



Ship Efficiency by STG

Practical Approach to Energy Efficient Ship Operation

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What successful companies do to become energy efficient operators

DNV's experience from 20 projects

DNV have extensive experience in assisting shipping companies energy efficiency



Leave your competitors behind

DNV Maritime Solutions – Management and technology consulting

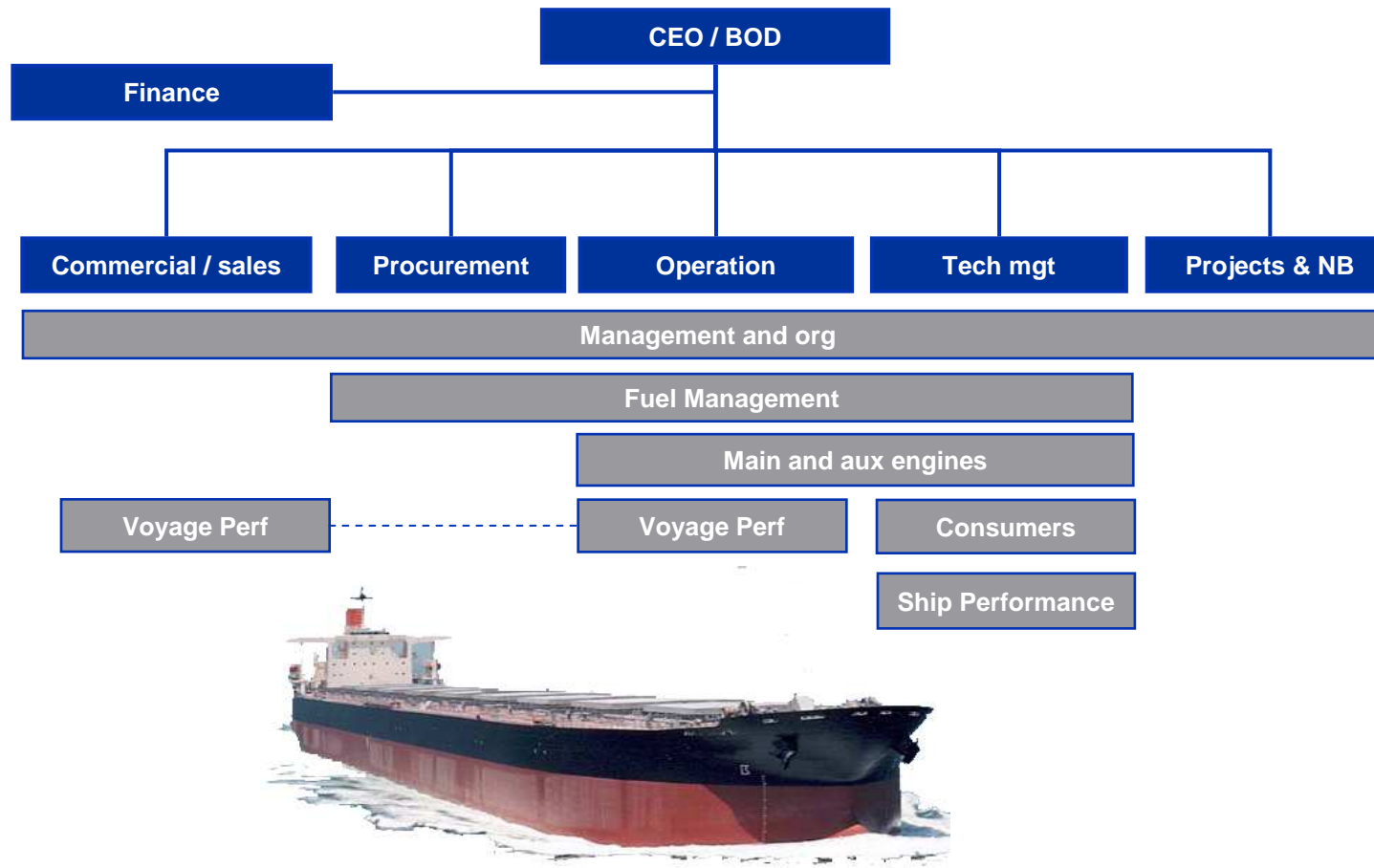
- Leading management & technology consultancy to the maritime industry
- All levels of operation; from the engine to the board room
- Oslo, London, and Singapore
- 90 professionals worldwide
- Energy management projects with 20 different clients - All major segments
- First project in 2004
- Fuel costs most important motivation
- Improvement potential, 5 – 15%



Key success factors to energy efficient operations

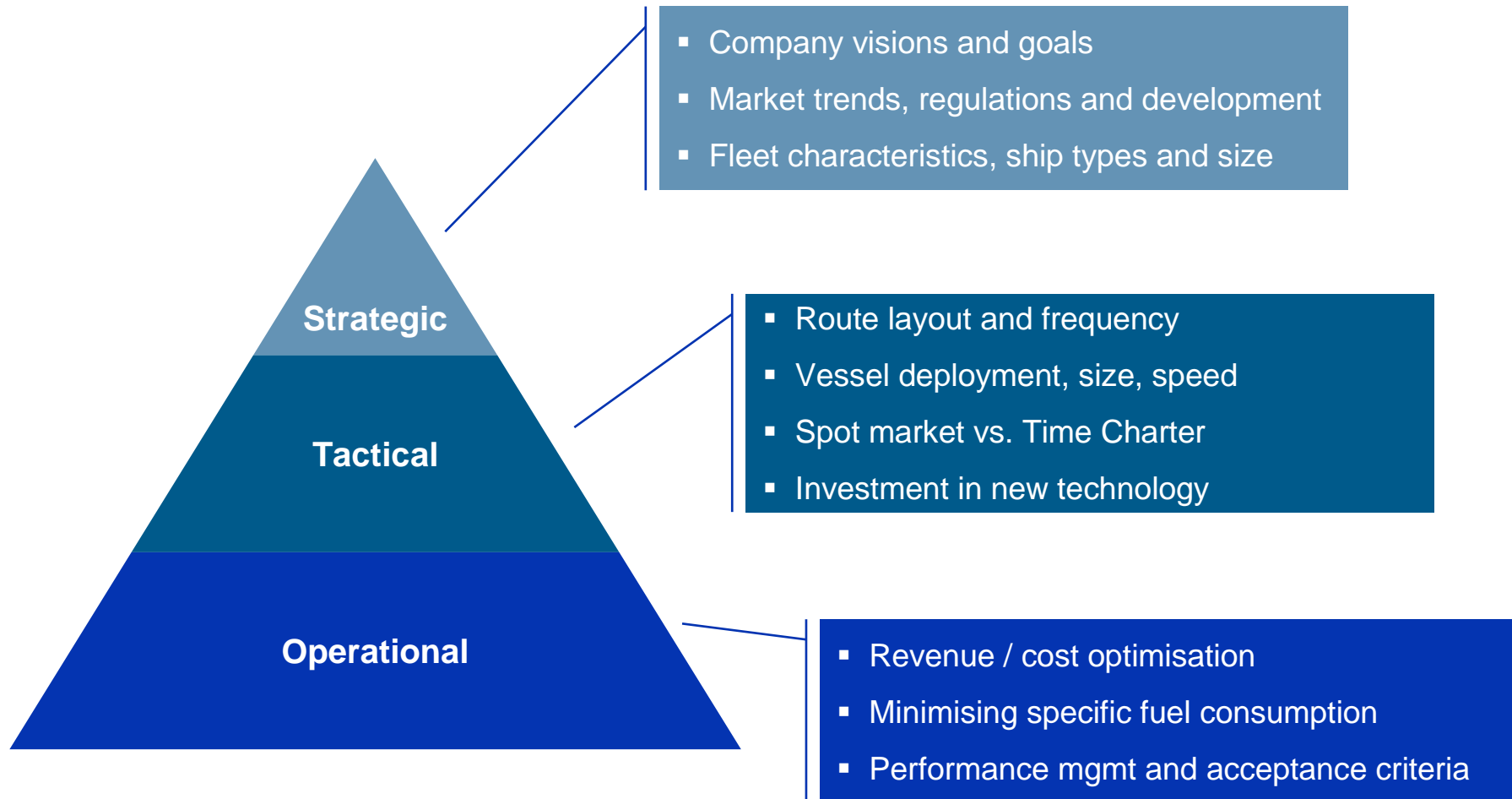
SUCCESS FACTORS	DESCRIPTION
Holistic	
Prioritise	
Structured	
Measure	
Pragmatism	
Follow through	

Holistic: Energy Management requires cross departmental cooperation



Paradox - nobody is fully accountable for fuel consumption either on-board or on-shore

Holistic: Energy management addressed at strategic, tactical and operational levels



Holistic: All stakeholder groups involved to ensure commitment, teamwork and knowledge transfer





Key success factors to energy efficient operations

SUCCESS FACTORS	DESCRIPTION
Holistic	
Prioritise	<ul style="list-style-type: none">▪ Identify improvement areas▪ Prioritise according impact and implementation difficulties
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Prioritise: Many aspects influence energy efficiency, but where to start



Voyage Performance

- Fleet planning, route and ship allocation
- Chartering/contracts
- Voyage planning
- Speed Management
- Weather routing & sea current
- Port/harbour operations



Main and AUX engines

- Main Engine efficiency
- Aux Engines efficiency & utilization
- Aux boilers efficiency and utilization



Ship Performance

- Hull condition
- Propeller condition
- Autopilot & rudder
- Trim and draft
- Hull Appendages & tech. mod.



Consumers

- Cargo Operations
- Thruster operations
- Ventilation, HVAC, lights
- Insulation and energy losses
- Water productions
- Incinerating



Fuel Management

- Pre-bunkering
- During bunkering
- Post-bunkering

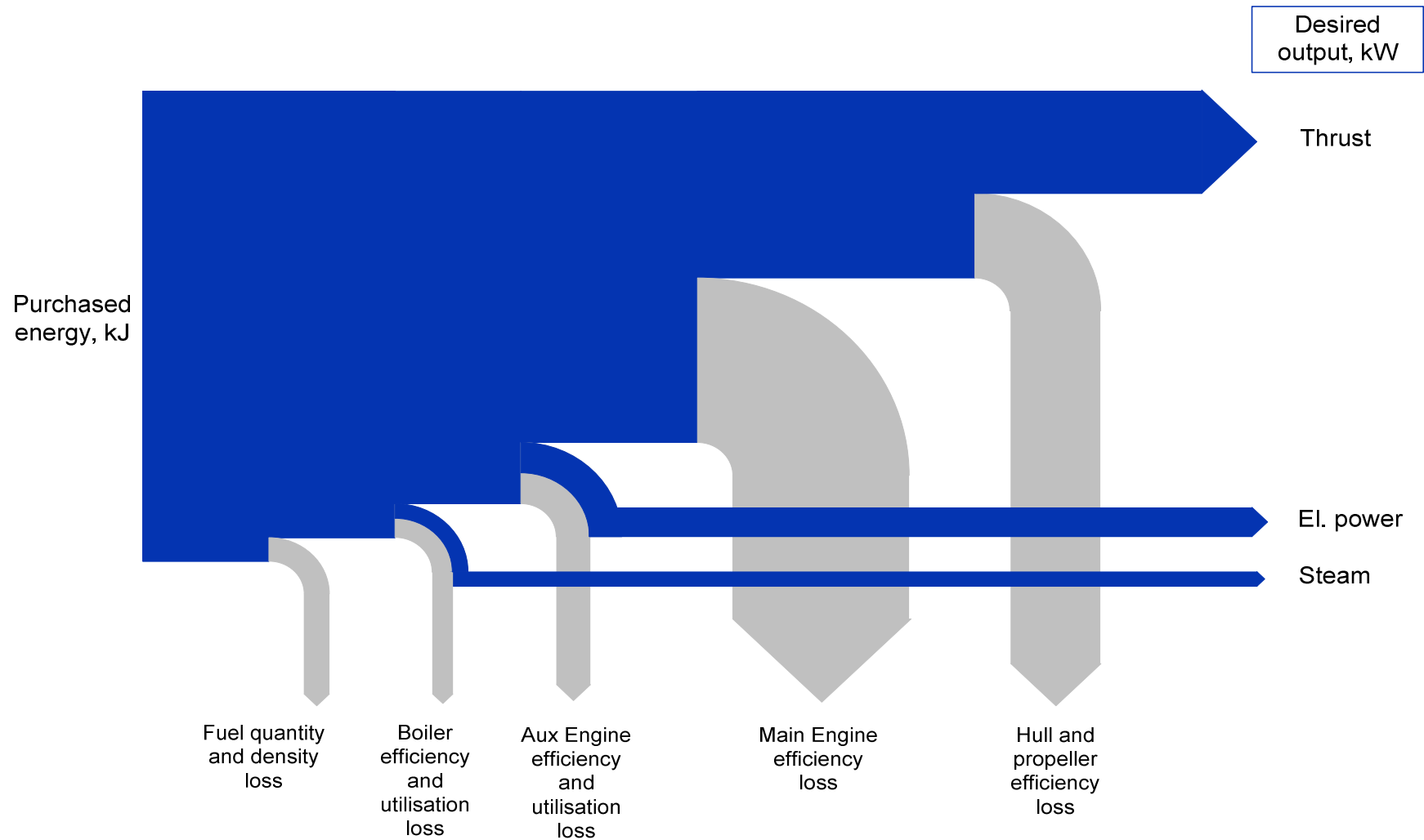


Management and organisation

- Strategy and tactical plans
- Performance Management
- Competence and training
- Culture and awareness
- Environment and CSR
- Life-cycle perspective



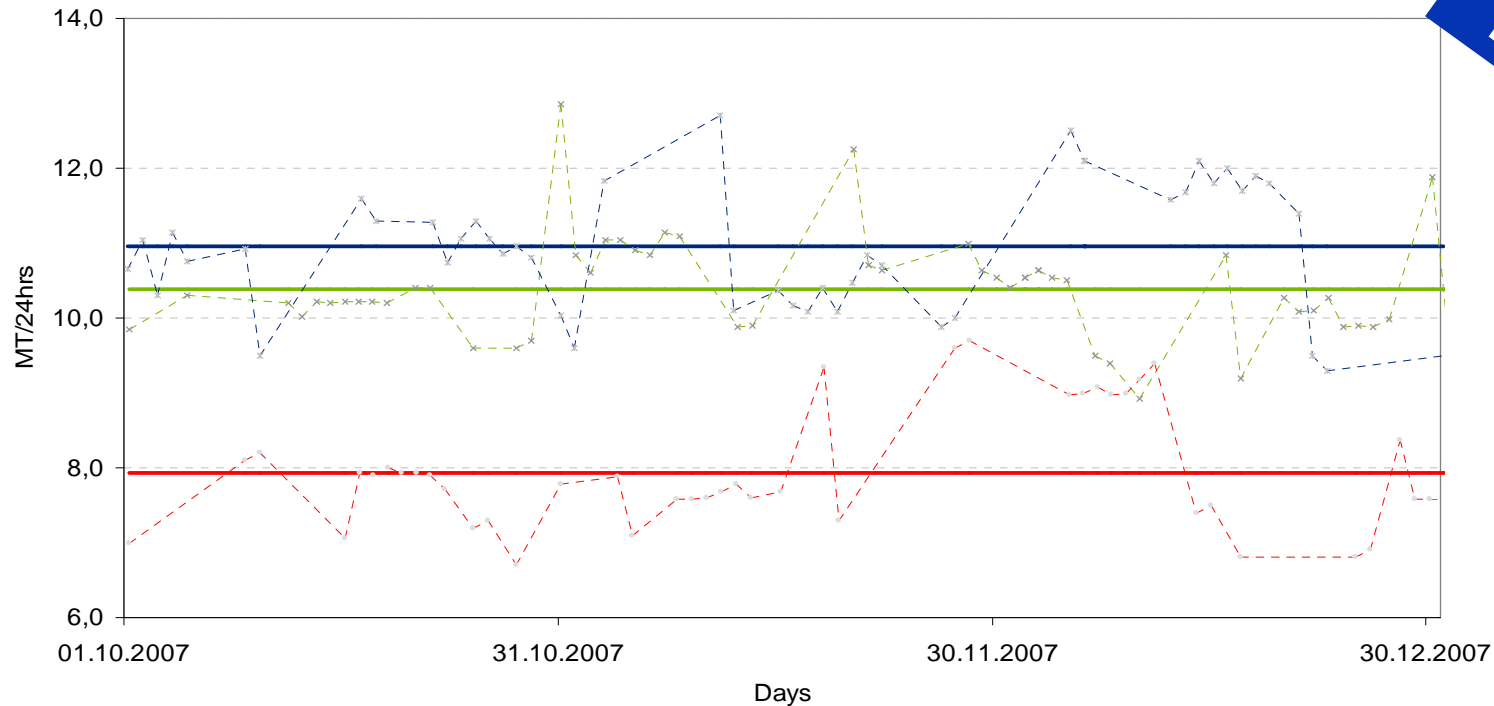
Prioritise: The ship energy flow has to be assessed to identify the improvement areas for “ship as a system”



Prioritise: Compare performance with established baselines or comparable ships in fleet



Aux Eng average fuel consumption for three sister ships

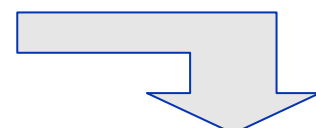
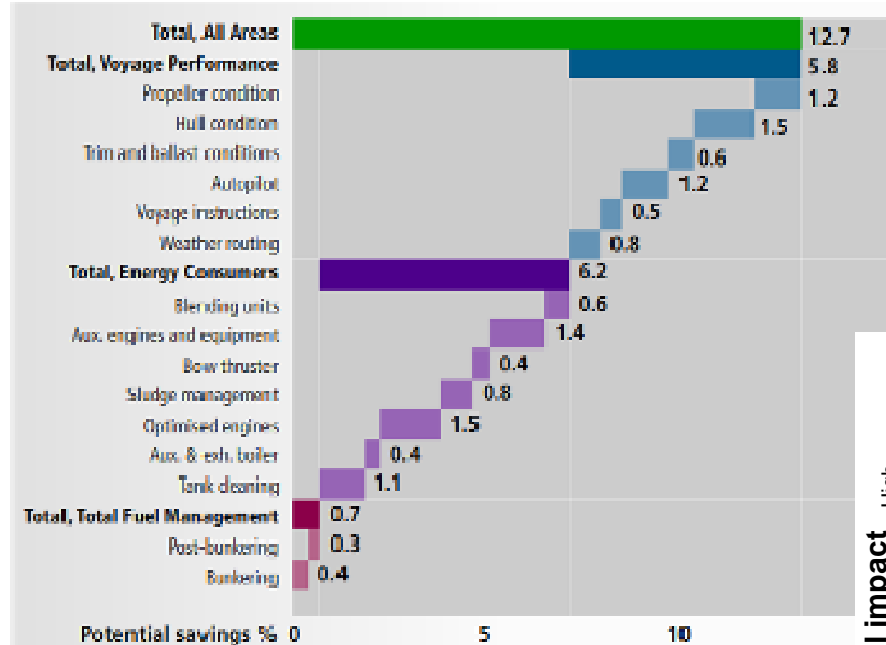


Onboard practices varies often from ship to ship leading to unnecessary high power consumption

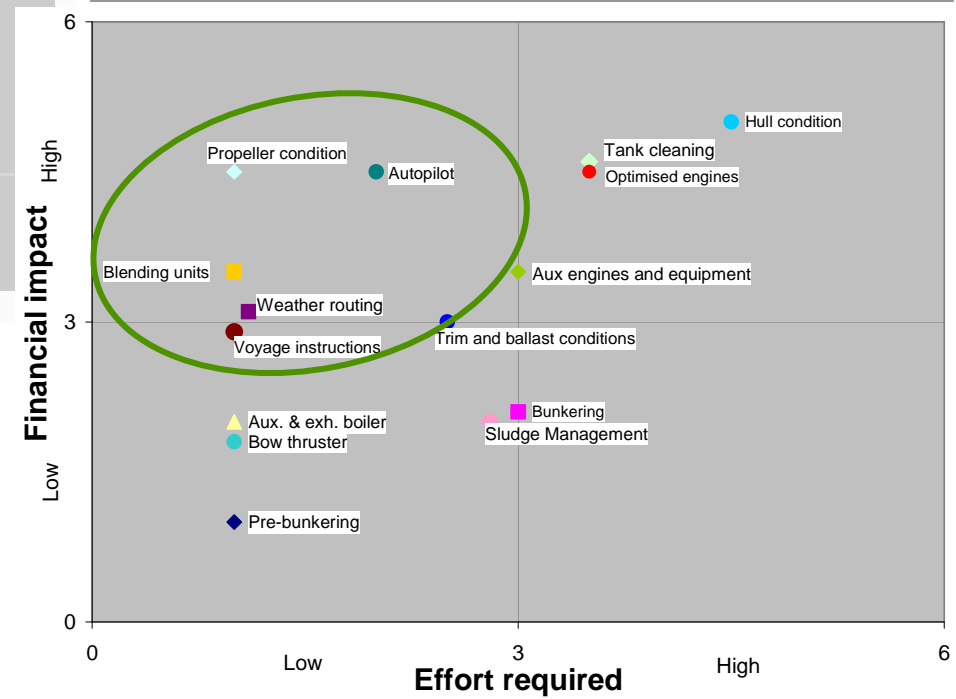
Prioritise: Improvement areas should be prioritised according to saving potential and effort required for implementation



Business case – Improvement potential



Prioritisation of activities

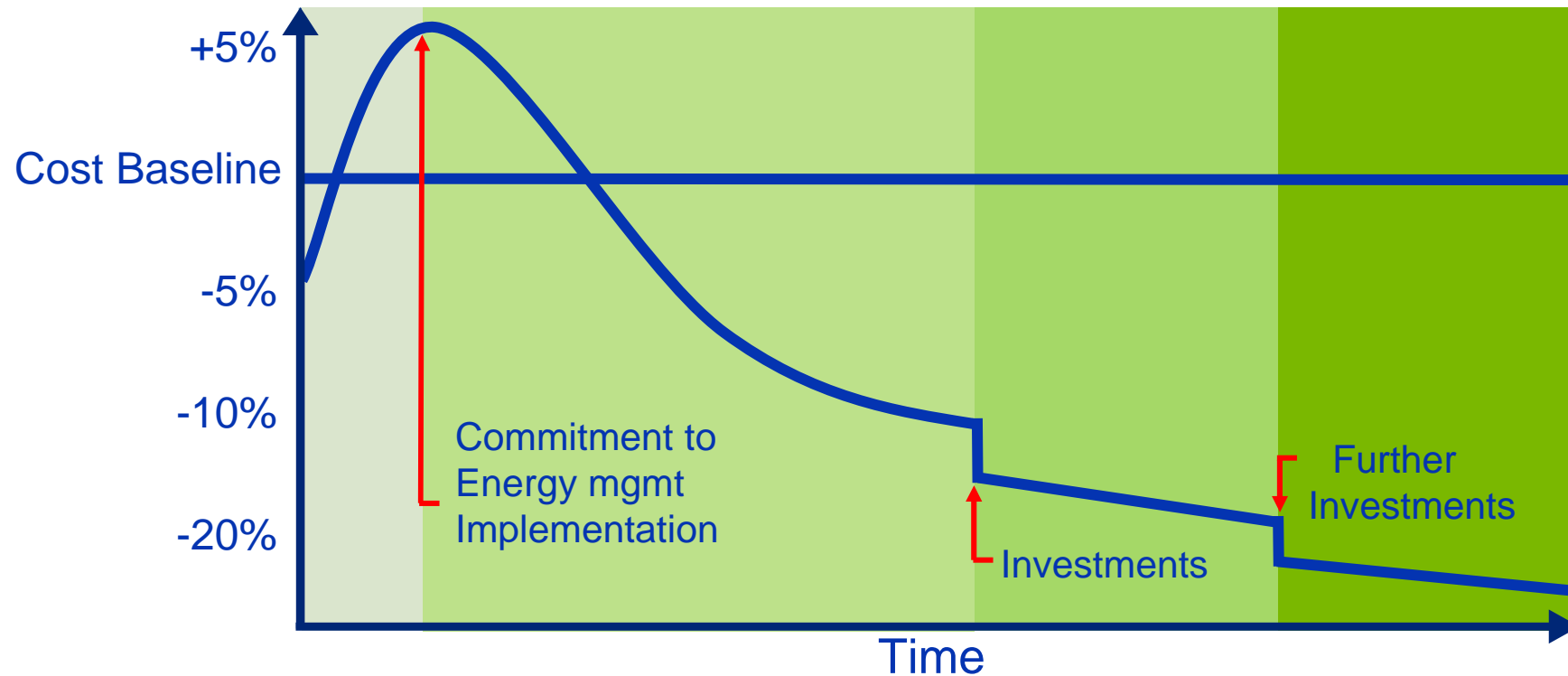




Key success factors to energy efficient operations

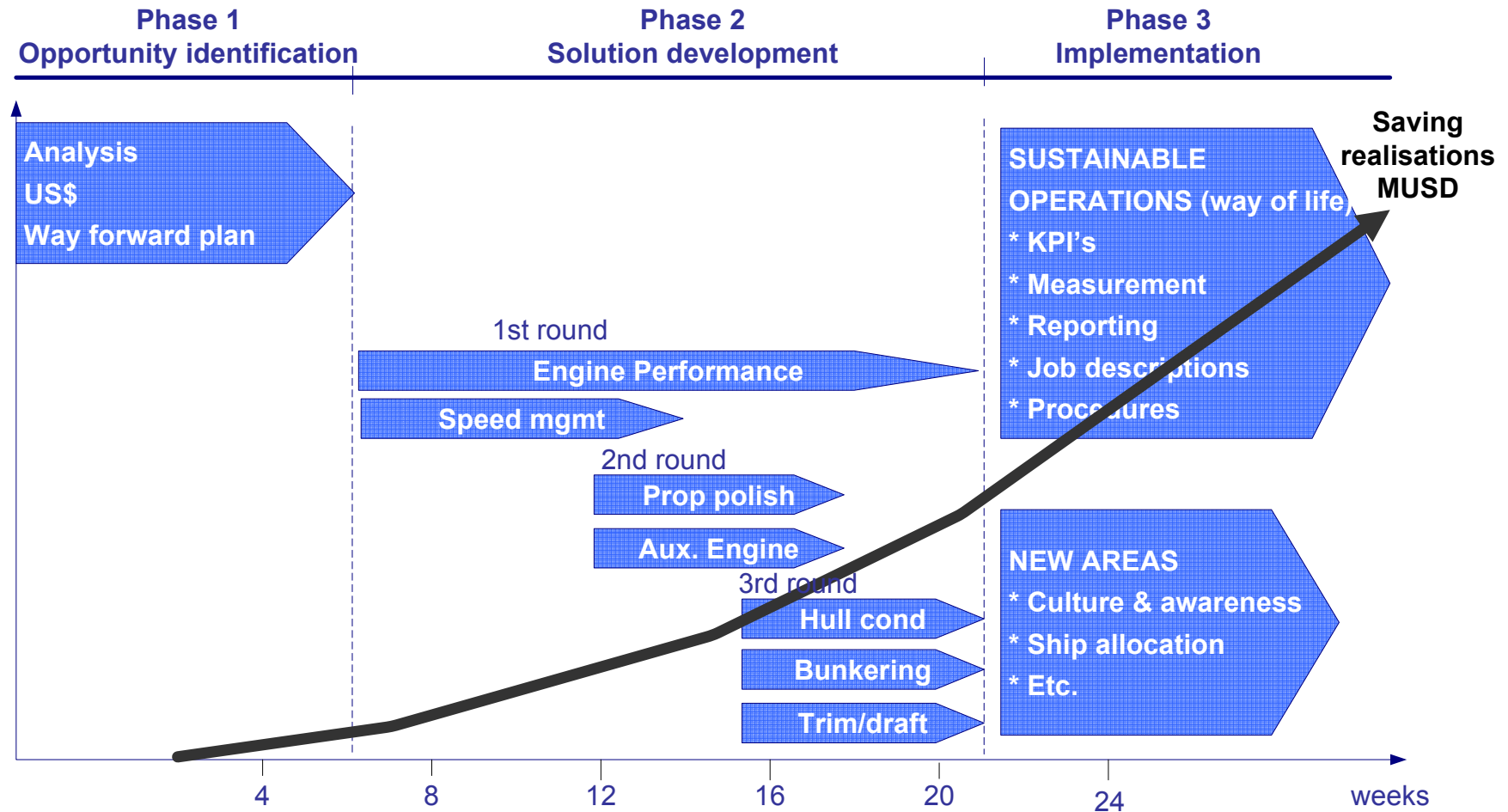
SUCCESS FACTORS	DESCRIPTION
Holistic	
Prioritise	
Structured	<ul style="list-style-type: none">▪ Develop plans and set goals▪ Commitment and continuous effort
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Pragmatism	
Follow through	

Structured: Continuous effort are the only route to sustainable energy efficiency improvements



Increasing energy costs	Decreasing energy costs by applying simple energy efficiency initiatives "Housekeeping"	Further savings due to promotion of energy-efficient practices	Saving energy becomes company culture
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Structured: Overall meta plan with expected time for savings realisation





Key success factors to energy efficient operations

SUCCESS FACTORS	DESCRIPTION
Holistic	
Prioritise	
Structured	
Measure	<ul style="list-style-type: none">▪ Define KPI's and manage energy efficiency performance▪ Invest in tools to measure performance
Pragmatism	
Follow through	

Measure: Energy efficiency are typically defined as specific energy consumption



- Challenges with measuring energy efficiency:
 - Ships don't have measuring equipments
 - Many factors with large uncertainties influence efficiency
 - Difficult to isolate effects of all factors

- “Simplicity” is the approach to start measuring
 - Define Energy efficiency indicators that are linked to company value chain (transport work)
 - Start measuring performance where uncertainties are low
 - Build up confidence in data and performance
 - Extend and include new efficiency indicators

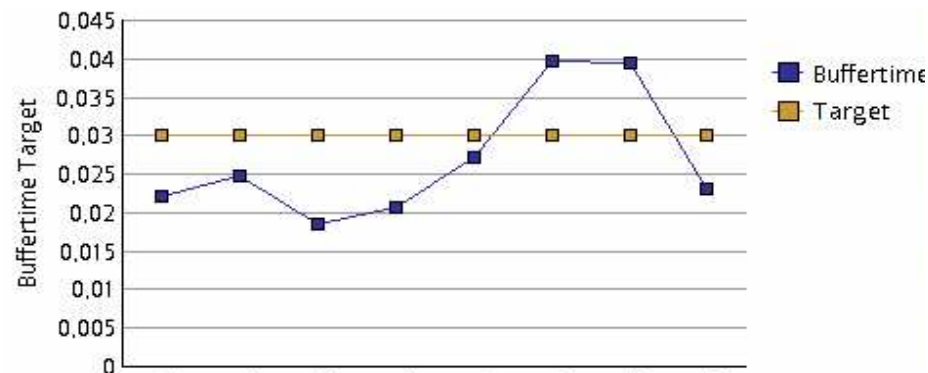


Measure: Energy efficiency requires measuring and analysis

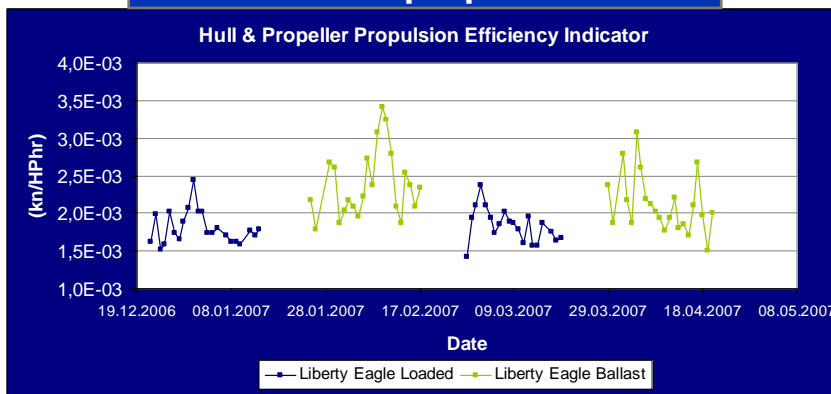
Overall fleet performance

2,8%	●	2,5%	●	0,380	●
1,5%	●	1,9%	●	0,453	●
0,2%	●	2,1%	●	0,457	●
4,4%	●	2,7%	●	0,380	●
4,5%	●	4,0%	●	0,401	●
5,4%	●	3,9%	●	0,416	●
1,7%	●	2,3%	●	0,360	●

Vessel speed mgt



Hull & propeller



Engine performance

Main Engine assessment		Test Date	Warning levels		Result
Engine balance (compared to average)					
P _{max}	Maximum combustion pressure	5	7	%	3.4 %
P _{comp}	Compression pressure	4	5	%	5.1 %
FPI	Fuel Pump Indicator	5	10	%	3.2 %
T _{exh}	Exhaust gas temperature	7	9	%	5.6 %
Engine efficiency (compared to new building sea trial)					
P _{max}	Corrected comb. press. drop compared to engine ref.	5	10	%	20.4 %
P _{comp}	Corrected compression pressure drop compred to engine ref.	5	15	%	13.8 %
T _{exh}	Corrected exhaust gas temp. increase compared to engine ref.	10	15	%	13.8 %
ΔT _{TC}	Turbo charger differential temp decrease compared to ref.	15	20	%	26.7 %
	Engine thermal load - MCR achivable		100	%	100 %
ΔP _{scav}	Scavenging air cooler air side fouling (mm H ₂ O)		280	mm	120
Engine overload					
a_P _{max}	Angle of maximum pressure less than 11,5 or greater than 16°	11,5	16	deg	0.0
P _{ignition}	Max pressure rise more than manufacturer's recommendation		30	bar	21
Fuel oil consumption (compared to NB sea trial)					
t/d	FO consumption increase to reference per day @ NCR	+4,31 (t/d)	0	0	3,8 %

Investment in measuring equipment and business intelligence system is necessary to have reliable data and efficient performance analysis



Key success factors to energy efficient operations

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Pragmatism	<ul style="list-style-type: none">▪ Don't seek perfection or overcomplicate things▪ Carry out pilot tests▪ Celebrate success and failures equally - Have fun
Follow through	



Be Pragmatic: Don't seek perfection or overcomplicate things

- Don't let imperfections and hurdles stop you
- Pilot tests unfinished solutions
- Use learning from pilots into permanent future solutions



Celebrate success and failures equally – Have fun



Key success factors to energy efficient operations

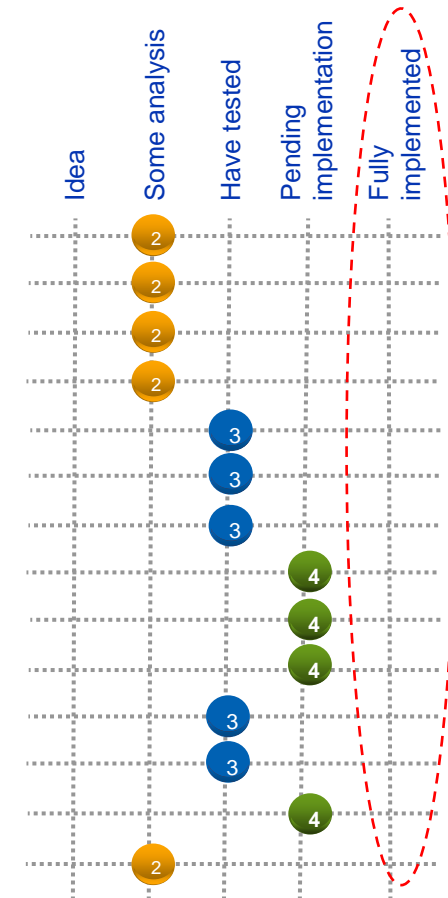
SUCCESS FACTORS	DESCRIPTION
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Follow through	<ul style="list-style-type: none">▪ Build culture and competence▪ Measure performance towards agreed targets

Follow through: Energy efficiency is common knowledge today – most companies have a long track record



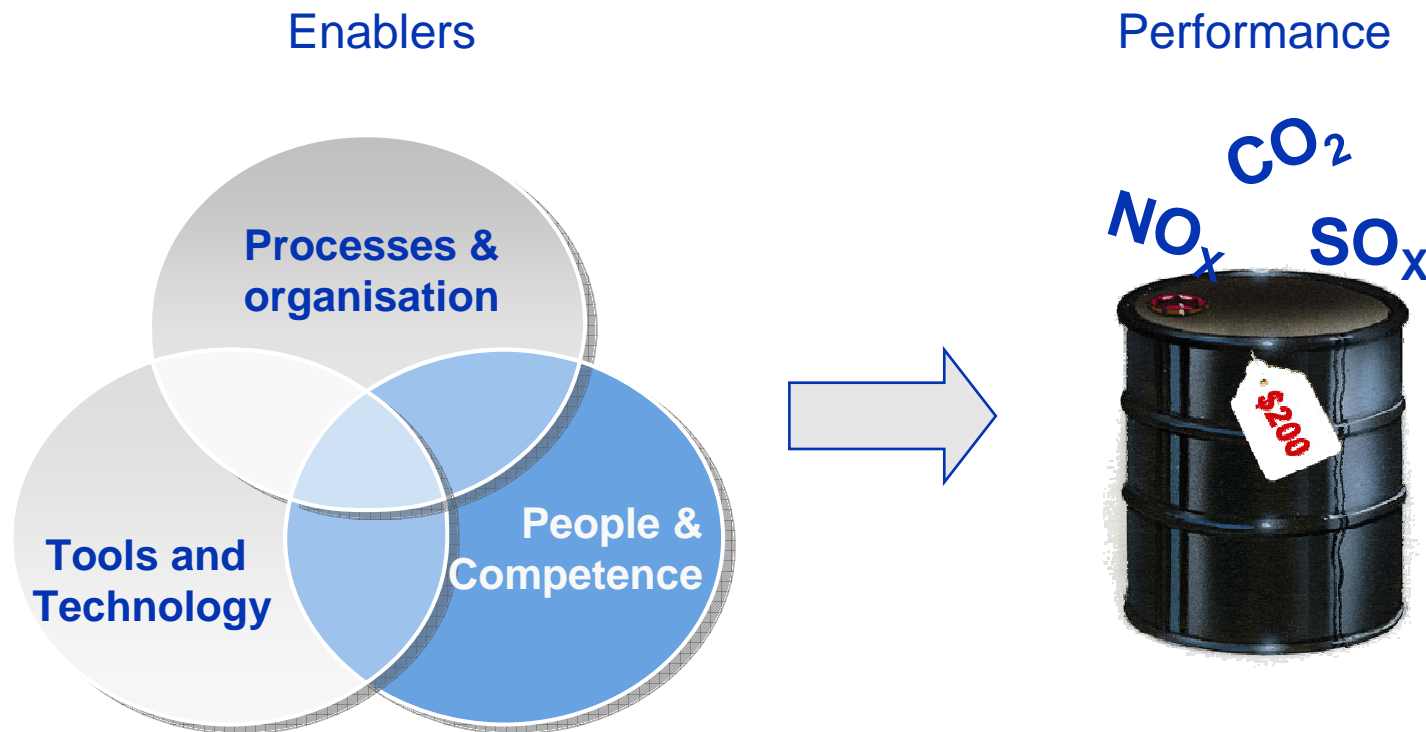
Energy efficiency initiatives

- Develop KPI structure for monitoring of vessel performance
- Establish database for vessel performance data
- Improve seafarer knowledge and competence to reduce fuel consumption
- Create procedures for optimal settings for trim and ballast
- Create procedures for optimal vessel speed in voyage planning
- Determine optimal antifouling system to be used
- Determine optimal hull cleaning programme
- Determine optimal propeller cleaning programme
- Implement Weather routing reporting on all vessels
- Include more time in voyage planning to allow for speed reduction
- Create procedures for engine, hull and propeller monitoring
- Ensure fully functional sensors and equipment for engine performance monitoring
- Install system for engine performance monitoring
- Optimisation of cylinder oil consumption



The real challenges occur when it comes to implementation and benefit tracking

Follow through: People, processes and technology are key enablers to ensure energy efficient performance

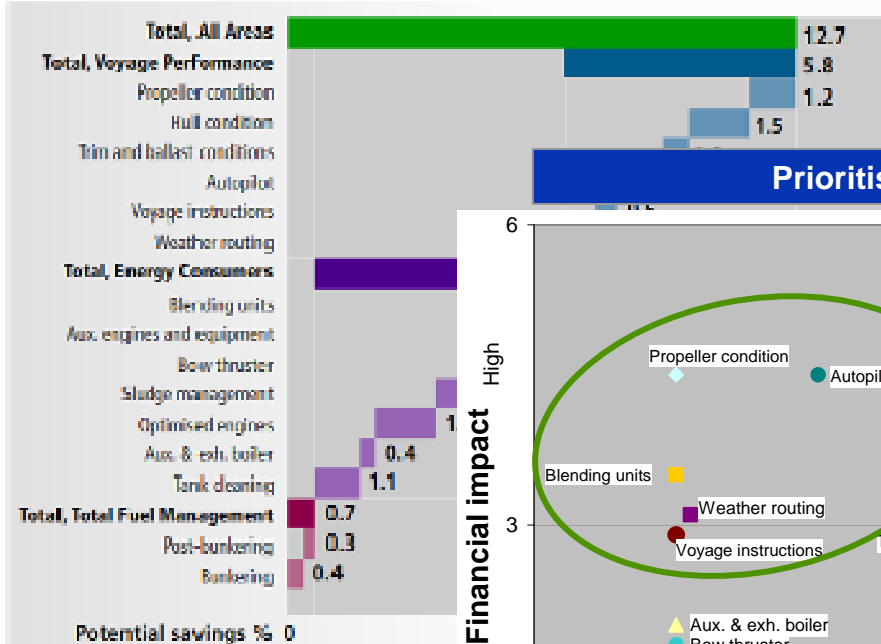


Promote incentives to reward desired behaviours and performance to speed up the implementation process

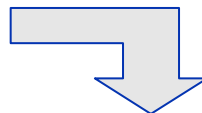
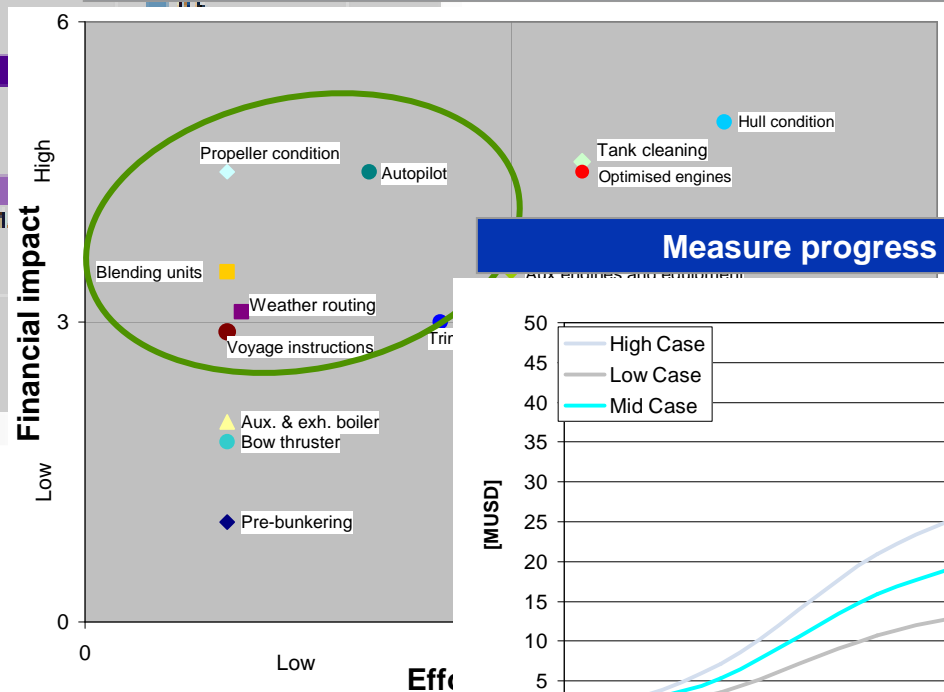


Follow through: Measure progress against defined targets

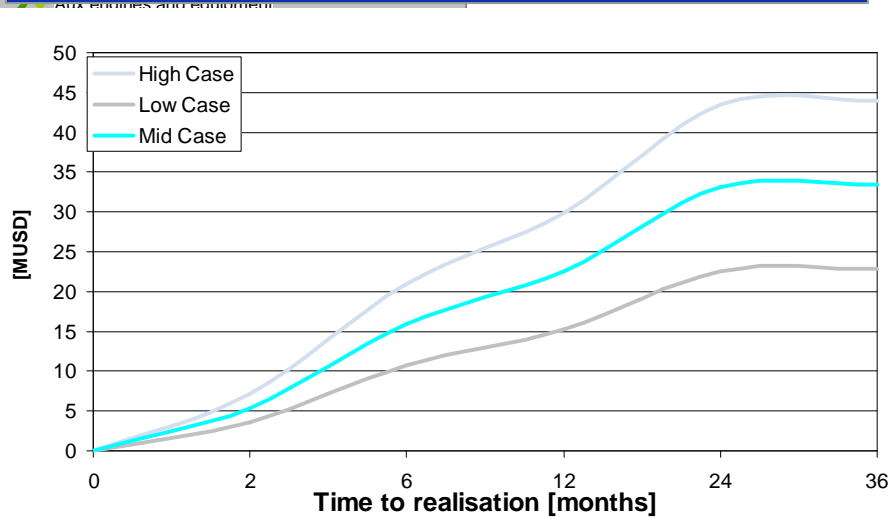
Business case – Improvement potential



Prioritisation of activities



Measure progress and follow up





Key success factors to energy efficient operations

SUCCESS FACTORS	DESCRIPTION
Holistic	<ul style="list-style-type: none">▪ Ensure ownership and commitment▪ Chase opportunities beyond technology▪ Involve whole organisation (ship and shore)
Prioritise	<ul style="list-style-type: none">▪ Identify improvement areas▪ Prioritise according impact and implementation difficulties
Structured	<ul style="list-style-type: none">▪ Develop plans and set goals▪ Commitment and continuous effort
Measure	<ul style="list-style-type: none">▪ Define KPI's and manage energy efficiency performance▪ Invest in tools to measure performance
Pragmatism	<ul style="list-style-type: none">▪ Don't seek perfection or overcomplicate things▪ Carry out pilot tests▪ Celebrate success and failures equally - Have fun
Follow through	<ul style="list-style-type: none">▪ Build culture and competence▪ Measure performance towards agreed targets



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