ABB MEASUREMENT & ANALYTICS | ARTICLE

PGC1000 vs. Classic gas chromatographs

Cost-savings comparison

A quantifiable cost-savings comparison of gas chromatographs

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The PGC1000 is ideal for measuring light hydrocarbon gases in locations where minimal space is available and a simple, reliable, low cost measurement is required.

The PGC1000 is a compact gas chromatograph (GC) which measures C1 through C9+, inert gases and H2S in hydrocarbon processing streams. The PGC1000 needs no shelter, no instrument air and requires reduced maintenance and troubleshooting. This document quantifies many of the capital and operational PGC1000 cost-savings when compared to using a classic GC. A 15-year GC product life is assumed in the analysis for select examples.

PGC1000 Cost-savings summary
Introduction

As manufacturing demands increase, regulation tightens and analytical human resources become harder to secure, the need to find viable solutions to plant analytical challenges are intensified.

The purpose of this document is to encourage PGC1000 plant use when operationally feasible in order to maximize operational efficiency and profitability over the product life of the GC. GC product life is expected to be 15 years. A summary of PGC1000 cost-savings are evaluated below.

PGC1000 Cost-savings comparison evaluated
- GC unit cost
- Shelter (including engineering, installation and HVAC utility costs)
- Shipping/transportation (domestic & international)
- Training
- Carrier gas usage
- Cal blend (calibration) gas usage
- Instrument air
- Power consumption
- Maintenance schedule and service rates
- Spare parts

PGC1000 Intangible benefits
The PGC1000 also provides significant intangible operational benefits. These intangible benefits offer customers value through convenience, flexibility, enhanced quality and time-savings. They include:
- Reduced spare parts inventory management.
- Labor flexibility, increasing the number of analyzers a tech supports with simpler training, servicing & troubleshooting.
- A reduced GC footprint for greater plant design alternatives.
- Mitigated environmental impact with the solar power option.
- Pre-defined (repeated) and pre-tested PGC1000 applications, providing consistent performance from unit to unit.
- Standardized and cost-effective sample handling systems four options). Custom sample handling systems are still much lower.

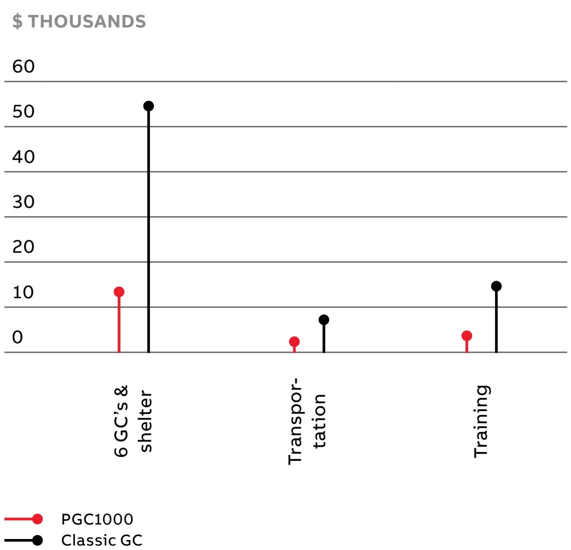
PGC1000 Early startup revenue impact
During a Greenfield plant GC startup and commissioning period, because the PGC1000 does not require a shelter, the customer can be operating two weeks sooner than with a classic GC. It takes 3 weeks on average to install and commission a classic GC. The PGC1000 takes one week or less to install and commission. This translates into 2 weeks of added revenue during the first year. For an 800,000 tons/yr. new ethylene plant, two weeks of additional operation can mean $34.9 million in ethylene product. Existing plant revenue is considerably less, but is still impacted by greater efficiency.

It should be noted, while the PGC1000 offers process customers enormous operational savings, the application scope is more limited than classic GCs. This is many times due to the PGC1000's operating range of 0° to 131°F. To expand the operating environment beyond this, a Sun Shade would be needed for higher temperatures and an environment enclosure for colder temperatures (down to -40°F). Both solutions add approximately $4,500 per PGC1000 unit.

PGC1000 cost-savings (capital and operational) when compared to a classic gas chromatograph (GC)

A classic GC is one where valves, detectors and ovens are separate, instrument air is required, and a shelter is needed.

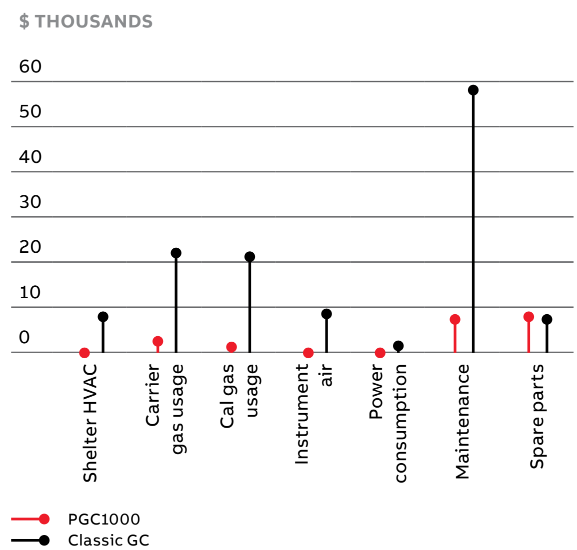
Capital cost-savings



Parameter	6 PGC1000 Cost-savings
6 GC units & shelter	$412,300
Transportation to China	$6,684
Training (2 persons)	$12,400
Total savings	**$431,384**

Note 01
Note 02

Operational cost-savings



Parameter	Annual PGC1000 Cost-savings for 6 units
Shelter HVAC utility	$8,400
Carrier gas usage	$21,000
Calibration gas usage	$19,380
Instrument air	$9,461
Power consumption	$2,064
Maintenance	$50,400
Spare parts	-($759)
Total savings	**$109,946**

Note 03
Note 04
Note 05

In addition, there is an expected plant revenue generation the first year. This is derived from 2 additional weeks of product due to earlier GC startup. For a Greenfield 800,000 ton ethylene plant, it equates to generating $34.9 million more revenue in year one. One could expect more limited revenue gain from an existing operation. However, a 10% efficiency gain is $3.5 million. See summarized chart (below).

PGC1000 Early startup financial impact for Greenfield plants
800,000 ton/yr. = 725,748 metric ton/yr. plant
725,748 ethylene ton/yr. /365 days = 1,988 ethylene ton/day
1,988 ethylene ton/day x $1,252/ethylene ton = $2,489,415/day
2 weeks = 14 days
$2,489,415 x 14 = $34,851,810 ($34.9M) for 2 weeks

Note 06

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01 6 GCs & shelter costs have been reduced in the graphic by a factor of 10 to fit all categories.
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02 Table is the GC type costs difference. Graphic shows the raw numbers for 6 GCs for each category.
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03 Over a 15-year product life, this number grows to $1.68 million.
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04 PGC1000 spare parts are more expensive because of the product's modularity. For example, the GCM is one part and includes the columns, valves and pressure regulators.
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05 Table is the costs difference. Graphic shows the raw numbers for 6 GCs for each category.
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06 An existing ethylene plant throughput efficiency improvement of 10% for 2 weeks = $3.5M

Capital equipment costs

The detailed capital equipment costs comparisons for a project which entails 6 classic GCs and 6 PGC1000s, are below. The project size of 6 GCs was selected to reflect the use of a mid-size shelter. Capital costs are the initial (one-time) expenditures to purchase and install a process GC.

GC unit & shelter costs (Example is for 6 GC units)

Unit costs	Classic GC	PGC1000
Average unit cost	$50,000 x 6 = $300,000	$20,000 x 6 = $120,000
Shelter	10' x 16' shelter @ $500 sq. ft. = $80,000	$0
Sample transport	6 x $5000/each GC = $30,000	$0
Sample system	6 x $10,000/each GC = $60,000	6 x $1,700 = $10,200
Installation & commissioning	$300,000 x 15% = $45,000	$2,500 x 6 = $15,000
Engineering costs	$300,000 x 15% = $45,000	$0
Total cost	$560,000	$147,700
PGC1000 Savings	**$412,300**	

*PGC1000 operating range is 0 to 131F. To expand the operating environment beyond this, a Sun Shade would be needed for higher temperatures and an environment enclosure for colder temperatures (to -40F). Both solutions (sun shade and environmental enclosure) would add approximately $4,500 per PGC1000. This would translate into an additional $27,000 for the example above. The PGC1000 solution savings would be reduced from $412,000 to $385,000.
Note 07

Transportation costs (Example is for 6 GC units)

Transportation costs	Houston, TX	Beijing, China
PGC1000	6 x $86 = $516	6 x $333 = $1,998
Classic GC	6 x $644 = $3,864	6 x $1,447 = $8,682
PGC1000 Savings	**$3,348 ($558/unit)**	**$6,684 ($1,114/unit)**

Note 08

Training costs

Training*	Classic GC	PGC1000
Basic GC training class (Level 1)	$2,000 per participant	$1,000 per participant
Advanced GC training class (Level 2)	$2,000 per participant	$1,000 per participant
Maxum II Analyzer Network	$2,000 per participant	$0
Maxum MaxBasic Programming	$2,200 per participant	$0
Total	$8,200 per participant	$2,000 per participant
PGC1000 Savings	**$6,200 per participant**	
Two technicians trained	**$12,400**	

Note 09

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07 The sample transport and sample system cost estimates for classic GCs, were sourced from JJ Gunnell, ExxonMobil Chemical Company's white paper titled, "Process Analytical Systems: A Vision for the Future." The white paper was presented at the fourteenth annual IFPAC Conference. Installation costs are at 15% of the project based on an article in Hydrocarbon Processing magazine, "Process Gas Chromatography: Avoid the Iceberg of Hidden Expenses," that estimated classic GC installation costs are between 15-20% of a project. Project engineering costs related to the shelter are at 15-18%. 15% was chosen for the above example. Engineering costs involve bringing a physical structure (shelter) to an industrial plant.
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08 Transportation costs for the classic GC include crating to protect the unit. Given the size and weight of the PGC1000 unit, crating is not required. For the shipping costs comparison above, the domestic and international destination points originate from Bartlesville, OK.
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09 Unlike most classic GCs, the PGC1000 does not require additional training for networking and software programming. The product is simple enough that these topics are covered in basic and advanced PGC1000 training courses. This results in half the training cost for GC training.

Early startup revenue impact

10 An existing ethylene plant throughput efficiency improvement of 10% for 2 weeks = $3.5M

While many plants focus on product cost and the associated installation, timing of the installation can be equally important. A faster installation can have a significant impact on the bottom-line. For example, a typical ethylene plant produces 725,748 metric tons (800,000 tons) per year. Platt Global Petrochemical Index (PGPI) price for ethylene in November 2012 was $1,252 per metric ton. The chart below shows the financial impact of enabling a plant to analyze and ship ethylene product in 1 week versus 3 weeks (2 weeks earlier).

PGC1000 Early startup financial impact for Greenfield plants
800,000 ton/yr. = 725,748 metric ton/yr. plant
725,748 ethylene metric ton/yr. /365 days/yr. = 1,988 ethylene metric ton/day
1,988 ethylene metric ton/day x $1,252/ethylene metric ton = $2,489,415/day
2 weeks = 14 days
$2,489,415 x 14 = **$34,851,810 ($34.9M) for 2 weeks**

Note 10

Operational costs

11 The shelter HVAC utility bill estimate is provided by a large petrochemical company. Monthly utility costs are $400 - $1,000. A median number of $700/mo. was chosen to reflect a mid-size shelter. “Avoid the Icebag of Hidden Expenses” article notes instrument air is $0.80/1,000 scf. Instrument air requirements should go up for FID and FPD applications.

12 A classic GC helium bottle is expected to be changed out every six weeks. This equates to 8 bottles a year.

Operational costs are on-going and extend to the life of the product. Most GCs can expect a product life of 15 years. The annual operational costs are multiplied by this amount to obtain the total operational costs over the life of the GC.

Operational costs (Example is for 6 GC units)

Annual operating expense	Classic GC	PGC1000	Operating difference
Shelter HVAC monthly*	$700 x 12 = $8,400	$0	S8,400
Carrier gas usage**	8 helium bottles (300 size) per GC each year at $500/bottle = $4,000 ; 6 GCs x $4,000 = $24,000	1 helium bottle (300 size) per GC each year = $500 6 GCs x $500 = $3,000	$21,000
Calibration gas usage	Size 300 cal blend bottle every 4 months at $1,200 per bottle = $3,600/yr. per GC 6 GCs x $3,600 =$21,600	Size 48 cal blend bottle once a year at $370 per bottle = $370/yr 6 GCs x $370 = $2,220	$19,380
Instrument air*	1,000 scf = 28,317 L $0.80/28,317 L x 100 L/min = $0.003 $0.003/min x 1440 min/day x 365 days = $1,577 per GC x 6 = $9,461	$0	$9,461
Power consumption	GC uses 500 watts @ steady state 0.5 kw x 8760 hr/yr x$0.08kwh = $350 per GC $350/GC x 6 = $2,100	GC uses 8 watts @ steady state 0.008 kw x 8760 hr/yr x$0.08kwh = $6 per GC $6/GC x 6 = $36	$2,064
Maintenance***	12 service calls x 4 hrs./call = 48 hrs 48 hrs./yr x $200/hr. = $9,600 yr/GC 6 GCs x $9,600 yr/GC = $57,600	4 service calls x 2 hrs./call = 8 hrs 8 hrs./yr x $150/hr. = $1,200 yr/GC 6 GCs x $1,000 yr/GC = $7,200	$50,400
Spare parts	**$1,200 x 6 = $7,200**	**$7,959**	
Annual total	**$130,361**	**$20,415**	**$109,946**
Savings on 15yr. GC product life	**15 x $130,361 = $1.96M**	**15 x $20,415= $306K**	**$1.65 M**

Note 11
Note 12

Operational costs continued

Maintenance costs

Maintenance	Classic GC	PGC1000
Maintenance schedule	Monthly	Quarterly
Average time spent servicing unit	4 hours	2 hours
Service rate	$200/hr	$125/hr

Note 13
Note 14

Spare parts

Spare parts costs over the life of the analyzer can be considerable for the classic GCs: Assuming the 6 PGC1000s are the same application, it is recommended to hold $7,959 in spare parts to support one year of service requirements. A customer can expect to incur on average $1,200 annually for spare parts per classic GC. For 6 classic GCs this comes to $7200. For spare parts, the largest cost-savings is the use of simplified PGC1000 spare parts to reduce maintenance downtime and troubleshooting.

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13 Instrument air is needed for air bath heated classic GCs. Cost for instrument air is on average $0.80/1,000 scf. The usage rate falls within the usage rate of the top classic GCs. Example above uses 100 L/min.

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14 A monthly maintenance schedule for classic GCs is highly recommended for FID and FPD applications. Conv. monthly TCD maintenance is typically recommended, but is optional. Tech travel expenses for more frequent visits should also be considered.*PGC1000 operating range is 0 to 131F. To expand the operating environment beyond this, a Sun Shade would be needed for higher temperatures and an environment enclosure for colder temperatures (to -40F). Both solutions (sun shade and environmental enclosure) would add approximately $4,500 per PGC1000. This would translate into an additional $27,000 for the example above. The PGC1000 solution savings would be reduced from $412,000 to $385,000.

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Maintenance schedule and service rates
Greg Smith, ABB Service Manager and Michael Roecker, ABB Lead Chemist

Spare parts
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