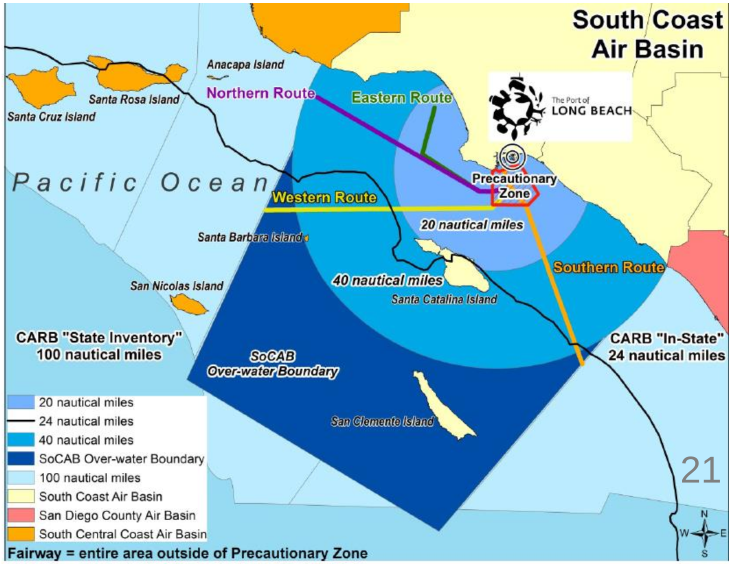
Marine fuel efficiency improvement tactics considered

- Slow steaming when ships approach 40 nautical miles of Port of Honolulu
- Fuel surcharge for shipping fuels sold in Hawaii
- Hull cleaning for OGVs and small boats
- Propeller polishing for OGVs and small boats
- Onshore power for OGVs visiting Port of Honolulu

Slow steaming

- Main engine fuel consumption scales with the cube of operational speed
- Encouraging OGVs to reduce speeds outside ports would reduce fuel consumption and air emissions
- Port of Los Angles and Port of Long Beach (POLB) both applied this method

$$F_{ij} = \sum_{i,j,k} \left[MF_k \times \left(\frac{s_{ik}}{s_{0k}} \right)^3 + AF_k \right] \times \frac{d_{ij}}{24 \times s_{ik}} \times \lambda$$



POLB (2012) Port of Long Beach inventory

Effectiveness

- Assumptions
  - Estimated energy consumption at Port of Honolulu using PoLB inventory and relative cargo throughput
  - Cargo growth increases 5% annually between 2011 and 2020
  - Speed reduced to 12 knots into the speed limit zone
- Effectiveness
  - 0.8 MGY
  - $0.5 million incentive in discounted port dues
  - $0.61 per gallon (excluding cost or gains from fuels from shipping companies)
- Policy implication: voluntary slow steaming program with incentives such as discounted port dues

Marine fuel efficiency improvement tactics considered

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- **Fuel surcharge for shipping fuels sold in Hawaii**
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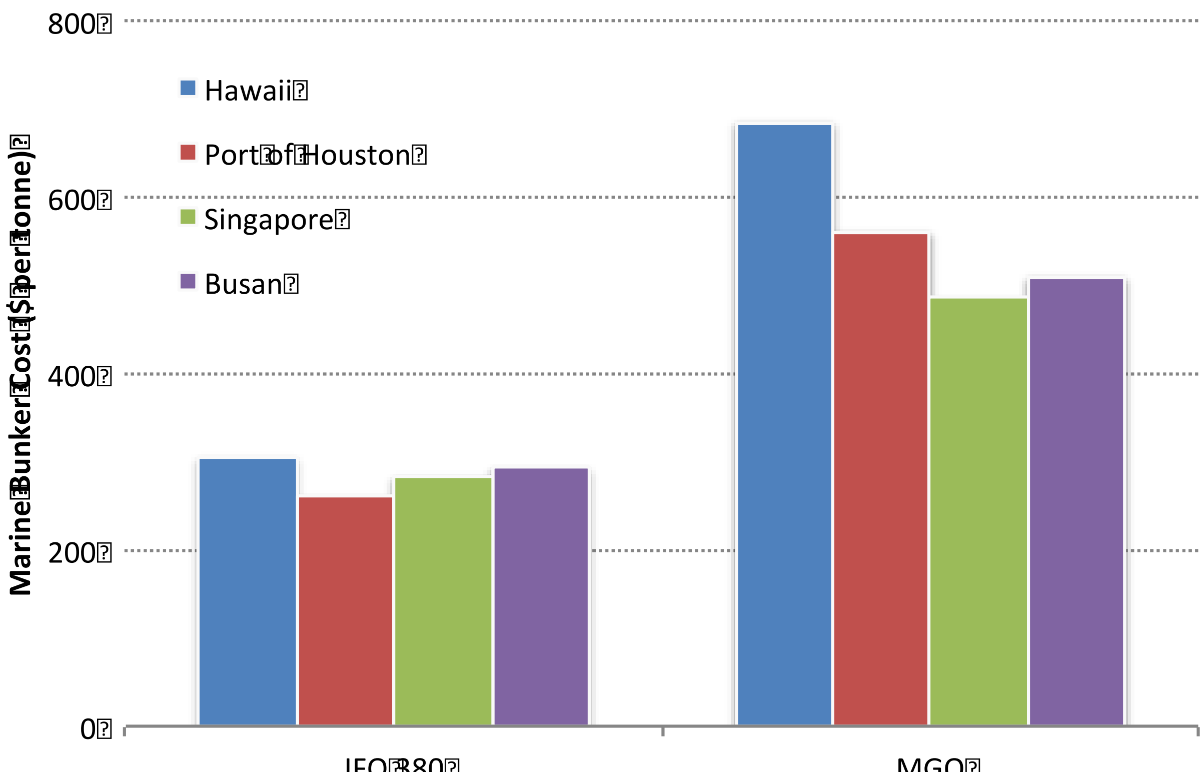
State and local sales taxes on transportation fuels

Jurisdiction		Tax (cents/gallon)						
		Gasoline	Highway Diesel	Highway LPG	Non-highway Diesel	Non-highway LPG	Aviation	Marine bunkers
State		17	17	5.2	2.0	2.0	2.0	-----
Count y	Honolulu	16.5	16.5	5.4	-----	-----	-----	-----
	Maui	16.0	16.0	4.3	-----	-----	-----	-----
	Hawaii	8.8	8.8	2.9	-----	-----	-----	-----
	Kauai	17.0	17.0	5.6	-----	-----	-----	-----

http://www.tfhawaii.org/taxes/fuel.html

Bunker price influence bunker sales, not transport supply

- Relative low bunker price in Hawaii drew ships calling Port of Honolulu purely for bunker around 2006, causing a spike in bunker demand (see slide 10)
- The price advantage disappear (see figure below), but the transport supply remain unaffected.



Based on data provided by William Anonsen

Effectiveness

- No fuel tax exists for ships; a fee surcharge could be viable
- Assumptions
  - 1% increase of fuel price will reduce fuel sales by 0.15% (average figure from ISL, 2013; Swedish shipping association, 2011; CE Delft, 2010)
  - Baseline fuel cost by 2020: $700 per tonne
  - $20 surcharge (4%)
- Effectiveness
  - 0.9 MGY
  - -$0.10 per gallon
- Policy implication: Consider a fuel surcharge for shipping fuels to encourage hull and propeller polishing business

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- **Propeller polishing for OGVs and small boats**
- Onshore power for OGVs visiting Port of Honolulu

Hull cleaning and propeller polishing

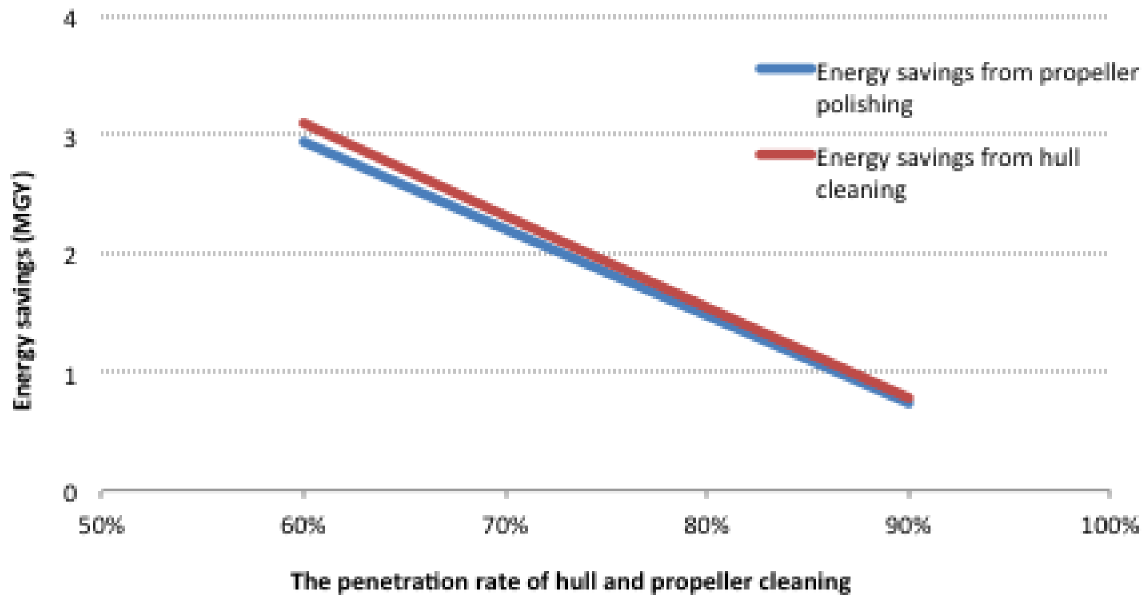
- Hull and propellers should be regularly cleaned and polished to reduce resistance in operation
- Literature shows some shipowners do not follow the maintenance schedule
- Real savings depend on the penetration rates of both tactics in Hawaii

Assumptions

- Hull cleaning: 1%-10% energy reduction; $75K – 112K cost for OGVs
- Propeller polishing: 3%-8% energy reduction; $80K - $90K cost for OGVs
- Market penetration rate: 60% (we examined the effect between 60% to 90% penetration rates)
- Both hull cleaning and propeller polishing can be applied to OGVs and small boats

Effectiveness

- Hull cleaning: 3.1 MGY; -$0.47 per gallon
- Propeller polishing: 2.9 MGY; -$0.67 per gallon
- Policy implications: fiscal policies such as tax credit and state subsidies to encourage hull cleaning and propeller polishing business



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- **Onshore power for OGVs visiting Port of Honolulu**

Onshore power

- Substitute fuel oil consumption from auxiliary engines for electricity onshore
- Assumption:
  - Capacity factor of utilities in Hawaii: 60%
  - Renewables in the generation mix by 2020: 25%
  - Onshore power share: 80%
  - Fuel consumption in Port of Honolulu is proportional to the cargo throughput between it and Port of Long Beach
- Effectiveness
  - 0.1 MGY
  - $1,300 per gallon

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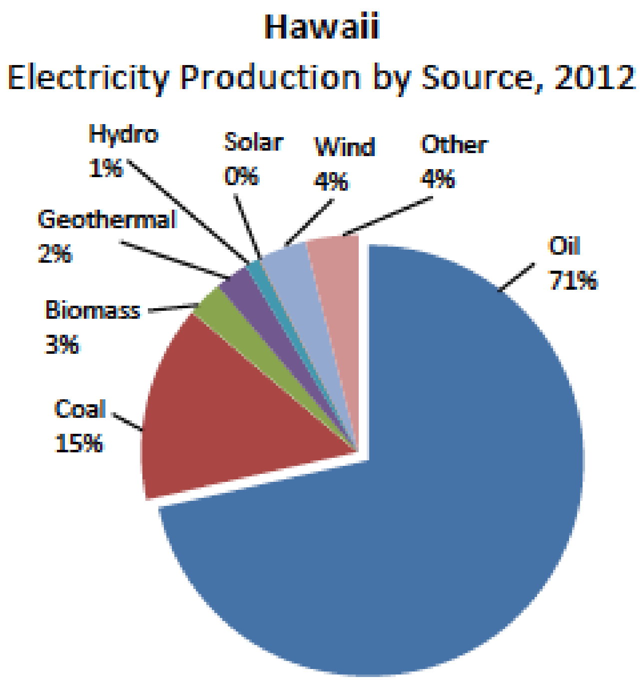
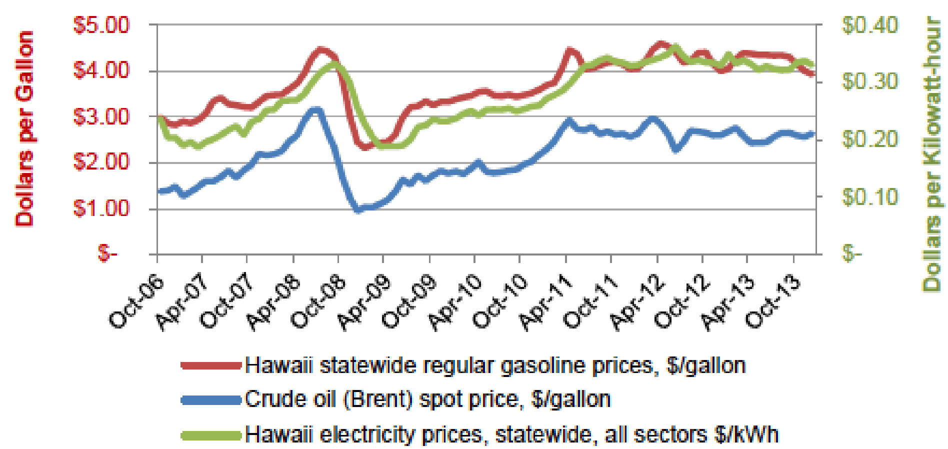
Effectiveness

- Onshore power is a less feasible option
  - Exchanging oil use at port for oil use in power generation
  - Baseline electricity price is relatively high
  - Overall reduction potential is small

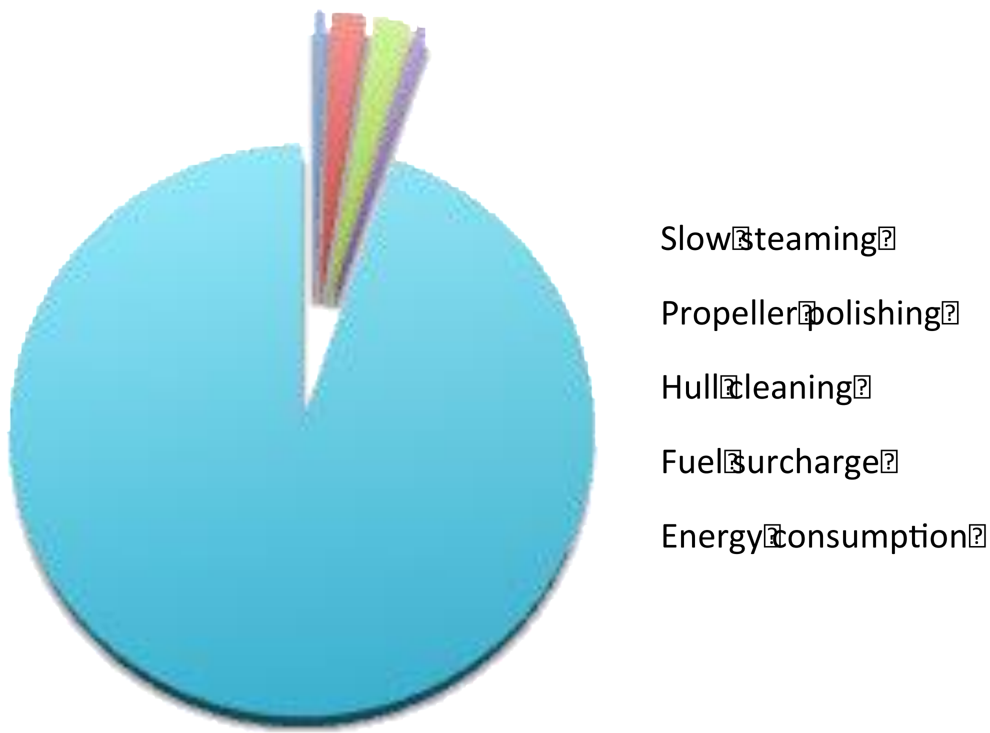




DBEDT (2014) Hawaii Energy Facts and Figures

Fuel savings by fully implementing the four tactics

- The four tactics could reduce energy consumption from shipping by 5.1%, or 10.4 MGY, by 2020 and 14.0 MGY by 2030



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Summary on fuel savings and cost effectiveness

Tactics	Fuel savings	Cost effectiveness
Slow steaming	0.8 MGY	$0.61 per gallon
Fuel surcharge	0.9 MGY	- $0.10 per gallon
Hull cleaning	3.1 MGY	- $0.47 per gallon
Propeller polishing	2.9 MGY	- $0.67 per gallon
Shore power	0.1 MGY	$1300 per gallon

For more information…

- Hawaii State Energy Office Facebook page:
  https://www.facebook.com/HawaiiStateEnergyOffice

- Hawaii Clean Energy Initiative Website:
  http://www.hawaiicleanenergyinitiative.org/

- Two question HCEI survey: http://tinyurl.com/HCEI-trans

- ICCT website: http://www.theicct.org/

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