



Connecting For Success...

ELECTRIC POWER DAYS 2017

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CATERPILLAR®

Maximizing Asset Performance

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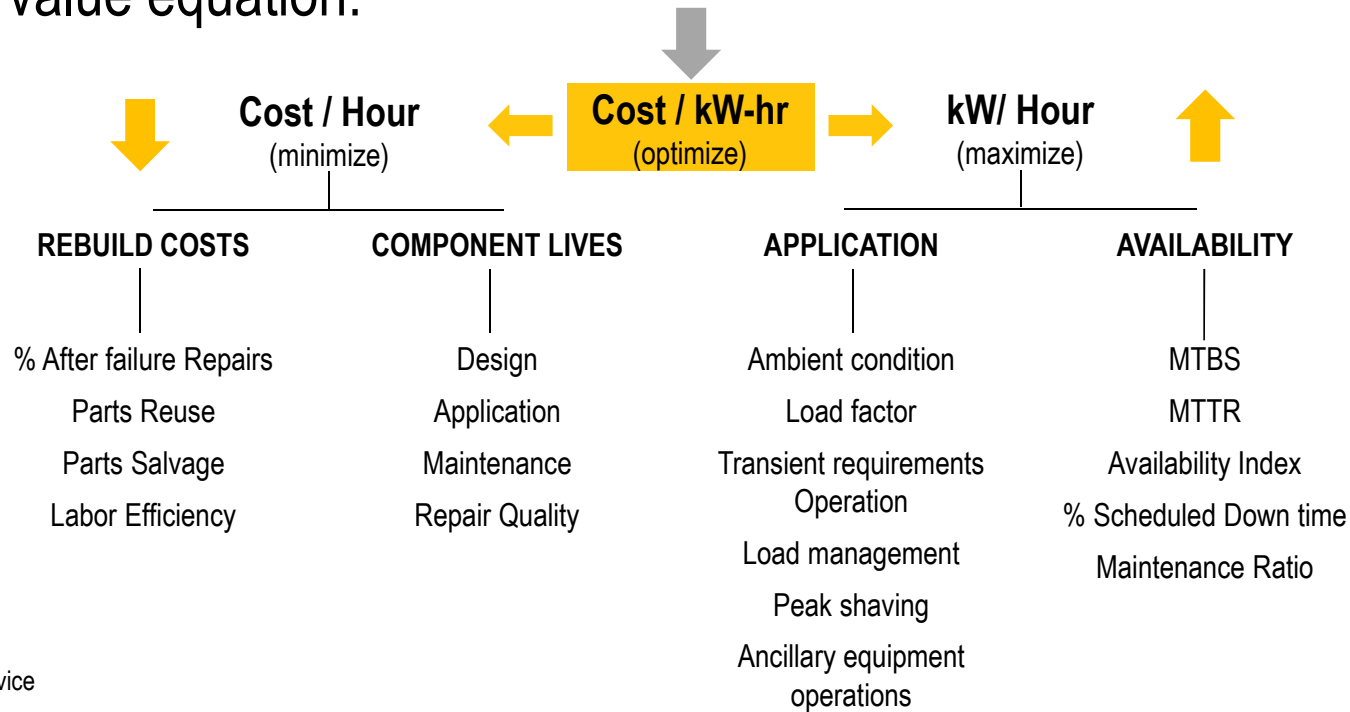
Agenda

- Caterpillar Proposition - Value-in-Use
 - Relationship based business model, with the largest Dealer network providing services closely coupled to customer use of the product
- Uptime (Availability) is a Key to Customer Intimacy
 - Customer productivity is the engine for our growth
- Lean Value Stream Creation
 - Controlling dependability costs in cost-effective manner is the key to overall success

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Factors Ensuring Equipment Up-Time

Customer value equation:



MTBS – mean time between service

MTTR – mean time to repair

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Operating Costs Typically expressed in \$cents/ekW-hr or \$/hr

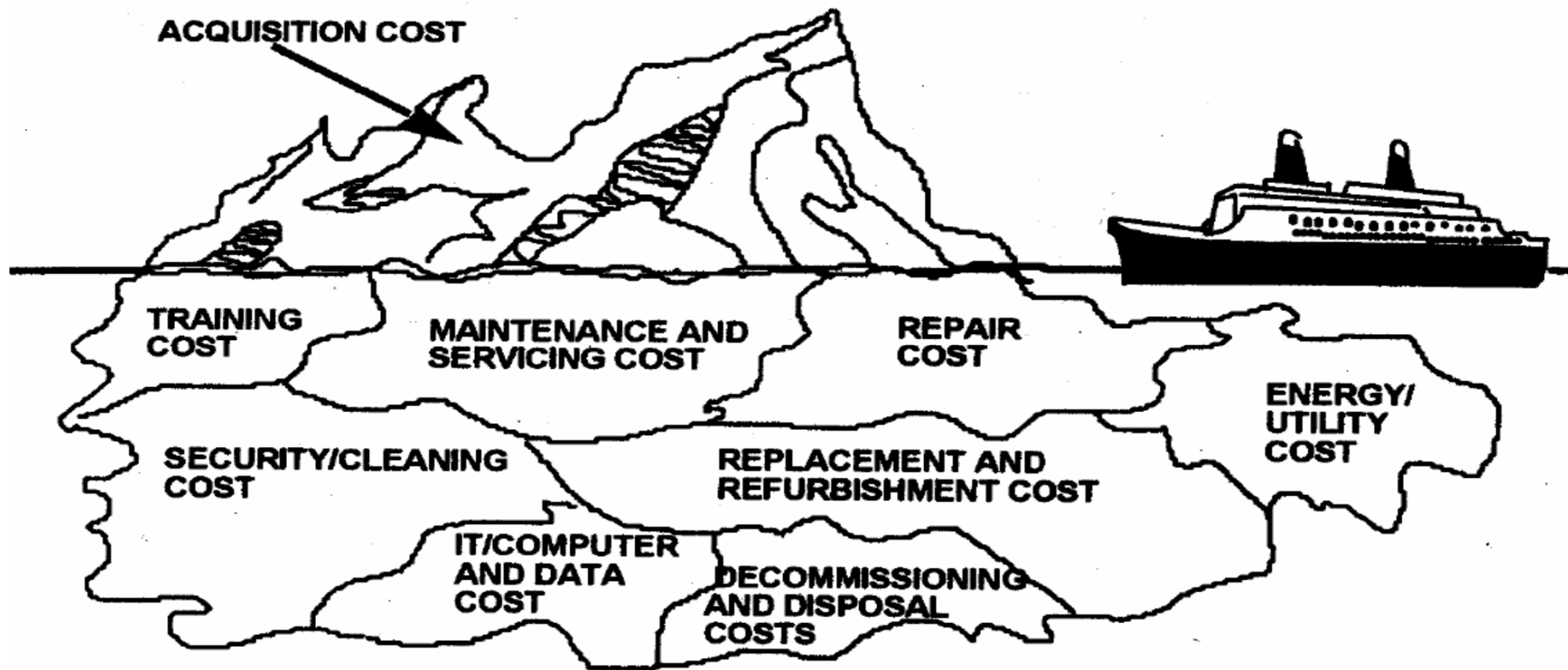
For Power generating equipment:

- Fuel
 - Fuel consumption is the major portion of non-Standby O&O costs for power applications, whereas capital cost is the primary concern for backup generators
- Fluids
 - Oil, coolants, fluids analysis program
- Scheduled preventive maintenance
 - Filters
 - Parts



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Running the Power Station: Costs, Costs, Costs

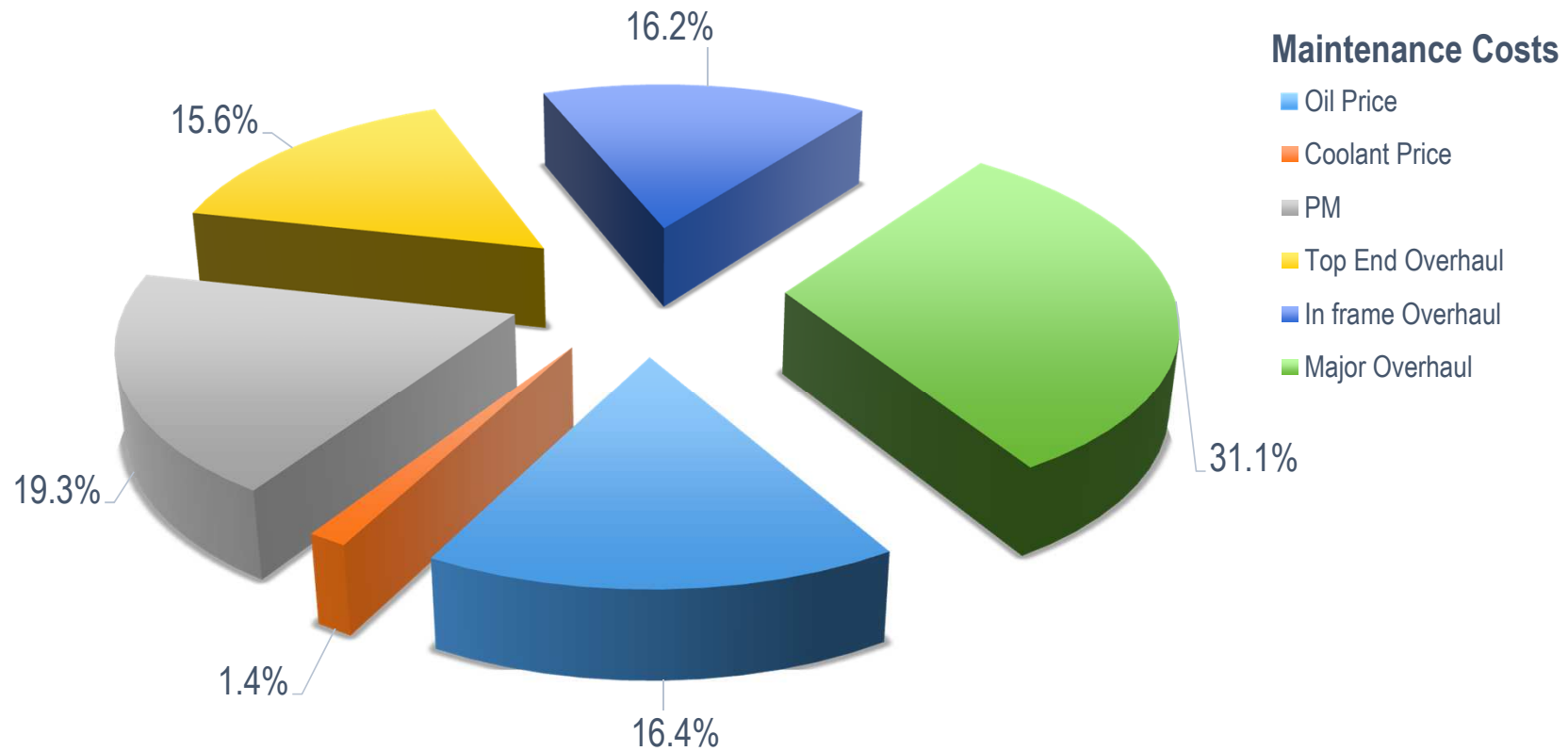


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What is needed to assess the Product Life Cycle Cost (LCC)?

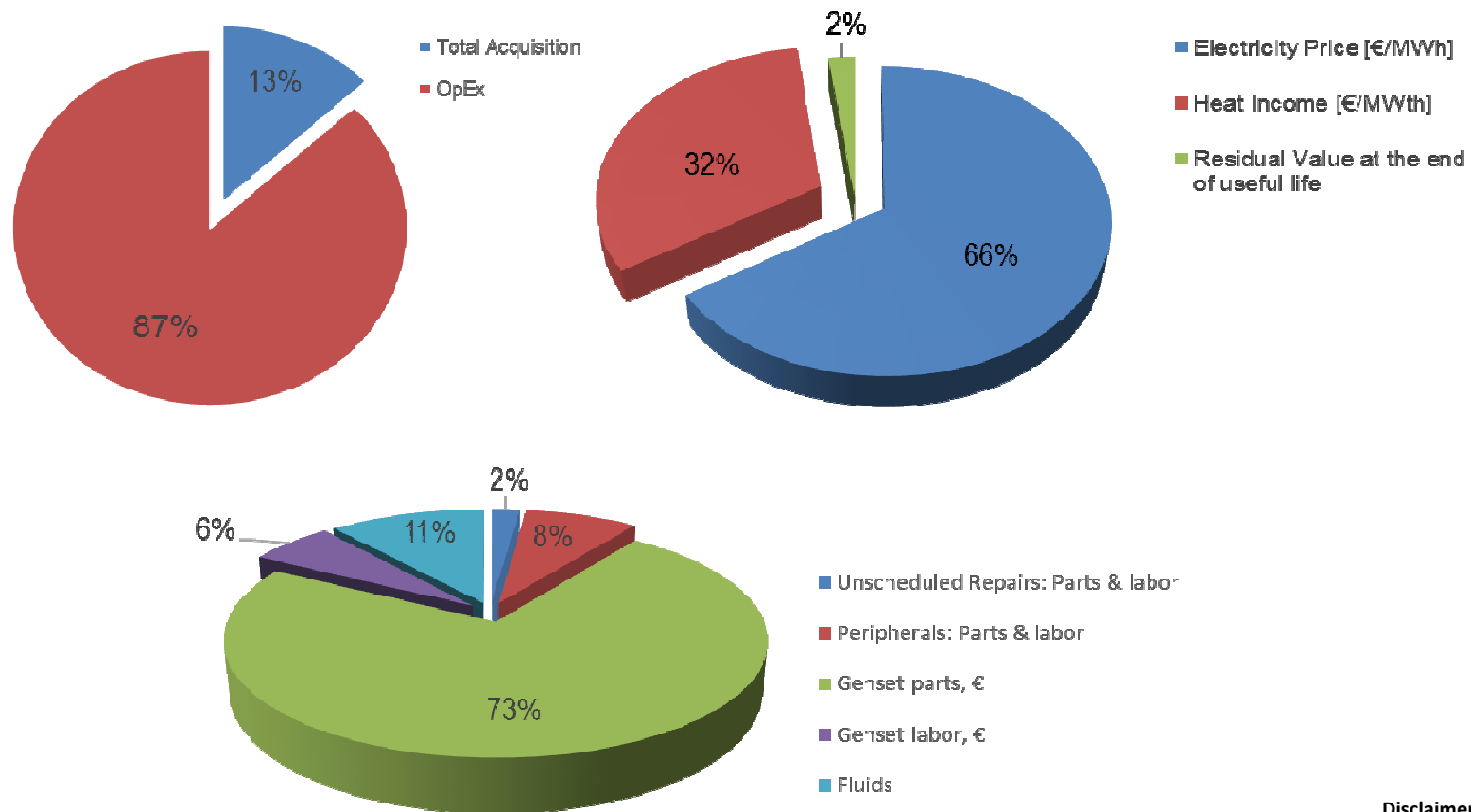
- Finance
 - CapEx summary
 - Cost Of Money
 - Annual Inflation Rates: Fuel, Parts, Fluids, Labour
 - Cash flow analysis
- Admin
 - Country
 - Contract Years
 - Risk assessment
- Product
 - Model, application, scope of supply (including balance of plant)
 - Expected annual running time
 - Maintenance schedules & repair estimates
 - Assumptions & contingencies
 - Manpower estimates
 - Lube Mean SOC and expected drain interval

G3520H Cont. @ 2500 ekW / 50 Hz, CHP, Europe



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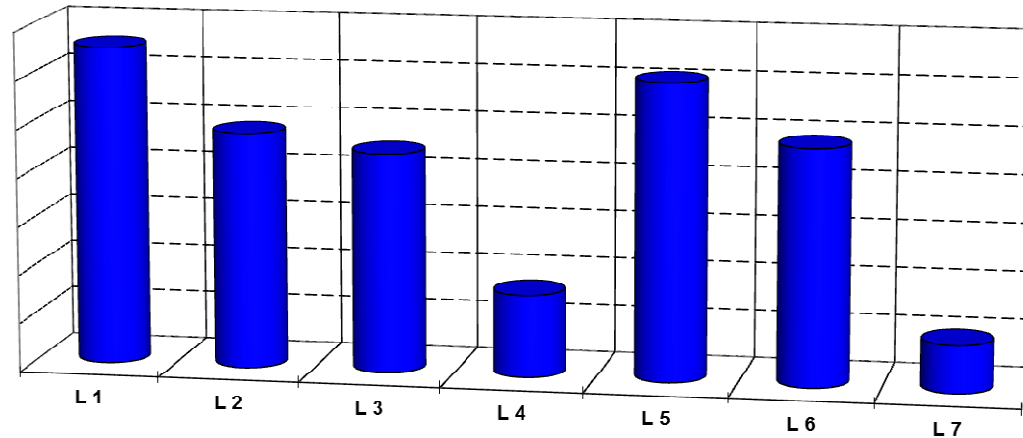
Net Present Value Example, CG260-16 genset



Disclaimer: for graphical purposes only.

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Service Contract offering: Tailored to the customer needs

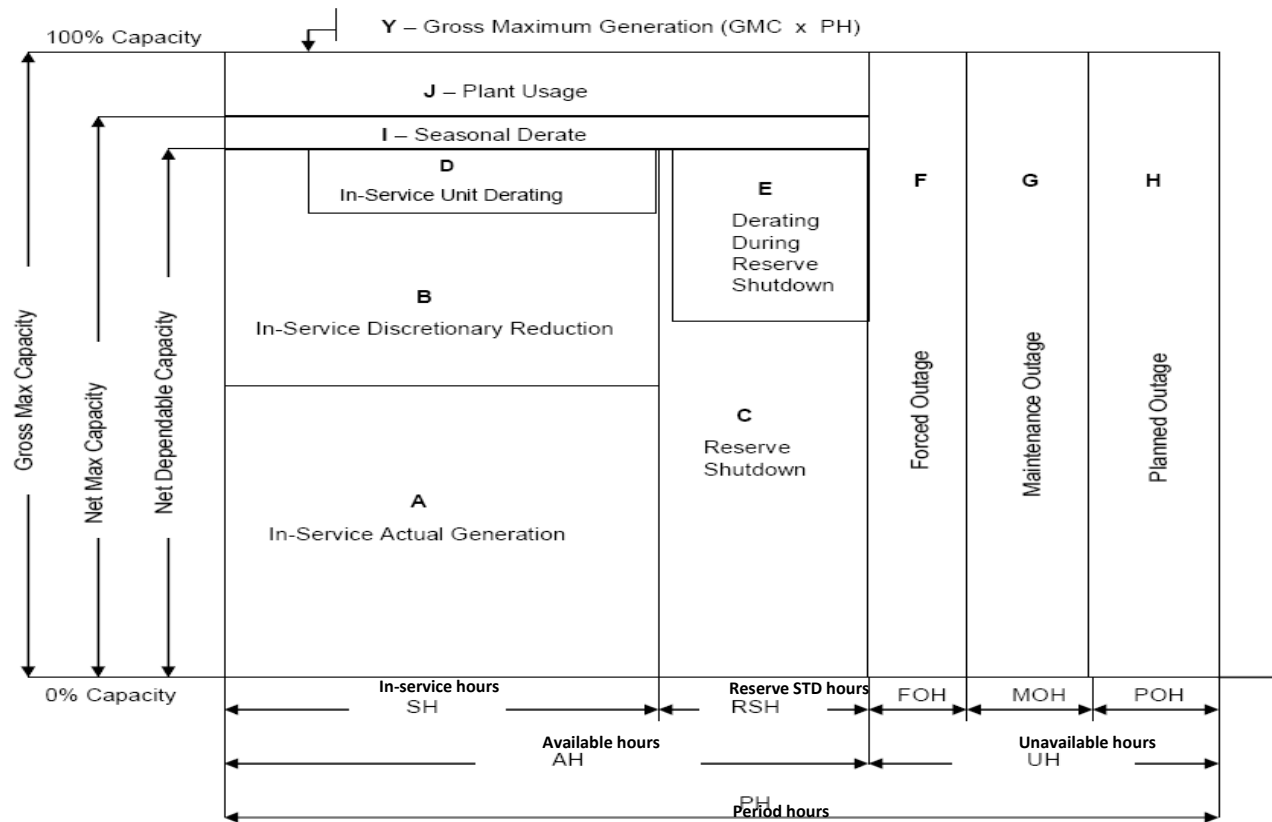


Disclaimer: for graphical purposes only.

- L1 – Full M & R Service contract with all unexpected maintenance and oil cost included , 60000 SMU / 6,000 SMU annually
- L2 – Same as L1 , without last Major overhaul.
- L3 – M & R Service contract for core engine only (with Major overhaul).
- L4 – Major Overhaul only estimate
- L5 – M & R Service contract like L1 for complete Genset without cogeneration and peripheral equipment services.
- L6 – Same as L1 without lube oil & unscheduled provisions.
- L7 – just oil supply services

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Understanding timeline – maximizing capacity usage



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IEEE Std 762-2006 - IEEE Standard Definitions for Use in Reporting Electric Generating Unit Reliability, Availability, and Productivity

	Year 1	Year 2	Year 5	Year 10	Year 12
9,73 ekW rated Genset					
Total PM downtime	395	844	2136	4377	5274
Total Repair downtime	0	928	1993	5086	5908
Averaged yearly Available op time	8365	7874	7934	7814	7828
4,30 ekW rated Genset					
Total PM downtime	56	106	413	819	919
Total Repair downtime	0	0	674	1415	1415
Averaged yearly Available op time	8704	8707	8543	8537	8566

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Loss of production: Maintenance downtime impact

	@ 8 hrs / 5 days workweek				
# of years	3x units @ 9,730 ekW		Loss of Generation income based on theoretical availability	7x units @ 4,300 ekW	
	Cost of downtime for 3 engines	cumulative downtime per engine		Cost of downtime for 7 engines	cumulative downtime per engine
1	€ 532,590	395 hrs	€ 356,552	€ 176,038	56 hrs
2	€ 2,386,814	1,772 hrs	€ 2,053,599	€ 333,215	106 hrs
3	€ 2,990,807	2,220 hrs	€ 2,112,188	€ 878,619	280 hrs
4	€ 5,029,602	3,733 hrs	€ 3,993,806	€ 1,035,796	330 hrs
5	€ 5,562,192	4,129 hrs	€ 2,146,737	€ 3,415,455	1,087 hrs
6	€ 7,487,819	5,558 hrs	€ 3,915,187	€ 3,572,631	1,137 hrs
7	€ 8,020,409	5,953 hrs	€ 4,290,601	€ 3,729,808	1,187 hrs
8	€ 10,290,927	7,639 hrs	€ 6,015,715	€ 4,275,212	1,360 hrs
9	€ 10,894,921	8,087 hrs	€ 6,462,531	€ 4,432,389	1,410 hrs
10	€ 12,749,144	9,463 hrs	€ 5,726,479	€ 7,022,665	2,234 hrs
11	€ 13,281,734	9,859 hrs	€ 6,101,893	€ 7,179,842	2,284 hrs

Comparing repair and maintenance schedules from different OEM

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Risk is neither created nor destroyed. Only transferred.

First Law of Customer Support Agreements Entropy

- **Contract Factors**
 - Availability guarantees
 - Redundancy
 - Staffing levels
- **Commercial**
 - Margin & Liquidated Damages
 - Contract Term
 - Customer / Service Provider Financial Stability
 - Contract Scope
- **External**
 - Ambient Conditions
 - Air & Fuel Quality
 - Site Access
 - Environmental Compliance
 - Parts Logistics & Customs Clearing
 - Statutory Restrictions & overall Industry Financial Health
- **Equipment**
 - Product Reliability
 - BOP Complexity
 - Plant Engineering & Construction Quality
 - Critical Spares & On-Site Tools
 - Plant Condition
- **Operations**
 - Application
 - Redundancy
 - Operating Regime
 - Load Duty
 - Run Hrs
 - Number of Starts
- **Service Provider**
 - Operation Expertise
 - Field Response Capability

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Excel in turning theory into action plan!



“Another flaw in the human character is that everybody wants to build and nobody wants to do maintenance.”
Kurt Vonnegut, Jr. "

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Questions?

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