

# MTG: ECONOMIC BENEFITS

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## HIGHER ACCURACY IN STATIC AND DYNAMIC MEASUREMENTS

1. MTG system has unique mass and volume accuracy. The instrumental accuracy of the MTG is within 0.05...0.1%. MTG in situ auto-calibration capabilities make it even more accurate with every tank cycle. In real tank situations the MTG transaction accuracy is only limited by the accuracy of a tank strapping table. MTG has passed OIML R-125 standard test in NMI (Netherland)
  
2. The MTG principle of operation assures that uncertainty on level, temperature and density does not affect the final mass accuracy, though the MTG does provide high accuracy for all abovementioned measurements.
  
3. MTG is normally installed on the same datum place that is used for the manual hand gauging. The measurements are taken from the bottom (true INNAGE measurements). The slipping flange of the MTG makes it unaffected by the roof movement.
  
4. MTG measures mass and volumetric water percentage in product in the tank (doesn't matter whether water is free or highly emulsified). This is done in both static and dynamic situations in the tank.
  
5. MTG requires only a single point of tank penetration on the tank roof with or without stilling well

NONE of the above is possible with any traditional methods, such as Radar, Servo or Magnetostrictive gauges, or any other gauges where the ullage level measurements are used as explained below:

- All Radar, Servo or other gauges calculate level as a difference between a stored fixed value of a tank reference height and the measured distance from the point of installation on the roof to the liquid surface. This is called OUTAGE or ULLAGE method. However, the problem is that the reference height is not a constant value. The standard regulating the custody transfer and inventory control manual gauging (API 3.1A) requires measurement of the reference height before any manual Ullage measurement. In other words when measuring liquid level as a distance from the reference point to the liquid level with a gauging tape it is required to measure the reference height first and use only MEASURED and not fixed value of the reference height for INNAGE calculations. Unfortunately, this is not what is happening with Automatic Tank Gauges such as Radar, Servo, etc. These systems use fixed value for the Reference Height making uncertainty and instability of the real reference height a direct component of their measurement error.
- All Radar, Servo- and other ullage gauges cannot compensate for instability of the roof or the bottom at the point of measurement
- Separate Density measurement is required in any above traditional ullage methods for product Mass calculations and for product quality assessment. But density measurements are problematic in such systems:

Hybrid systems use pressure sensors mounted on the side wall of a tank for average density calculations. These sensors are subject to influences by ambient temperature and pressure changes, wind, temperature gradient over the pressure sensor assembly body from ambient to product temperature at the diaphragm, changes of diaphragm position due to tank bulging and others.

The usage of displacer weight in Servo-measurements provides very limited accuracy for density measurements in real tank situations

If a density measurement involves a vibration sensor then the density is measured in a very small volume. Such measurement cannot provide average density or density profile in the tank leading to significant errors in mass determination and insufficient information for quality assessment.

It must be taken into account that not only the density but also the temperature at which it is taken should be measured and then those readings should be extrapolated to the full volume of the tank for mass calculations (Note the MTG has no influence of temperature in Mass calculations)

All above factors are leading to accuracy degradation and are typical for hybrid systems based on primary level measurements. However, these factors have no effect on the MTG technology. As a result, MTG has significant accuracy advantage for mass and volume measurements as compared to any alternative methods.

Below table illustrates the economic benefit of accuracy improvement by just 0.1% for a terminal with a throughput of 50 million barrel.

<b>Throughput millions BBI</b>	<b>50</b>
<b>Price per BBI</b>	<b>\$60.00</b>
<b>Accuracy improvement</b>	<b>0.10%</b>
<b>Economical benefit in 12 months</b>	<b>\$3,000,000.00</b>

*The above example of economic benefit is given for an average terminal of 10-15 tanks (MTG systems) assuming only 0.1% of accuracy increase*

***The actual accuracy advantage of MTG as compared to alternative systems is higher than 0.1% with corresponding increase of economic benefits. The detailed analysis and comparison of accuracy are available based on manufacturers' literature and specifications for Radar and Servo hybrid systems vs. the MTG system***

An exceptional MTG advantage is found with mass measurements, which are of poor accuracy in any alternative technology

Note that mass measurements are in fact mandatory for liquid products in multiple countries.

Mass accounting is used worldwide for chemical and lubricant products.

Some major Oil companies such as Total switch to mass accounting and mass balance in their operations.

Mass is the most important parameter in some niche markets such as airplane fueling systems

## ECONOMIC BENEFITS UNIQUE TO MTG TECHNOLOGY

### OPTIMIZATION OF WATER SEPARATION AND TANK USAGE EFFICIENCY

The MTG system allows real-time monitoring of water separation process in any settling tank or a water separation tank. This includes such unique parameters as water content percentage in layers and above sensor positions. The water can be in free or emulsified phases or mixture of both. There is no existing system that can provide this kind of information, which allows to optimize tanks usage, demulsifies usage and total plant operation with huge economic benefits

### REAL TIME QUALITY MONITORING

The real time MTG density monitoring allows for a few crucial benefits:

- a) Optimization of crude mixing and benchmark crude preparation  
The tanks used for mixing of different crudes to a target specification becomes much easier and faster with the MTG provided multilayer and average density and temperature information in real time
- b) Prevention of routing errors  
MTG allows to detect if a wrong product with a different density is being fed into a tank, preventing product contamination and losses

### LEAK DETECTION AND UNAUTHORIZED MOVEMENT PREVENTION

The MTG mass accuracy provides the capability of leak detection and even small unauthorized movement detection, which in turn translates in benefits of environmental protection and theft prevention. The economic benefits of early leak detection can help prevent losses of millions of dollars in fines and remediation.

### CAPITAL ASSETS PROTECTION AND RUPTURE PREVENTION

The MTG gives an option of continuous monitoring of pressure under the roof. Use of the MTG technology has warned and thus prevented of tank roof rupture with vacuum buildup during fast liquid transfer and malfunctioned pressure relief valve.

MTG can even allow analysis of the pressure relief valve performance

## EMISSION CALCULATIONS AND GAS BLANKETING MONITORING

The MTG is the only gauge providing all necessary measurements for emission calculations as well as inert gas blanketing monitoring - thus providing tank operators with process optimization capabilities and environmental protection

## MASS BALANCE VS A FLOWMETER OR A SCALE

Significant losses could be incurred when a pipeline flowmeter has a slightly shifted accuracy curve while formally within stated calibration accuracy. This could lead to thousands of tons of unaccounted product. However, MTG installed on multiple tanks of a terminal can provide a vital statistic to compare with flowmeter to keep the product balance in check. Multiple independent MTG gauges with their unique accuracy will never statistically match the flowmeter with systematic error - thus giving an advance notice to the tank operators to check the flowmeter.

The same applies to applications which use truck scales or railway scales for custody transfers.

Due to extreme mass accuracy MTG can control losses resulting from inaccuracy of flowmeters Below is an example of savings that MTG could bring during Mass balance control in transactions					
				Cost per barrel	\$60.00
		Bbl.	Flowmeter systematic error	Product accounting error, Bbls	Cost of inaccuracy
Daily movement (about one tank a day)		30000.00	0.10%	30.00	\$1,800.00
Monthly movement		900000.00		900.00	\$54,000.00
Estimation for:	12	Months		10800	\$648,000.00

***The cost per barrel can reach hundreds of dollars for refined and chemical products correspondingly increasing the economic benefits of MTG use.***

***An increase of mass balancing accuracy alone can pay for the terminal automation with the MTG systems in a period of a few weeks.***

The MTG offers perfect mass balance opportunity vs. modern Coriolis flowmeters and mass scales unavailable with any alternative systems.

## SAVINGS ON STILLING WELLS INSTALLATIONS AND TANK OUT-OF-OPERATION TIME

Both Radar and Servo gauges require an installation of a slotted stilling well to perform accurately.

The modern safety and environment protection standards such as API 2350 require full gauge redundancy. Some Radar gauges only offer partial redundancy (with shared antenna), but none of Radar or Servo system provide full redundancy without secondary level gauge installation.

However, many cone roof tanks have no stilling well while many floating roof tanks have only a single stilling (gauge) well.

Therefore, installation of a Radar or a Servo gauge in many cases require an installation of a new stilling well, which in turn involves taking tank out of operation, degassing, cleaning etc. The associated expenses amount over hundred thousand dollars per tank and should be added to any cost calculations related to the gauging system installation.

The MTG allows two completely and fully redundant gauges installed in a single stilling well, using single flange opening on the roof for a floating roof tank or completely without a stilling well in a cone roof tank. This brings significant savings for tank operators.

## CONCLUSIONS

The MTG system can provide very significant economic benefits and fast recoupment time due to the unique set of its characteristics unavailable in any other tank gauging technology:

1. Extremely high mass and volume accuracy, leading to much more accurate product accounting
2. Optimization of tank usage and effectiveness of technological processes in cases of water settling and separation
3. Real time product quality monitoring, optimization of mixing, prevention of product contamination
4. Environmental protection and theft prevention - mass leak detection capabilities can save millions in potential fines and remediation
5. Emission monitoring and gas blanketing monitoring - allows to optimize processes and comply with regulations
6. Capital asset protection - allows to monitor pressure/vacuum build-up under the roof and warn against possible tank roof rupture - saving millions
7. Masse balance vs. flowmeter or scale. MTG provides capability to avoid losses due to small inaccuracies in flowmeters and or truck or rail scales, which lead to serious savings over time
8. No requirements of stilling well - significant savings in installation costs compared to other technologies all requiring stilling wells

All above is done with a single gauge installed in a single opening on a tank with no moving parts and virtually maintenance free.