
# Evaluating the Capacity of Ontario Municipal Sludge Digesters to Process Off-site Organics

**Prepared by**

**Dr. Chao Jin and Dr. Wayne Parker**

**Civil and Environmental Engineering**

**University of Waterloo**

**For**

**Southern Ontario Water Consortium**

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## Executive Summary

This project estimated the current and potential capacity of existing digesters at WWTPs in Ontario to accept off-site organics. Information on the current AD processes was collected from Environmental Compliance Approval (ECA) documents and published annual reports and through direct approaches made to individual municipalities. The gathered information on digester volumes and capacities is categorized by the number of implementations and scale of digestion capacity. Geographic distributions of the current maximum capacities are categorized according to MPAC regions.

The results of the study reveal

I) the total volume of primary digesters is approximately $6.4*10^5$ $m^3$ while the total volume of secondary digesters is approximately $1.7*10^5$ $m^3$.

II) the total design digestion capacity in Ontario is approximately $3.7*10^5$ Tonnes VS/year. This capacity could increase to $4.7*10^5$ and $4.8*10^5$ Tonnes VS/year if secondary digesters were upgraded or innovative pretreatment technologies were implemented respectively.

III) a majority of the anaerobic digestion capacity is present in relatively few large municipalities; plants with digesters smaller than 1000 $m^3$ contribute a relatively small fraction of the overall digestion capacity

IV) at least one WWTP with an AD process exists in each MPAC region; around 70% of the MPAC regions (19 out 27) could improve their digestion capacity by more than 30% through either upgrading of secondary digesters or implementing innovative technologies thus may have the potential to accept off-site organics from other sources.

V) A majority of the 44 WWTPs that provided data on current operations do not have significant excess capacity under the current practices; Upgrading of secondary digesters or implementing of innovative technologies would generate substantial excess capacities that follow a similar pattern to that of the digester volumes.

# 1 Project overview

A proposed ban on landfilling organics in Ontario would create a demand for alternative pathways to manage these materials. Anaerobic digestion (AD) at municipal wastewater treatment plants (WWTPs) is one of the possible options to convert these materials into biogas that can be employed as an alternative "green" fuel. However, the capacity of municipal WWTPs in Ontario to accept off-site organics has not been well quantified. This project estimated the current and potential digestion capacity in Ontario and builds upon the work that was conducted in the prior project "Needs Assessment for Biosolids Processing in Ontario".

This report addresses the following objectives:

I. Document the current digesters at WWTPs in Ontario
II. Summarize the current operation of AD digesters
III. Evaluate the excess and potential digestion capacity

Chapter 2 describes the methods that were employed to establish the current status of anaerobic digestion in Ontario. The approach employed to gather data on anaerobic digester volumes, and the quality and quantity of sludges currently being treated is described. Methods that were used to estimate the maximum, current and excess capacity of evaluated WWTPs are introduced. In addition the approach employed to estimate potential additional digestion capacity to accept off-site organics that could be achieved by implementing innovative technologies is described.

Chapter 3 summarizes the current anaerobic digester volumes and capacities (i.e. primary and secondary digesters) in Ontario. The information is categorized by the number of implementations and scale of digestion capacity. Geographic distributions of the current maximum capacities are categorized according to MPAC regions.

Chapter 4 describes the current loading into the anaerobic digesters for the surveyed plants. Excess capacities which are defined as the net difference between design capacity and current loading are calculated for the individual municipalities. A discussion of the potential opportunities of accepting off-site organics within the existing municipal WWTPs is introduced herein.

# 2 Methods

This section documents the methods that were employed to establish the current status of anaerobic digestion in Ontario. Methods of data collection are introduced herein. Specifically, data describing tankage volume, quality and quantity of sludges currently being treated were collected, analyzed and classified by relevant indicators such as digester volume and geographic distribution. In addition, the methods used to determine maximum and excess capacities for current operations and enhanced operations are introduced herein.

## 2.1 Data collection

In the present work, quantitative information on the current AD processes in Ontario was collected from the following sources:

a) ECA documents from the MOECC

b) Published annual reports from WWTPs

c) Direct approaches made to individual municipalities.

ECA documents were collected from the MOECC online database (http://www.gisapplication.lrc.gov.on.ca). ECA documents for WWTPs that were identified as employing AD to stabilize sludge were collected and analyzed. Information on the rated flow rate ($m^3$/day), anaerobic digestion process configuration (one stage/ two stages), volume of the primary and secondary digesters, holding tanks and storage tank ($m^3$) were documented.

Where available, annual reports from individual municipalities that provided quantitative information related to sludge quantity and quality were collected. There is no standard reporting format of these reports in Ontario and hence the information provided by individual municipalities were somewhat inconsistent in nature. Accordingly, the information from the annual reports was used to provide complementary data to that provided by the ECA documents.

A majority of the information describing the current operational status of the AD processes at individual WWTPs was collected directly from individual municipalities and operators (i.e. Ontario Clean Water Agency, OCWA). Specifically, information on flows (wastewater flow to WWTP, $m^3$/day); hydraulic retention time (HRT) of sludge treatment, (days); sludge quantities, $m^3$/day (i.e. primary sludge flow, secondary flow, co-thickened

sludge flow); sludge quality, (g/L of TS and VS in primary and WAS/TWAS sludges) and quantity of biosolids leaving the plant ($m^3$/year) was gathered. The information typically described average values on an annual basis. The variability of the parameters and seasonal trends were not documented as they were mostly not made available. For some municipalities, some information such as tankage volume and status of on-duty digesters differed from the values recorded in the ECA documents. In these cases the information provided by the municipalities was used to reflect the current conditions. For the purposes of this project, the digester volume at a WWTP referred to the total volume of primary (or secondary) digesters that was in some cases contributed by several tanks.

## 2.2 Geographic distribution

To facilitate an evaluation of the potential capacities for off-site organics, the geographic distribution of the WWTPs was recorded. The WWTPs were categorized based on MPAC region for consistency with other waste management studies. Information on population (Statistics Canada, 2016) and the number of WWTPs using AD processes within 27 MPAC regions was gathered. MPAC region codes were employed to be consistent with other province-wide studies that were based on municipal boundaries provided by the province of Ontario (MPAC, 2012). Table 2-1 and Figure 2-1 provide descriptions of each MPAC region.

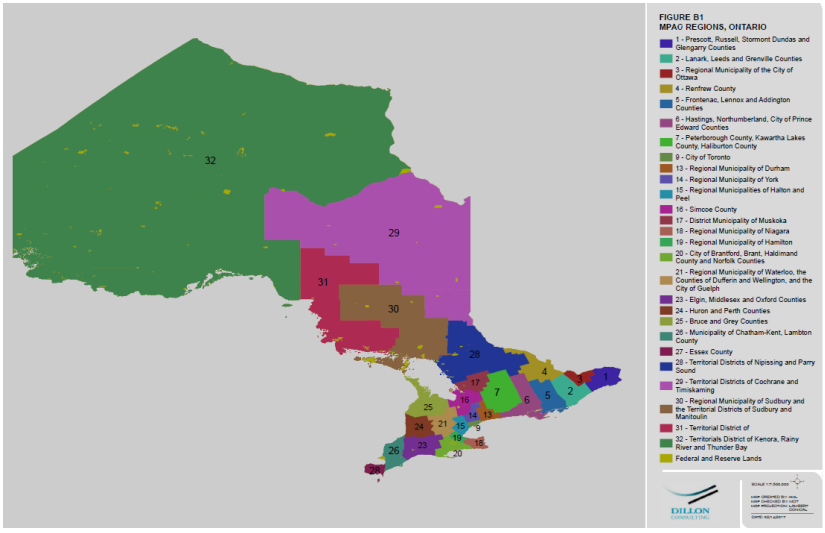


**Figure 2-1. MPAC map of Ontario (MPAC, 2012)**

**Table 2-1. MPAC region code and populations**

| ID | MPAC Region | Total population |
|---|---|---|
| 1 | Prescott, Russel, Stormont Dundas and Glengarry Counties | 202,762 |
| 2 | Lanark, Leeds and Grenville Counties | 169,244 |
| 3 | Regional Municipality of the City of Ottawa | 934,243 |
| 4 | Renfrew County | 102,394 |
| 5 | Frontenac, Lennox and Addington Counties | 193,363 |
| 6 | Hastings, Northumberland, City of Prince Edward Counties | 246,778 |
| 7 | Peterborough County, Kawartha Lakes County | 231,721 |
| 9 | City of Toronto | 2,731,571 |
| 13 | Regional Municipality of Durham | 645,862 |
| 14 | Regional Municipality of York | 1,109,909 |
| 15 | Regional Municipalities of Halton and Peel | 1,930,174 |
| 16 | Simcoe County | 479,650 |
| 17 | District Municipality of Muskoka | 60,599 |
| 18 | Regional Municipality of Niagara | 447,888 |
| 19 | Regional Municipality of Hamilton | 536,917 |
| 20 | City of Brantford, Brant, Haldimand and Norfolk Counties | 244,595 |
| 21 | Regional Municipality of Waterloo, The Counties of Dufferin and | 819,615 |
| 23 | Elgin, Middlesex and Oxford Counties | 655,366 |
| 24 | Huron and Perth Counties | 136,093 |
| 25 | Bruce and Grey Counties | 161,977 |
| 26 | Municipality of Chatham-Kent, Lambton County | 228,680 |
| 27 | Essex County | 398,953 |
| 28 | Territorial Districts of Nipissing and Parry Sound | 125,974 |
| 29 | Territorial Districts of Cochrane and Timiskaming | 111,933 |
| 30 | Regional Municipality of Sudbury and the Territorial Districts of Sudbury | 196,448 |
| 31 | Territorial District of Algoma | 114,094 |
| 32 | Territorial District of Kenora, Rainy River and Thunder Bay | 231,691 |
| | | |
| | Total | 13,448,494 |

## 2.3 Summary of data gathering from WWTPs

A summary of the WWTP dataset that was developed in this project is presented in Table 2-2. Initially, 96 municipal facilities were identified as implementing AD by the MOECC documents. After validation from various sources, 12 of the plants were found to not implement/operate an AD process and thus were excluded from further analysis. Another 8 WWTPs were excluded as the rated wastewater flows were smaller than 1000 $m^3$/day. These facilities were located in plants that were in remote areas or included specific community/industries that were deemed un-likely to accept additional loading of waste from other sources. A total of 26 WWTPs chose not to participate in the study. In total, the effective response of the current operational practices was 63%, (44 out of 70). It is believed that the data collection gathered sufficient information on existing WWTPs using AD process to provide a reasonable assessment of digester loadings in Ontario. Although some facilities did not provide information on the current operational status of their AD process, this only limited the quantification of current loading and excess capacity of anaerobic digestion at these WWTPS. The maximum design capacities, and potential additional capacities that could be obtained by either upgrading secondary digesters into primaries or implementing innovative technologies were calculated for all facilities.

**Table 2-2. Summary of data gathering on WWTPs**

| | Number | Note |
|---|---|---|
| Plants labeled as AD for sludge from MOECC | 96 | Provided by MOECC |
| Plants not operating for Anaerobic Digestion | 12 | Checked with ECA |
| WWTPs with flow <1000 m3/day | 8 | Not included |
| Plants not providing operating data | 26 | - |
| Plants transporting sludge to another facility | 5 | ECA/ annual report |
| Plants providing operating data | 44 | |

## 2.4 Calculations

***Capacities***

Based on the collected information, most of the WWTPs in Ontario employ a two-stage anaerobic digestion configuration. Hence the current maximum digestion capacities were estimated on the basis of a volatile solids (VS) loading of 1.6 kg/$m^3$-day (Equation 1) to the primary digesters as per the MOECC Design Guidelines [MOECC, 2008]. The secondary digesters are commonly designed for liquid solid separation through decanting to provide thickening and thus were not credited in the estimation of the facility capacity.

$$Max\ Capacity = Primary\ Digester\ Volume * 1.6\ kg\ VS/m^3\text{-}day \quad (1)$$

In addition to the estimation of the current maximum current digestion capacity, the potential digestion capacity that might be obtained by upgrading existing secondary digesters was assessed. This assumed that mixing and heating would be added to the secondary digesters and mechanical dewatering would be added for digestate dewatering. On the basis of these assumptions, the additional digestion capacity that could be obtained through secondary digester conversion was estimated using Equation 2.

$$Secondary\ Capacity = Secondary\ Digester\ Volume * 1.6\ kg\ VS/m^3\text{-}day \quad (2)$$

Additional digestion capacity could also be obtained by implementing innovative technologies (i.e. Enzymic hydrolysis, thermal hydrolysis, pretreatment, etc) to enhance/optimize the digestion process was (Bungay and Abdelwahab, 2008; Azman et al, 2015, Pili et al, 2015; Ariunbaatar et al, 2014]. Compared to the traditional AD process, such innovations could reduce the HRT, increase organic loading and enhance pathogen inactivation (Mao et al, 2015; Jain et al, 2015; Mata-Alvarez and Llabres, 2002]. The potential additional capacity that might be created was termed "Innovation Capacity" and was estimated as per Equation 3

$$Innovation\ Capacity = \alpha * Primary\ Digester\ Volume * 1.6\ kg\ VS/m^3\text{-}d \quad (3)$$

Where $\alpha$ is a capacity enhancement factor due to implementation of an innovative technology. In the present work, an α value of 30% was selected based on the feedback obtained from an industrial advisory group and is deemed to be a reasonable estimate of the enhanced performance that might be provided by several commercially available technologies.

***Current Digester Loadings***

The current VS loading to the anaerobic digesters in the individual WWTPs was estimated using Equation 4 based on the average flows (i.e. primary and waste active sludge (WAS)/Thickened wasted active sludge (TWAS) and VS concentration of feed sludge into the primary digester [MOECC, 2008; Burton et al, 2014]. Quantitative information for these parameters was obtained either from annual reports or from values provided directly by the individual WWTPs.

$$\textit{Current loading} = \textit{TS concentration} * \textit{VS fraction} * \textit{Volume/day} \quad (4)$$

***Excess capacities***

Based on the values generated from Equations 1 and 4, the current excess digestion capacity was estimated using Equation 5 where operational data was available.

$$\textit{Current excess capacity} = \textit{Max Capacity} - \textit{Current Loading} \quad (5)$$

Under the assumption that the secondary digesters could be converted to primary digesters, the potential secondary excess capacity was estimated by combining Equations 1, 2 and 4 to yield Equation 6.

$$\textit{Potential Secondary excess capacity} = \textit{Max Capacity} + \textit{Secondary Capacity} - \textit{Current Loading} \quad (6)$$

If a WWTP were to implement an innovative technology to enhance the AD process, the innovation excess capacity was estimated by combining Equations 1, 3 and 4 to yield Equation 7:

$$\textit{Innovation excess capacity} = \textit{Max Capacity} + \textit{Innovation Capacity} - \textit{Current Loading} \quad (7)$$

# 3 Results

This section summarizes the data gathered on the current anaerobic digester volumes and capacities (i.e. primary and secondary digesters) in Ontario. Total tankage volume ($m^3$), current maximum digestion capacities and potential digestion capacities (Tonnes VS/year) are summarized. The digesters were further categorized by the number of implementations and the scale of digestion capacity (Tonnes VS/year). A detailed classification of the current digestion capacities was completed by sorting them according to digester volume. The primary digester volumes were divided into 5 ranges, namely a) <1,000 $m^3$, b) 1,000~3,000 $m^3$, c) 3,000~5,000 $m^3$, d) 5,000~10,000 $m^3$ and e) >10,000 $m^3$. Some WWTPs have multiple primary digesters and in these cases the volumes presented reflect the total of all primary digesters at the WWTP. In each volume range, the number of WWTPs and the total digestion capacities were determined. The geographic distribution of the capacities as categorized according to MPAC regions is presented.

## 3.1 Tankage volumes

Figure 3-1 describes the total tankage volume of all AD processes at municipal WWTPs in Ontario. It can be see that the total volume of primary digesters is approximately $6.4*10^5$ $m^3$ while the total volume of secondary digesters is approximately $1.7*10^5$ $m^3$. The maximum digestion capacity (Equation 1) was estimated to be $3.7*10^5$ Tonnes VS/year on the basis of design loadings provided by MOECC design manual. The potential additional digestion capacity assuming the upgrading of secondary digesters to primary digesters (Equation 2) was estimated to be $9.8*10^4$ Tonnes VS/year. Further the potential additional digestion capacity that could be obtained by implementing innovative digester enhancement technologies (Equation 3) was estimated to be $1.2*10^5$ Tonnes VS/year assuming a 30% enhancement of the primary digestion capacity.

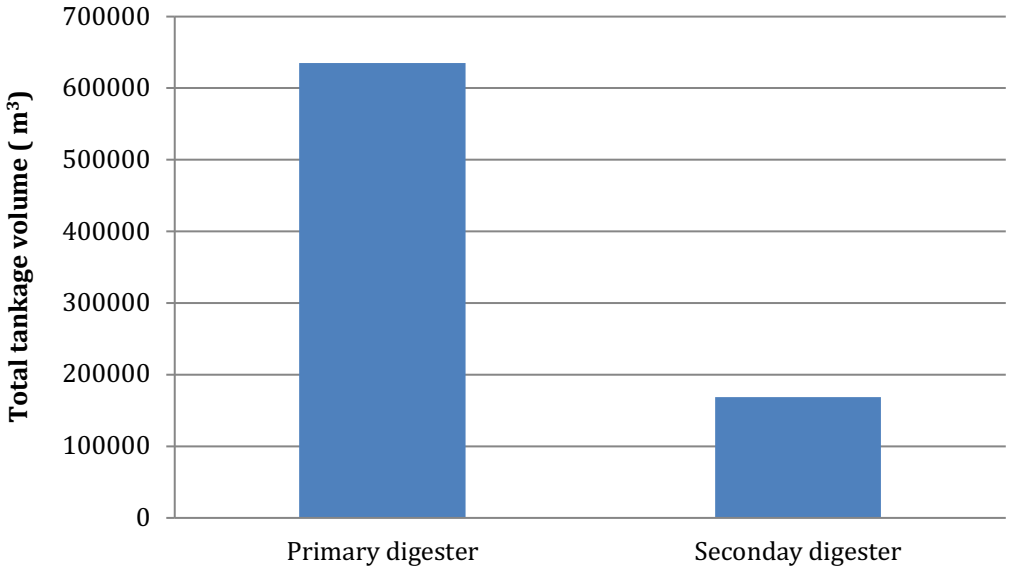


**Figure 3-1. Total AD digester volumes AD in Ontario**

Figure 3-2 presents a summary of the current implementation of primary digesters in the province as sorted into digester volume ranges. From Figure 3-2 it can be observed that 34% of all WWTPs (24 out of 70) have primary digestion with volumes in the range of 1000-3000 $m^3$ and this is followed by WWTPs with digester volumes in the range of 3000-5000 $m^3$ (23%). The high level of implementation of such digester sizes is due the large number of WWTPs employed in medium-size communities. Only 17% of the plants (12 out of 70) have primary digesters larger than 10,000 $m^3$. These plants mostly serve large municipalities located around the Great Toronto Area. WWTPs with primary digesters smaller than 1000 $m^3$ represent 13% of total implementations in Ontario and is reflective of the limited use of AD by small municipalities due to the challenges associated with operational complexity and cost.

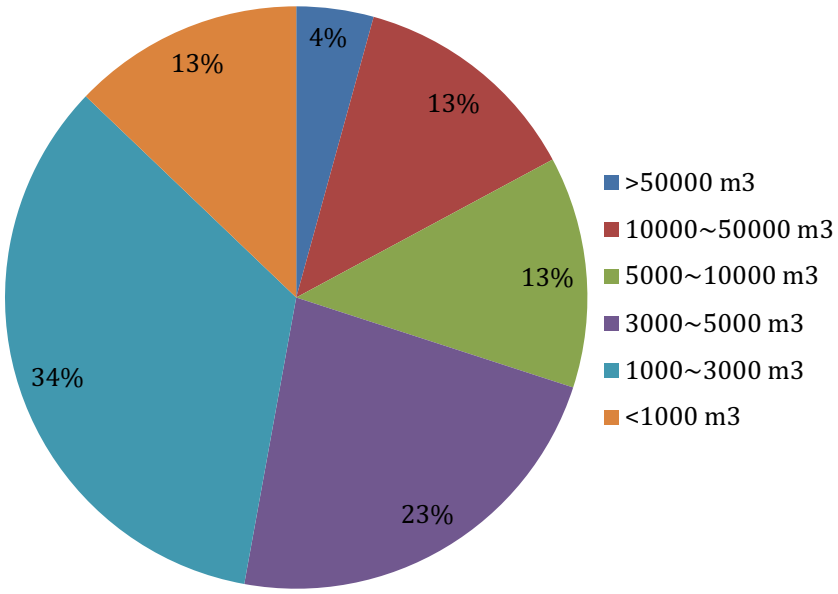


**Figure 3-2. Distribution of WWTPs as categorized by primary digester volume**

Figure 3-3 presents a summary of the current implementation of secondary digesters in the province. Figure 3-3 reveals a trend in volumes that is different from that observed for primary digesters. It can be seen that 57% of all WWTPs (31 out of 54) with secondary digesters have tankage volumes in the range of 1000-3000 $m^3$ and this is followed by the WWTPs with volumes less than 1000 $m^3$ (17%). The remaining secondary digesters have similar numbers and contribute 8-13% of the total implementations. None of the WWTPs have secondary digesters with volumes greater than 50,000 $m^3$. Typically large WWTPs employ mechanical dewatering rather than secondary digesters and hence the number of WWTPs with secondary digesters is less than the number with primary digesters.

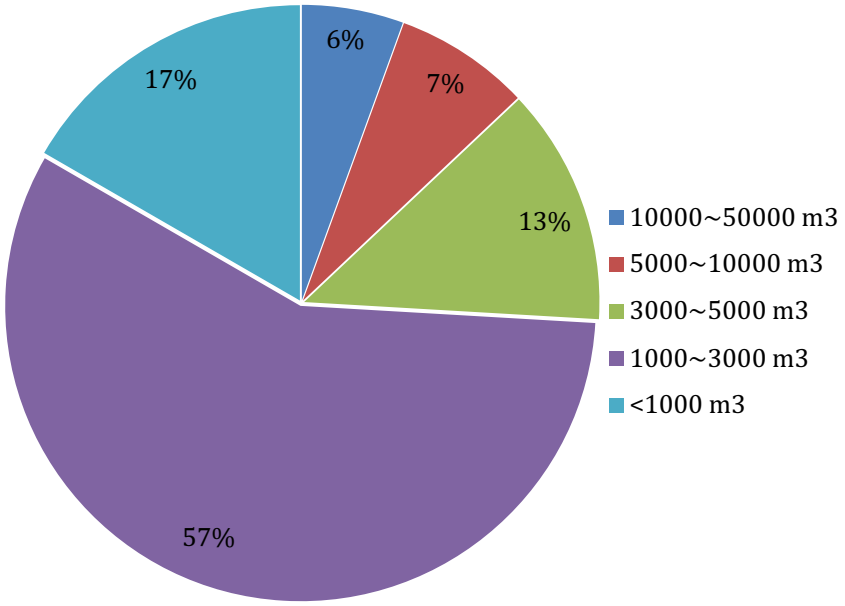


**Figure 3-3. Distribution of WWTPs as a function of secondary digester volume**

## 3.2 Digestion capacity

Figure 3-4 presents the distribution of digestion capacity (Tonnes VS/year) as a function of digester volume ($m^3$) in the province. The maximum digestion capacity provided by large facilities (i.e. primary tankage volume >10,000 $m^3$) was estimated as $1.5*10^5$ Tonnes VS/year, which is significantly greater than that estimated for the remainder of the categories. The mid-sized digester volumes (1000-10,000 $m^3$) categories each have similar total maximum digestion capacities of approximately $3.5*10^4$ Tonnes VS/year. The data indicate that the majority of anaerobic digestion capacity is present in relatively few large municipalities. Plants with digesters smaller than 1000 $m^3$ contribute a relatively small fraction of the digestion capacity.

The potential capacity that might be obtained by upgrading WWTP infrastructure was also characterized as a function of the associated digester volume. The distribution of capacities that could be obtained by upgrading the existing secondary digesters followed a similar trend to that observed with the primary digesters (Figure 3-4) with the exception that there are no secondary digesters in the large range of WWTPs. Facilities with secondary digesters larger than 10,000 $m^3$ have the greatest potential to provide additional digestion capacity and this is followed by facilities with secondary digester volumes in the range

1000-3000 $m^3$. The potential digestion capacity that could be obtained by implementing innovative technologies followed a similar trend to that of the current maximum digestion capacities. This reflects the approach that was employed to estimate these capacities which was based on primary digester volumes.

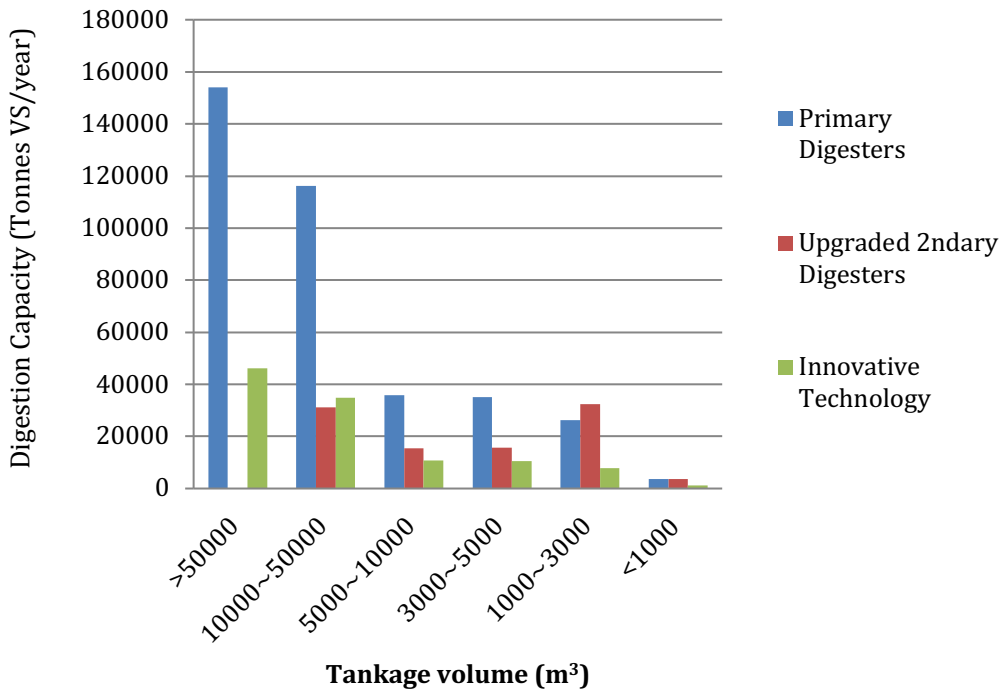


**Figure 3-4. Distribution of digestion capacities by primary and secondary digester volume**

Figure 3-5 details the distribution of WWTPs under the current and potential upgrading conditions as sorted into digestion capacities. Under the current practice, the total digestion capacity is around $3.7*10^5$ Tonnes VS/year. A majority of the WWTPs (30 out 70) have digestion capacity in the range of 1000~3000 Tonnes VS/year, followed by the plants whose digestion capacities are between 500~1000 Tonnes VS/year. Large facilities with capacities larger than 10000 Tonnes VS/year and between 5000~ 10000 Tonnes VS/year have similar levels of implementation (7 and 8 respectively). Facilities with AD capacities between 3000~5000 Tonnes VS/year have the lowest number of installations. This data reflects that fact that the majority of the WWTPs have mid-size digesters. WWTPs while small capacity anaerobic digesters (< 500 Tonnes VS/year) are typically not employed due to operational and economic challenges.

If the WWTPs were to upgrade existing secondary digesters into primary digesters, additional AD capacity could be added to most of the facilities in Ontario. Accordingly, the distribution of plants within each capacity category would change and the total AD capacity of the province would increase to $4.7*10^5$ Tonnes VS/year. The number of plants with digestion capacity in the range of 3000 to 5000 Tonnes VS/year would increase the most, followed by the ones with capacities greater than 10000 Tonnes VS/year. The number of plants with capacities between 1000-5000 Tonnes VS/year would not change. In contrast, the number of plants with capacities less than 1000 Tonnes VS/ year will decrease. The additional capacity gained here reflects the availability of secondary digester at individual WWTPs.

A similar trend would be observed if WWTPs were to implement innovative technologies to enhance the AD process (Figure 3-5). The total digestion capacity that could be reached is $4.8*10^5$ Tonnes VS/year, which is higher than that which could be achieved by upgrading of secondary digesters. The number of plants with capacity in the ranges of >10000 and 3000~5000 Tonnes VS/year increase in this scenario while the number of WWTPs in the remaining categories decrease when compared to the current conditions. The additional capacity gained by implementing innovative technologies depends on the tankage of existing primary digesters that reflects the approach employed to calculate these capacities.

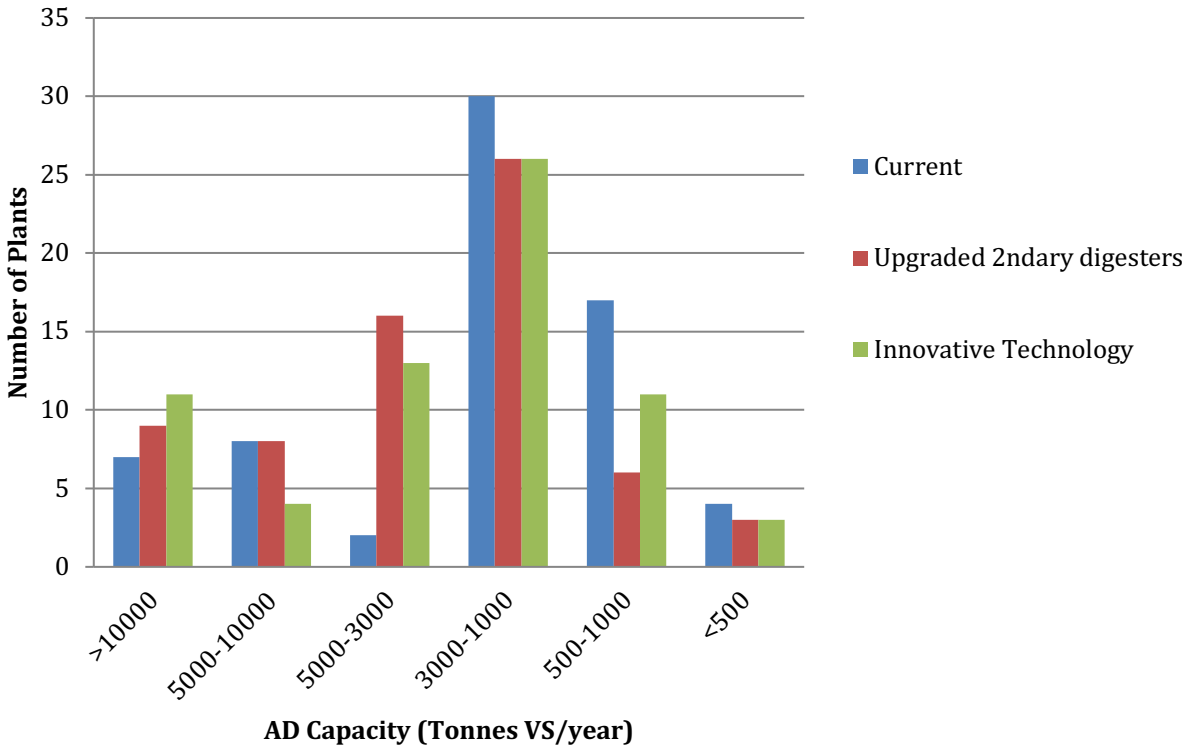


**Figure 3-5. Distribution of WWTP by digestion capacity**

## 3.3 Geographic distribution

Table 3-1 provides detailed information for individual MPAC regions including the tankage volume of primary and secondary digesters, current capacity and potential additional capacities that might be achieved by upgrading secondary digesters into primary digesters or by implementing innovative technologies. From Table 3-1, it also can be seen that there is at least one WWTP with an AD process in each MPAC region. Approximately 26% (7 out 27) of the MPAC regions have more than 3 WWTPs with AD processes. These are mostly located around the Greater Toronto Area and include the City of Toronto/Regional Municipality of Durham, Simcoe County, Regional Municipalities of Halton, Peel, Niagara and Waterloo, Counties of Dufferin and Wellington, the City of Guelph and Bruce and Grey Counties, respectively. There are 7 MPAC regions that have significant AD digestion capacity (> 10000 Tonnes VS/ year) and 11 MPAC regions that have AD capacity less than 3000 Tonnes VS/year.

Almost all the regions (23 out 27) have WWTPs that have the potential to upgrade their existing secondary digesters into primary digesters to increase the digestion capacity. Around 70% of the MPAC regions (19 out 27) could improve their digestion capacity by more than 30% in this way and thus may have the potential to accept off-site organics from other sources. A few MPAC regions such as Lanark, Leeds and Grenville Counties, District Municipality of Muskoka, Territorial Districts of Cochrane and Timiskaming and Territorial District of Algoma could obtain more than 100% improvement by upgrading their secondary digesters.

If all WWTPs were to adopt innovative technology, an additional 30% of AD capacity would be added to all the MPAC regions which reflects the method employed to estimate the additional capacity. A total of 3 MPAC regions could gain additional digestion capacity more than 10000 Tonnes VS/year (City of Toronto, Region of Durham, Region of Halton and Peel). An additional 6 MPAC regions that are located in area surrounding Toronto and Ottawa could obtain additional capacity in the range of 2000 to 10000 Tonnes VS/ year. A majority of MPAC regions (15 out of 27) would obtain additional capacity less than 2000 Tonnes VS/year with most of these located in less populated areas.

**Table 3-1. Digester information and calculated capacities within MPAC regions**

| MPAC Region, Ontario | MPAC ID | Number of AD plant | Primary digester volume | Secondary digester Volume | Max current capacity | Secondary potential capacity | Innovative tech |
|---|---|---|---|---|---|---|---|
| Unit | - | - | $m^3$ | $m^3$ | Tonnes VS/yr | Tonnes VS/yr | Tonnes VS/yr |
| Prescott, Russel, Stormont Dundas and Glengarry Counties | 1 | 1 | 2272 | 0 | 1327 | 0 | 398 |
| Lanark, Leeds and Grenville Counties | 2 | 2 | 1369 | 2942 | 799 | 1718 | 240 |
| Regional Municipality of the City of Ottawa | 3 | 2 | 53484 | 826 | 31235 | 482 | 9370 |
| Renfrew County | 4 | 3 | 4995 | 3045 | 2917 | 1778 | 875 |
| Frontenac, Lennox and Addington Counties | 5 | 3 | 9270 | 5350 | 5414 | 3124 | 1624 |
| Hastings, Northumberland, City of Prince Edward Counties | 6 | 3 | 12949 | 6133 | 7562 | 3582 | 2269 |
| Peterborough County, Kawartha Lakes County | 7 | 1 | 4888 | 2910 | 2855 | 1699 | 856 |
| City of Toronto | 9 | 4 | 242900 | 14944 | 141854 | 8727 | 42556 |
| Regional Municipality of Durham | 13 | 5 | 66576 | 23306 | 38880 | 13611 | 11664 |
| Regional Municipality of York | 14 | - | - | - | | | |
| Regional Municipalities of Halton and Peel | 15 | 8 | 73252 | 21994 | 42779 | 12845 | 12834 |
| Simcoe County | 16 | 4 | 7948 | 7199 | 4642 | 4204 | 1392 |
| District Municipality of Muskoka | 17 | 1 | 1887 | 1844 | 1102 | 1077 | 331 |
| Regional Municipality of Niagara | 18 | 8 | 27470 | 17340 | 16042 | 10127 | 4813 |
| Regional Municipality of Hamilton | 19 | 1 | 38525 | 25089 | 22499 | 14652 | 6750 |
| City of Brantford, Brant, Haldimand and Norfolk Counties | 20 | 3 | 12131 | 6916 | 7085 | 4039 | 2125 |
| Regional Municipality of Waterloo, The Counties of Dufferin and Wellington, and the City of Guelph | 21 | 5 | 39489 | 15023 | 23062 | 8774 | 6919 |
| Elgin, Middlesex and Oxford Counties | 23 | 3 | 7618 | 3474 | 4449 | 2029 | 1335 |
| Huron and Perth Counties | 24 | 1 | 1710 | 1710 | 998 | 998 | 300 |
| Bruce and Grey Counties | 25 | 4 | 3947 | 1215 | 2305 | 710 | 692 |
| Municipality of Chatham-Kent, Lambton County | 26 | 2 | 5040 | 2520 | 2943 | 1472 | 883 |
| Essex County | 27 | - | - | - | | | |
| Territorial Districts of Nipissing and Parry Sound | 28 | 1 | 3434 | 512 | 2006 | 299 | 602 |
| Territorial Districts of Cochrane and Timiskaming | 29 | 1 | 2247 | 2247 | 1312 | 1312 | 394 |
| Regional Municipality of Sudbury and the Territorial Districts of Sudbury and Manitoulin | 30 | - | - | - | - | - | - |
| Territorial District of Algoma | 31 | 1 | 2198 | 2198 | 1284 | 1284 | 385 |
| Territorial District of Kenora, Rainy River, Thunder Bay | 32 | 1 | 9770 | 0 | 5706 | 0 | 1712 |
| Total | | | 635369 | 168736 | 371056 | 98542 | 111317 |

# 4 Excess digestion capacities

This section presents estimates of excess capacities that might be available for digestion of offsite organics after current VS loadings to the AD digesters are accounted for. The analysis was conducted based on the information collected from annual reports and feedback provided by individual municipalities. Operational data from 44 WWTPs were collected and used for the analysis conducted herein which represents 63% of the facilities using the AD process in the province. The analysis (i.e. excess capacity and potential excess capacity by upgrading) conducted here provides an indication of distribution of current loading and excess capacity in the province and also provides some insight into how plant upgrading could impact the AD capacity in the province.

Figure 4-1 presents the distribution of excess capacity under the three alternative scenarios as sorted into the capacity ranges. From Figure 4-1 it can be seen that the current excess capacity (calculated as the difference between the design capacity and current loading) of a majority of the digesters (37 out 44) is less than 3000 Tonnes VS/year. Under current conditions one WWTP could receive more than 10000 Tonnes of VS material per year while 5 and 1 WWTPs could receive 5000~10000 and 3000~5000 Tonnes VS/year respectively.

Upgrading of secondary digester into primary digesters was found to substantially change the distribution of excess capacities. WWTPs which could receive between 1000~3000 Tonnes VS/year increased the most followed by the ones in the range of 3000~5000 Tonnes VS/year and > 10000 Tonnes VS/year respectively. The number of plants with excess capacities in other categories would decrease.

Implementing innovative technology to increase digestion capacity was found to cause the distribution of excess capacities to follow a similar trend to that of upgrading secondary digesters. Specifically, the number of WWTPs with excess capacities in the range of 1000~3000 Tonnes VS/year would increase the most and this is followed by those with excess capacities greater than 5000 Tonnes VS/year. The number of plants with capacity smaller than 1000 Tonnes VS/year would decrease whereas the remainder of the categories would have minimal change.

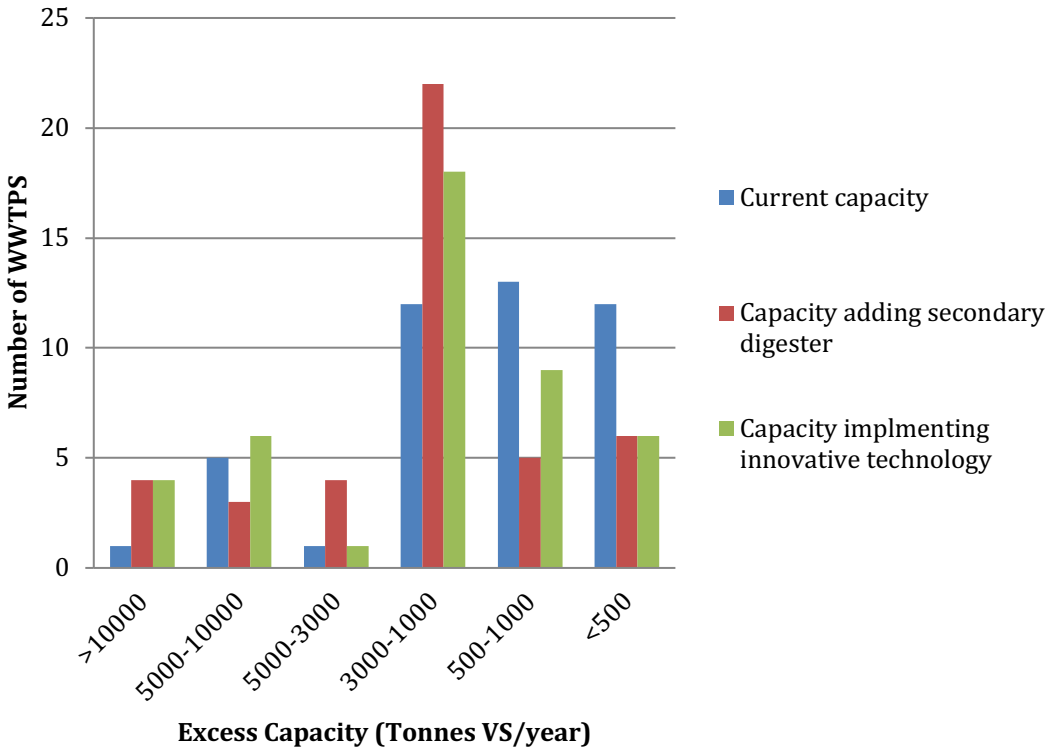


**Figure 4-1. Distribution of WWTPs as a function of excess capacity under different scenarios**

Based on the analysis conducted it was found that most of responding WWTPs have little excess capacity under the current practices. In contrast, significant excess digestion capacity can be obtained by either upgrading secondary digesters or implementing innovative technologies. The trends of changes in capacity due to either upgrading secondary digesters or implementing innovative technologies reflect the current scale and distribution of digester volumes (primary and secondary).

# 5 Conclusions

This report presents the results of a study that was conducted to characterize the potential for municipal wastewater treatment plants to receive offsite organics into their anaerobic digesters. It was found that

a) the total volume of primary digesters is approximately $6.4*10^5$ $m^3$ while the total volume of secondary digesters is approximately $1.7*10^5$ $m^3$.

b) the total design digestion capacity in Ontario is around $3.7*10^5$ Tonnes VS/year; This capacity could increase to $4.7*10^5$ and $4.8*10^5$ Tonnes VS/year if secondary digesters were upgraded or innovative pretreatment technologies were implemented respectively.

c) a majority of the anaerobic digestion capacity is present in relatively few large municipalities; plants with digesters smaller than 1000 $m^3$ contribute a relatively small fraction of the overall digestion capacity

d) at least one WWTP with an AD process exists in each MPAC region; around 70% of the MPAC regions (19 out 27) could improve their digest capacity by more than 30% through either upgrading of secondary digesters or implementing innovative technologies thus may have the potential to accept off-site organics from other sources.

e) A majority of the 44 WWTPs that provided data on current operations do not have significant excess capacity under the current practices; Upgrading of secondary digesters or implementing of innovative technologies would generate substantial excess capacities that follow a similar pattern to that of the digester volumes.

# 6 Glossary

**Biogas:** Gas produced by the fermentation of organic matter including, sewage sludge, under anaerobic conditions. Biogas is comprised primarily of methane and carbon dioxide

**Biosolids:** Solids generated from the treat of sewage sludge with processes such as anaerobic digestion, aerobic digestion, lime stabilization, etc.

**Greenhouse Gases:** Gases in the atmosphere that contribute to Climate Change. Those gases include but are not limited to, carbon dioxide, methane and nitrous oxides.

**Sewage Sludge:** Excess solids produced in municipal wastewater treatment plants Innovation.

**Thickening:** The process used to increase the solids content of sludge by the separation and removal of a portion of the liquid phase.

**Stabilization**: A chemical or biological process that stops the natural fermentation of the sludge.

**Disposition**: Sludge disposition herein refers to the final management route for the treated biosolids and commonly includes either landfill, agricultural land application, etc.

**Incineration**: A waste treatment process that involves the combustion of organic substances contained in waste materials.

# 7 Abbreviations

| | |
|---|---|
| AD | Anaerobic Digestion |
| ECA | Environmental Compliance Approval |
| MOECC | Ontario Ministry of Environment and Climate Change |
| OCWA | Ontario Clean Water Agency |
| SOWC | Southern Ontario Water Consortium |
| USEPA | United States Environmental Protection Agency |
| WWTP | Wastewater treatment plant |
| VS | Volatile solid |
| TS | Total solid |
| MPAC | Municipal Property Assessment Corporation |

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