The Changing Landscape of Biosolids Management in Florida: The 21st Century's First Decade & Predictions for the Next One

Robert H. Forbes Jr.

The state of Florida, with its inviting climate, high population density, and substantial natural resources to protect, has set the trends for water-related and environmental regulations in the Eastern U.S. for at least the past 30 years. An often overlooked part of that trend is the ever-increasing volume of water and wastewater residuals (biosolids) that are produced, in addition to the other organic byproducts of Florida's economic activity, such as food processing, forestry, farming, and livestock operations.

Because of the sensitivity of Florida's natural resources and its growing population, the state produces a large volume of biosolids and other biomass products suitable for unrestricted distribution and marketing; but markets appear to be approaching saturation for some products, such as alkaline-stabilized biosolids and heat-dried pellets. In light of the increasing costs of energy, biosolids are being re-evaluated as a carbon-rich energy source, as well as a source of nutrients and carbon for the soil.

This article reviews Florida's trends in biosolids management over the last decade and touches on the emerging trends of energy and resource recovery, which are currently developing in the state's major metropolitan areas such as Jacksonville, Miami, Orlando, and Tampa.

Florida's Current Trends in Biosolids Management

A national biosolids survey based on 2004 data (New England Biosolids Recycling Association (NEBRA), 2007) estimated that 17 percent of Florida biosolids met Class AA standards (a Florida designation for biosolids meeting the U.S. Environmental Protection Agency's [EPA's] Class A pathogen limits with pollutant concentrations all within EPA's "exceptional quality" standards). Total Class AA production was estimated at 52,000 dry tons that year.

By 2009, the percentage of Class AA products had increased to approximately 40 percent of total biosolids production, with an estimated 160,000 dry tons of Class AA biosolids products produced in Florida and used primarily within the state. In addition, 59,000 dry tons of Class AA biosolids products (mostly dried and pelletized biosolids) were imported into Florida from other states that year (Florida Department of Environmental Protection (FDEP), 2010).

Figure 1 – Excerpt from Florida DEP Report on Summary of Class AA Biosolids Produced in 2009 (Florida DEP, 2010)

Notes:

Number of Florida Companies/Facilities Reporting:	30
Number of Out-of-State Companies/Facilities Reporting:	6
Number of Florida Counties Receiving Class AA Residuals in Report:	50
Quantity Distributed and Marketed by Florida Companies in Florida (dry tons):	160086.62
Quantity Distributed and Marketed by Out-of-State Companies in Florida (dry tons):	59183.44

Quantities Exported by Florida Companies (not included in data given above)

Company Name	State	Quantity (dry tons)
Escambia County Utilities Authority	AL	342.31
Tampa, City of	AL	46.91
Tampa, City of	GA	70.73
VCDSW/Tomoka Farms Road Landfill RMF	GA	57.63
	Total Exported:	517.58

Robert (Bob) Forbes, a registered P.E. in Florida and North Carolina, currently serves as CH2M Hill's regional technology leader for biosolids resource recovery in the Eastern U.S. This article was presented as a technical paper at the 2011 Florida Water Resources Conference in May.

Figure 1 shows a summary of the biosolids companies and facilities that reported to the FDEP in 2009 and the total quantities of Class AA residuals that were marketed and distributed as a result.

In 2004 there were an estimated 322 treatment facilities producing biosolids in the state of Florida, and the total amount of biosolids production in the state that year was estimated at 300,000 dry tons (NEBRA, 2007). Of that total, approximately 83 percent was used beneficially; 66 percent of it was land applied as Class B material and 17 percent was marketed under more stringent Class AA standards. The remaining 17 percent of the total was disposed of by landfilling with municipal solid waste. There are no biosolids incinerators and no dedicated (i.e., sludge-only) surface disposal sites reported to be operating in Florida at present.

By 2009, the amount of biosolids treated to Class AA standards had grown substantially to 160,000 dry tons, or about 40 percent of total biosolids production that year. Primary reasons for the strong shift toward production of Class AA products, despite its higher costs, were (1) decreasing amounts of farm sites within economical hauling distances and (2) public perception that Class AA products are safer. These two issues are very indicative of national trends.

Figure 2 (NEBRA, 2007) shows the results of utility surveys across the U.S. concerning the barriers to beneficial use and land application of biosolids. The bars in the figure represent what the survey respondents regarded as the number 1, number 2, and number 3 greatest barriers to beneficial use.

As shown, public involvement and decreasing farmland availabilty were reported as

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Figure 2 – Barriers to Beneficial Use of Biosolids in the U.S. as Reported by a Nationwide Survey of Municipal Wastewater Utilities (NEBRA, 2007)

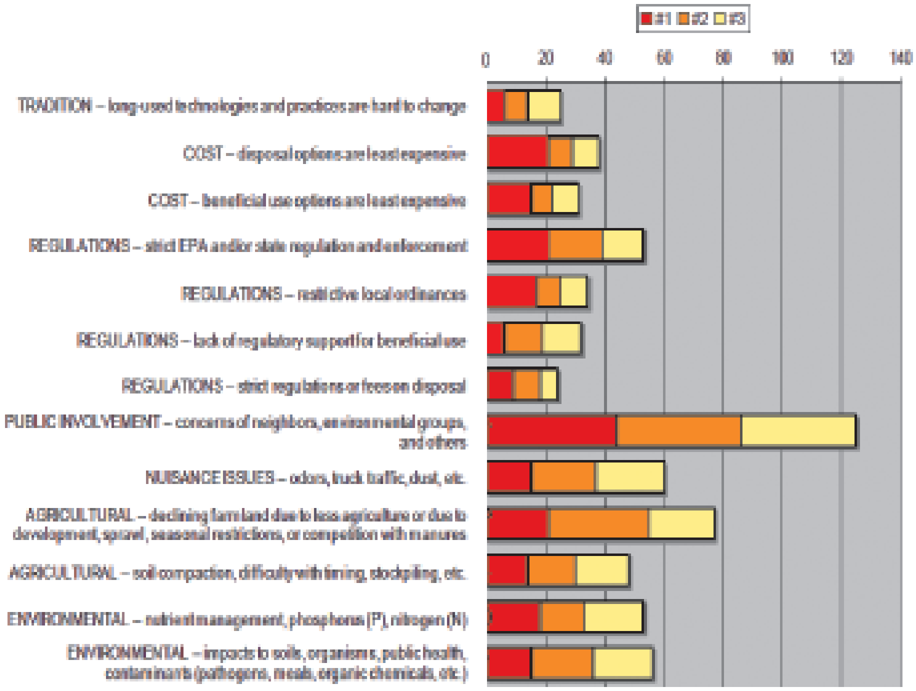
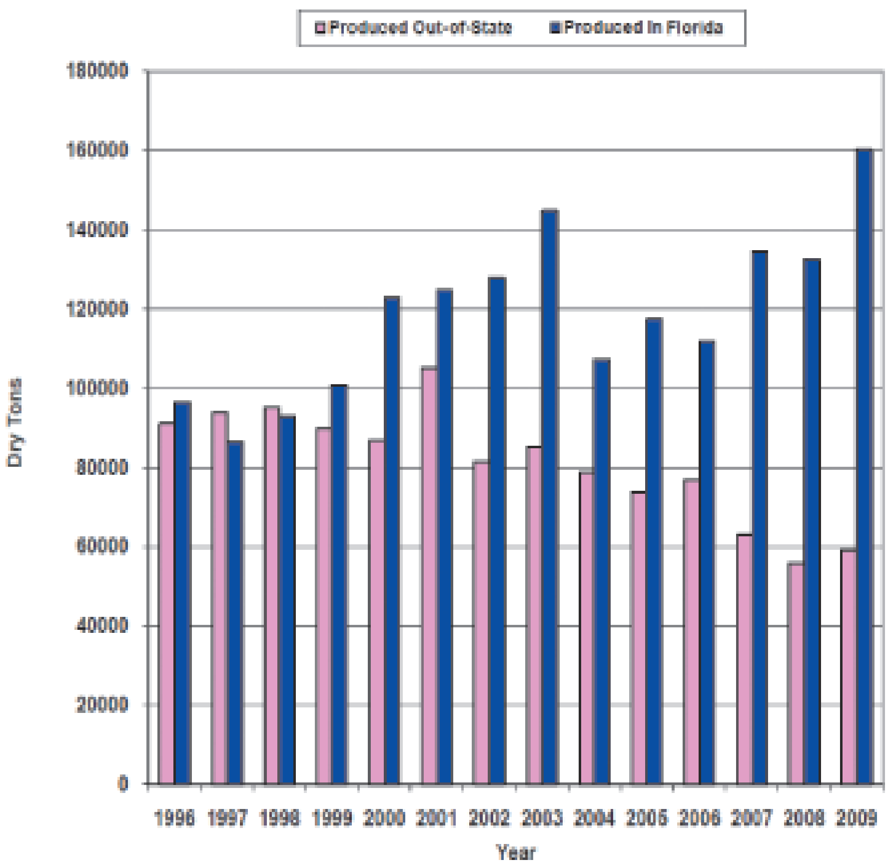


Figure 3 – Comparison of Class AA Biosolids Used in the State of Florida (imported biosolids amounts in pink and locally-produced amounts in blue, Florida DEP, 2010)



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the main two barriers, followed by environmental and regulatory barriers. Interestingly, the costs of biosolids use and disposal were reported to be less important barriers to beneficial use. That explains the trend toward increasing production of Class AA biosolids in Florida, at generally higher costs than Class B options or even landfill disposal in many cases.

Traditionally, Florida has been the largest market of heat-dried (pelletized) biosolids in the eastern U.S., primarily because of the prevalent use of biosolids pellets on citrus groves and golf courses. In the latter half of the last decade, however, importing Class A biosolids from other states (almost all in the form of heat-dried pellets) has decreased, while the production of Class AA biosolids within the state has increased dramatically. Those trends are shown in the bar chart of Figure 3 (FDEP, 2010).

Producing Class AA biosolids is usually more costly than other options in terms of both capital and operating costs, and only a fraction of those costs can be recovered through product sales. The cash value of biosolids pellets, for instance, has decreased substantially in real terms since mechanical drying of biosolids first began in the 1980s, as more pellets are being produced and the market for product has not grown substantially.

Also, cash-strapped municipalities and utilities have difficulty raising sufficient capital to build new biosolids facilities. Some facilities have become too costly to operate and have been shut down, with owners opting for the more expedient option of landfill disposal. Class AA facility shutdowns and startups explain the rise and fall of Class AA biosolids production figures from year to year, as shown in Figure 3.

There are other constraints and barriers to beneficial uses of biosolids related to Florida's sensitive environment, including the emergence of watershed-based regulations that impose stringent restrictions, and in some cases outright bans on land application of biosolids within specified watersheds. Those constraints apply to some of Florida's most heavily used land application areas, which are located close to population centers along the east and west coasts of the Florida peninsula.

Figure 4 shows the locations of Florida's Class AA production facilities and its counties with the heaviest land application amounts. Figure 5 shows three watersheds in south Florida (Lake Okeechobee, St. Lucie River, and Caloosahatchie River) which are now part of the Northern Everglades and Estuaries Protection Program. The nutrient loading restrictions in these watersheds will effectively ban land application of biosolids once the new permitting program is fully enacted in 2013.

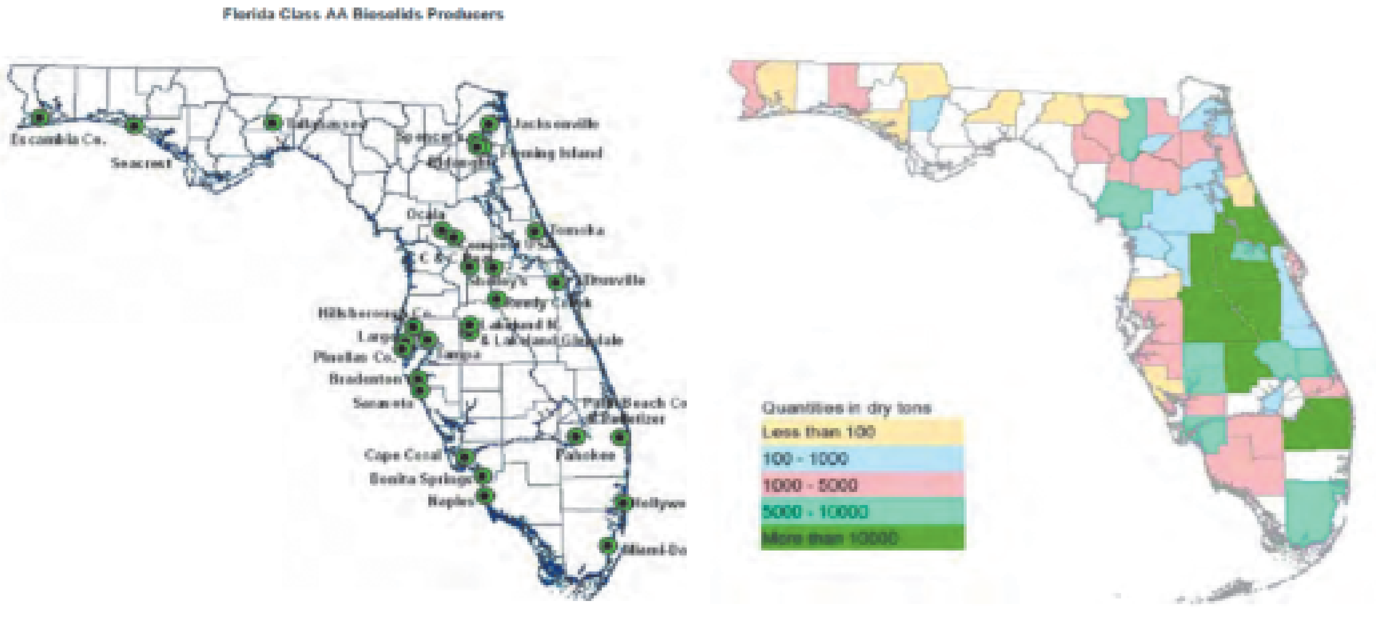

Figure 4 – Locations of Florida's Class AA Biosolids Production Facilities and Florida's Most Heavily Used Counties for Biosolids Land Application (FDEP, 2010)

Without the means to produce high-quality biosolids products, and with agricultural demand for Class B products decreasing and even outlawed in some areas of Florida, many utilities have found landfill disposal of biosolids to be the most expedient choice. In view of the disturbing trends of limited outlets for biosolids and increasing costs for beneficial use and disposal, practitioners are considering some new, innovative choices for the management of biosolids and other organic byproducts. For example, the high carbon content of biosolids can make it a viable source of renewable energy (even when landfilled), and scientific advances are making it possible to recover more of that bound energy.

Other resources also are being recovered from biosolids, such as struvite (magnesium ammonium phosphate), which forms problematic mineral deposits in wastewater and sludge pipelines but can be recovered selectively. The recovered product, usually in crystal or powder form, is predicted to increase in value because of an emerging need for more phospate fertilizers.

These types of energy and resource recovery trends are now occurring in Florida and nationwide, as further described in following sections.

Evolving Trends – Nationally & Statewide

In December 2010, a national group of biosolids practitioners and experts met in Alexandria, Virginia, to discuss emerging regulatory and technology trends in biosolids management (WEF, 2010). Participants discussed a confluence of existing and emergent regulatory activity that threatens to restrict, eliminate, and/or substantially increase the costs of biosolids management. Among the concerns discussed at this meeting that are pertinent to the state of Florida were:

- Volatile organic compound (VOC) emission restrictions in ozone non-attainment areas;
- More stringent nutrient (especially phosphorus) limitations in discharges to surface waters;
- Fertilizer product certification requirements;
- Increasing links between biosolids, solid wastes, and other orgainic residuals such as animal manures.

As noted previously, population growth places further pressure on the availability of land application sites, exacerbating the "urban-rural divide" while increasing urban utility management needs. Participants in the December 2010 meeting expressed concern that regulatory efforts are often characterized by poor stakeholder input, unrealistic (court-

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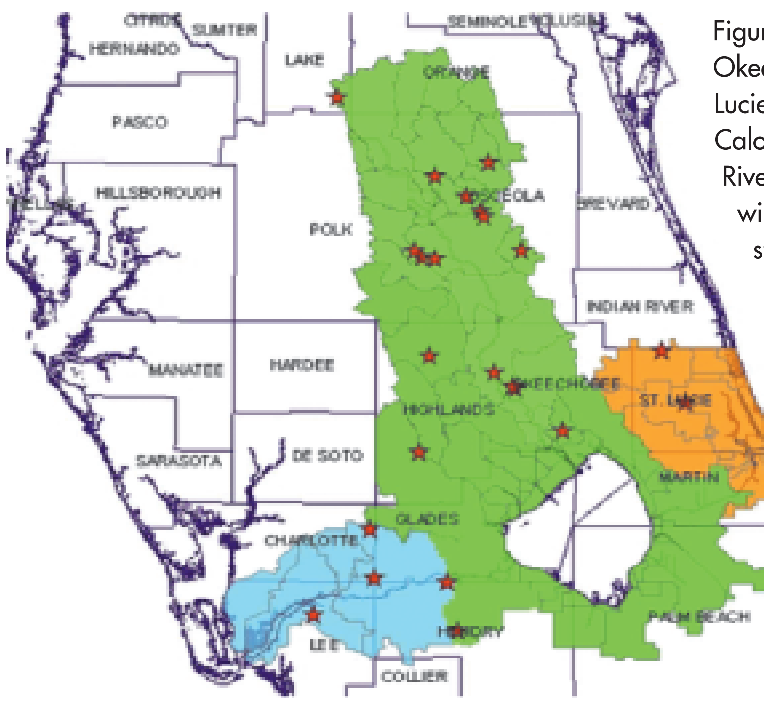

Figure 5 – Lake Okeechobee, St. Lucie River, and Caloosahatchie River Watersheds with Nutrient Restrictions - Stars Show Permitted Land Application Sites that will be Lost

(Barker and Minsky, 2010)

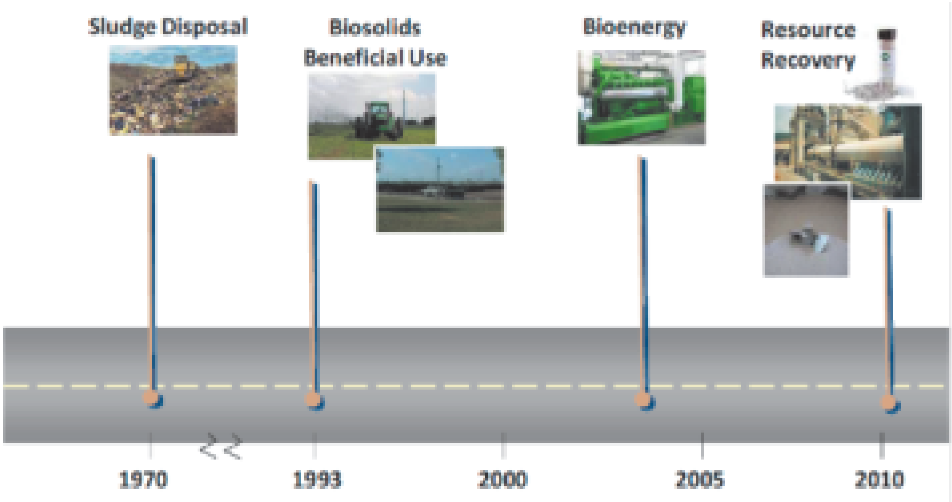

Figure 6 - Trends in Biosolids Management from 1970s to the Present (WEF, 2010)

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defined) timeframes, and the lack of an integrated view across regulatory domains.

Greenhouse gas (GHG) mitigation efforts (such as the California cap-and-trade program) were viewed by participants as an important driver for expanded interest in renewable fuels, including biogas, biomethane, and other biosolids combustible products. This interest can create an opportunity for certain biosolids management alternatives, while concern was expressed that there has been a lack of federal policy acknowledgement for biosolids as a valuable resource, particularly in the renewable energy context.

Discussion indicated that a failure to address key biosolids concerns (odors, pathogens, microconstituents, overall public perception, phosphorus loadings) holds the potential to impact biosolids management negatively in the future. Participants in the December 2010 meeting identified the following potential negative impacts:

- A more fragmented, state-by-state regulatory framework that increasingly drifts from the federal regulatory baseline;
- The introduction of more restrictive management practices such as fence-line setbacks and incorporation requirements; increased legal liability;
- Greater uncertainty around the mid-term viability of technology and programmatic choices;
- A substantial increase in management costs;
- Greater complexity associated with obtaining and maintaining management options.

Technology Drivers

While regulatory and policy drivers and trends raised substantial concerns for a more restricted biosolids management future, technology drivers and trends tend to be viewed from the perspective of creating additional opportunities. These perspectives include increasing the demand for biosolids products, increasing opportunities for greater extraction of resource value (e.g., energy and nutrients) from biosolids production and management, and increasing "side-stream" product options. Important technology drivers and trends discussed by participants incorporated the following areas:

Urban Sustainability

Urban sustainability initiatives reflect an interest in the deployment of "green" technologies to improve stormwater management, urban heat island effects, energy efficiency, GHG reduction, transportation efficiency, and community livability and aesthetics. Green technologies often involve the use of planted and managed vegetation deployed in a variety of settings (e.g., roadway buffer strips, bioswales). These plantings require nutrients and effective soil tillage, creating an increased opportunity for biosolids use (e.g., compost) in urban settings.

The cultural shift toward sustainability and resource conservation also has the potential to provide the basis for a shift in public perception about the nature of biosolids, moving from biosolids as a waste to biosolids as a resource. Most of Florida's larger cities, and especially its large retirement and resort areas, are emphasizing urban sustainability, which represents an opportunity for using Class AA biosolids products such as compost and heat-dried pellets.

Biosolids as a Renewable Resource

Furthering the "biosolids as a valuable resource" theme, discussions indicated a confluence of emerging resource constraints (e.g., energy, carbon, phosphorus, water) that can set biosolids on a path to be viewed as a better fuel, a better fertilizer, and better soil amendment.

Climate change concerns have driven substantial emerging interest in "green energy" in such contexts as state renewable energy portfolio requirements and an interest in carbon offsets, while energy prices have sent a signal for more diversified energy portfolios. In this context, both solids processing activities and biosolids products may play a role.

These trends, combined with technical improvements in such areas as digester optimization for energy production, improved gas cleaning technologies, and overall management of solids to maximize energy value, are opening opportunities for deeper extraction of resource value from biosolids. More utilities are producing biogas from biosolids as an energy supplement to supply to gas pipelines (as biomethane) and as fuel for cogeneration of heat and energy. Florida utilities in urban areas such as Jacksonville, Miami, Orlando, and Tampa-St. Petersburg have implemented projects and initiatives exhibiting these trends.

Indications that mined phosphorus may become more limited in the future, combined with continued soil degradation, suggest biosolids as a sustainable source of plant nutrients, as well as a critical organic soil amendment to improve soil tillage and water retention. The success of some of these biosolids products, as seen through substantial farmer demand in many areas, establishes a solid footing for the use of biosolids as a valuable community resource.

For example, Miami-Dade Water and Sewer Department is exploring the use of a recovery process that produces a phosphorus-rich fertilizer supplement from struvite (magnesium ammonium phosphate), which forms naturally in some biosolids processes such as anaerobic digestion. Struvite can create severe pipeline clogging problems if not controlled, so selectively harvesting the struvite for beneficial use can provide multiple benefits.

Drive toward increased Flexibility, Efficiency & Productivity

More forward-thinking utilities and cities are seeing increased interest in technological and operational flexibility, efficiency, and productivity, in part linked to decreasing the physical and environmental operational footprint, as well as operating costs. This drive includes better energy, GHG, and staffing efficiency; incremental improvements in existing technologies that allow for more optimization; and

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capital investment strategies that provide for flexibility in biosolids management options (to help manage risk associated with changing regulatory, policy, or public perception constraints on any given option).

Efficiency drivers are contributing to growth in the use of anaerobic digestion, solids drying, and a move to producing more Class AA to biosolids to address such factors as public perception, more sustainable options for beneficial use, and lower overall costs associated with the product. At the same time, an increase in disposal of biosolids in landfills has become evident, as the cost of this option has decreased in some areas, while the acceptance of organic material into landfills has increased on the part of some landfill operators.

Florida and other populous states are seeing a move toward the use of centralized and regionalized biosolids management facilities, both within systems with multiple wastewater treatment sites and among different systems that operate in reasonable proximity to each other. Florida's dense population centers, coupled with a regulatory environment that discourages Class B land application, offer a number of opportunities in this area.

Another example of such an opportunity is the super-critical water oxidation process pilot currently operating in Orlando, in which biosolids are subjected to extremely high heat and pressure that destroy the biological cell mass and result in elemental ashes, carbon dioxide, and water. Once it achieves supercritical conditions, the oxidation reaction also generates excess heat that can be converted to energy, according to the process developer.

As of this date, the pilot project has yet to achieve sustainable operation. Nevertheless, research and development of evolving processes and emerging technologies result in incremental improvements and successes that continue to advance the science and technology of biosolids resource recovery.

Conclusion

Biosolids management is shifting into new paradigms both nationally and in Florida. Trends are evolving from beneficial use into bioenergy and resource recovery, as noted in Figure 6.

Biosolids are rich in carbon and nutrients that can be recovered for a number of beneficial uses, including green energy, nutrients, and soil amendments. Scientific thought and public opinion in Florida and the U.S. are increasingly recognizing that fact. These trends will lead to the continued development of innovations that will change the perception of biosolids management from an issue of disposal to one of opportunity for resource recovery as we enter the next decade.

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