

THOMAS LEHMAN RICHARD

Curriculum Vitae
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EDUCATION

Ph.D. Cornell University. 1997.

Thesis title: The Kinetics of Solid-State Aerobic Biodegradation
Major: Biological Engineering
Minors: Microbiology, Environmental Engineering

M.S. Cornell University. 1987.

Thesis title: Macropore Influences on Solute Transport
Major: Agricultural Engineering
Minor: Agronomy

B.S. University of California, Berkeley. 1978.

Major: Political Economy of Natural Resources
Phi Beta Kappa.

RESEARCH INTERESTS

Application of systems engineering principles to agricultural and environmental problems. Specific interests include:

- Microbial conversion of biomass, agricultural byproducts and manures for nutrient, energy, and organic matter recovery and value-added manufacturing,
- Nutrient, carbon, and energy flows in agricultural ecosystems.
- Integrated assessment of coupled human-agroecological systems

RESEARCH EXPERIENCE

Professor. Department of Agricultural and Biological Engineering, Pennsylvania State University, State College, PA. 2011-present.

- Director, Penn State Institutes of Energy and the Environment (2008-present)
- Director, Biomass Energy Center (2007-present)
- Research and teaching in biological engineering and agroecosystem design.

Visiting Scholar. College of Natural Resources and Environment, University of Freiburg, Germany. Spring 2015. (on sabbatical from Penn State University)

- Research on forest carbon and energy flows and sustainable harvest strategies and technologies.

Visiting Scholar. Energy Biosciences Institute, University of California Berkeley, Berkeley, CA. Fall 2014. (on sabbatical from Penn State University)

- Research on biomass energy and sustainable technologies and policies.

Associate Professor. Department of Agricultural and Biological Engineering, Pennsylvania State University, State College, PA. 2004 - 2011.

- Research and teaching related to microbial bioconversion processes, agroecosystems and environmental impacts.

Associate Professor. Department of Agricultural and Biosystems Engineering, Iowa State University, Ames, IA. 2003 - 2004.

- Chair, Graduate Program in Sustainable Agriculture
- Research and teaching related to bioprocessing of organic residuals.

Assistant Professor. Department of Agricultural and Biosystems Engineering, Iowa State University, Ames, IA. 1997 - 2003.

- Research and teaching related to bioprocessing of organic residuals.

Visiting Professor. Department of Environmental Technology, Wageningen University and Research Centre, Wageningen, The Netherlands. 2000.

- Research on manure bioconversion and greenhouse gas emission monitoring.

Research Support Specialist. Department of Agricultural and Biological Engineering, Cornell University, Ithaca, NY. 1987 — 1997.

- Leadership responsibility for research and extension activity in biological waste management.

Hydrologist. U.S. Geological Survey, Water Resources Division. Ithaca, NY. 1987.

- Managed field study of pesticide movement under conventional and no-till corn culture.

Graduate Research Assistant. Department of Agricultural Engineering, Cornell University. Ithaca, NY. 1985-1987.

- Designed and conducted tracer and dye field experiments to study solute transport through biologically induced macropores.

Undergraduate Research Assistant. Chemistry Department, University of California, San Diego. 1974-1975.

- Applied environmental chemistry and simulation modeling to environmental problems as member of ongoing undergraduate research team.

- Proposed and directed a National Science Foundation study of the environmental interactions in the San Diego and Tijuana region.

TEACHING EXPERIENCE

Principal Instructor:

- Ag. and Bio. Eng. 884 – Biomass Energy Systems (2013). Pennsylvania State University – 3 credits – graduate level, distance education.
- Ag. and Bio. Eng. 001S – Freshman Seminar (2005). Pennsylvania State University – 1 credit – undergraduate level. With Roy Young
- Biological Eng. 464 (initially Ag. and Bio. Eng. 497) – Biomass Energy Systems (2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2015, 2016, 2017). Pennsylvania State University – 3 credits – undergraduate level
- Ag. and Bio. Eng. 402 – Transport Processes for Biological Production (2005, 2006, 2007). Pennsylvania State University – 3 credits including lab – undergraduate level
- Ag. and Bio. Eng. 597A – Bioconversion Processes (2005). Pennsylvania State University – 3 credits – graduate level
- Ag. Systems Technology 475 – Manure Management Systems for Livestock Production (1998, 1999, 2000, 2001, 2002, 2004). Iowa State University – 3 credits – undergraduate level
- Ag. Eng. 473/573 – Manure Treatment and Bioconversion (1997, 1998, 2000, 2002, 2004). Iowa State University – 3 credits – graduate level
- Ag. Systems Technology 403 – Senior Seminar (2002, 2003). Iowa State University – 1 credit – undergraduate level
- SustAg/AgEng/AnSci/Agron 515 – Integrated Crop and Livestock Production Systems (2001, 2003). With M. Weidenhoeft and J. Russell. Iowa State University – 3 credits – graduate level
- SustAg/AgEng/Soc 610- Society and Technology in Sustainable Food Systems (2003). With C. Hinrichs. Iowa State University – 3 credits – graduate level.

- Ag. Systems Technology 496 – Agricultural Systems Analysis and Planning (2001). With S. Melvin. Iowa State University – 3 credits – undergraduate level
- Agricultural Waste Management (1995). Seoul National University, Korea – 30 hours – graduate level
- Biomass Refining: Pathways to Sustainability and Security (2007). Penn State University short course – professional audience.
- Midwest Composting School (1998, 1999, 2000, 2002, 2003, 2004). Joint course of University of Wisconsin, University of Minnesota and Iowa State University – professional audience
- Garbage Engineering Short Course (1993). Cornell University – professional audience
- Municipal Compost Management Short Courses (1992, 1993, 1996, 1997, 2003). Cornell Univ., Montana State Univ., San Jose, CA – professional audiences
- Ag. Eng. 672 - Drainage (1987, co-taught with T.S. Steenhuis). Cornell University – 3 credits – graduate level
- Energy Management 100 - Fundamentals of Solar Design (1981). Edmonds (Wa.) Community College – 3 credits – undergraduate level

MANAGEMENT EXPERIENCE

Director, Penn State Institutes of Energy and the Environment. Penn State University. University Park, PA. 2008-present.

- Facilitate research, teaching, and outreach for over 500 faculty and over \$100 million of research expenditures annually
- Develop and implement strategic initiatives in energy and environmental research
- Engage industrial, governmental and foundation partners
- Supervise staff of 11 in accounting, office administration, communications, information technology, and spatial analysis.

Director, Biomass Energy Center. Penn State University, University Park, PA. 2006 - present.

- Coordinate research and outreach activities for over 70 faculty.
- Plan and organize conferences, workshops, and seminar series
- Develop industrial collaborations for faculty across the university

Director. Northeast Sun Grant Center of Excellence, Penn State University, University Park, PA. 2014 – present.

- Managed USDA center to support Northeast bioeconomy
- Awarded and administered over \$2 million in regional grants

Deputy Technical Director. National Risk Assessment Partnership. Department of Energy, National Energy Technology Laboratory, Pittsburgh, PA. 2012 – present.

- Coordinate carbon storage risk assessment among 5 DOE National Labs.

Project Manager. Rebound Building Materials Recycling Project, Central Area Motivation Program. Seattle, WA. 1981-1983.

- Conceived, developed, and managed a non-profit building materials recycling business.
- Developed strategies for advertising, soliciting donations, sales, staffing, inventory, accounting, etc.

Operations Manager. Seattle Recycling, Inc. Seattle, WA. 1978-1981.

- Managed the City of Seattle's home collection of recyclables pilot project.
- Supervised collection and processing of materials from 20,000 homes.

ARTICLES IN REFEREED JOURNALS

Hoffman, E., Cavigelli, M.A., Camargo, G., Ryan, M., Ackroyd, V.J., Richard, T.L. and S. Mirsky. 2018. Energy use and greenhouse gas emissions in organic and conventional grain crop production: Accounting for nutrient inflows. *Agricultural Systems*. 162:89-96. DOI:10.1016/j.agsy.2018.01.021

Malone, R.W., J.F. Obrycki, D.L. Karlen, L.Ma, T.C. Kaspar, D.B. Jaynes, T.B. Parkin, S.H. Lence, G.W. Feyereisen, Q.X. Fang, **T.L. Richard**, and K. Gillette. 2018. Harvesting fertilized rye cover crop: Simulated revenue, net energy, and drainage nitrogen loss. *Agricultural and Environmental Letters* 3:170041, doi:10.2134/aer2017.11.0041

Wolfe, M.L. and **T.L. Richard**. 2017. 21st century engineering for on-farm food-energy-water systems. *Current Opinion in Chemical Engineering* 18:69-76, <https://doi.org/10.1016/j.coche.2017.10.005>

Ligaba-Osena, A., B. Hankoua, K. DiMarco, R. Pace, M. Crocker, J. McAtee, N> Nagachar, M. Tien and **T.L. Richard**. 2017. Reducing biomass recalcitrance by heterologous expression of a bacterial peroxidase in tobacco (*Nicotiana benthamiana*). *Scientific Reports* 7:17104, <https://www.nature.com/srep/> ; doi:10.1038/s41598-017-16909-x

Dale, V.W., K.L. Kline, **T.L. Richard**, D.L. Karlen and W.W. Belden. 2017. Bridging biofuel sustainability indicators and ecosystem services through stakeholder

- engagement. *Biomass and Bioenergy (in press)*,
<https://doi.org/10.1016/j.biombioe.2017.09.016>
- Liu, W., J. Wang, **T.L. Richard**, D. Hartley, S. Spatari, and T. Volk. 2017. Economic and Life Cycle Analyses of Biomass Utilization for Bioenergy Products in the Northeastern United States. *Biofuels, Bioproducts and Biorefining* 11(4):633-647. DOI: 10.1002/bbb1770
- Ramcharan, A.M, and **T.L. Richard**. 2017. Carbon and nitrogen environmental trade-offs of winter rye cellulosic biomass in the Chesapeake Watershed. *Agricultural Systems* 156:85-94. <http://dx.doi.org/10.1016/j.agsy.2017.05.017>
- Bonifacio, H.L. C.A. Rotz and **T.L. Richard**. 2017. A process based model for cattle manure compost windrows: Part 2. Model performance and application. *Transactions of the ASABE* 60(3):893-913.
- Bonifacio, H.L. C.A. Rotz and **T.L. Richard**. 2017. A process based model for cattle manure compost windrows: Part 2. Model description. *Transactions of the ASABE* 60(3):877-892.
- Pandey, J.L., S. N. Kiemle, **T.L. Richard**, Y. Zhu, D.J. Cosgrove and C.T. Anderson. 2016. Investigating biochemical and developmental dependencies of lignification with a click-compatible monolignol analog in *Arabidopsis thaliana* stems. *Frontiers in Plant Science Research* 7:1309. doi: [10.3389/fpls.2016.01309](https://doi.org/10.3389/fpls.2016.01309)
- Carroll, S., J. W. Carey, D. Dzombak, N.J. Huerta, L.Li, **T.L. Richard**, W. Um, S.D.C. Walsh and L. Zhang. 2016. Review: Role of chemistry, mechanics, and transport on well integrity in CO₂ storage environments. *International Journal of Greenhouse Gas Control* 49:149-160. DOI: 10.1016/j.ijggc.2016.01.010
- Xiong, X., **T.L. Richard** and M. Kumar. 2015. Integrated acidogenic digestion and carboxylic acid separation by nanofiltration membranes for the lignocellulosic carboxylate platform. *Journal of Membrane Science* 489:275-283. DOI: [10.1016/j.memsci.2015.04.022](https://doi.org/10.1016/j.memsci.2015.04.022)
- Kapp, N.E., W.J. Barnes, **T.L. Richard** and C.T. Anderson. 2015. Imaging with the fluorogenic dye Basic Fuchsin reveals subcellular patterning and ecotype variation of lignification in *Brachypodium distachyon*. *Journal of Experimental Botany* erv158. DOI: 10.1093/jxb/erv158.
- Shao, X., K.M DiMarco, **T.L. Richard** and L.R Lynd. 2015. Winter rye as a bioenergy feedstock: impact of crop maturity on composition, biological solubilization and potential revenue. *Biotechnology for Biofuels* 8:35. DOI: 10.1186/s13068-015-0225-z.

- Pandey, J.L., B. Wang, B.G. Diehl, **T.L. Richard**, G. Chen, and C.T. Anderson. 2015. A versatile click-compatible monolignol probe to study lignin deposition in plant cell walls. *PLOS ONE* 10(4) e0121334.
- Malcolm, G.M., G.G.T. Camargo, V.A. Ishler, **T.L. Richard**, and H.D. Karsten. 2015. "Corrigendum to Energy and greenhouse gas analysis of northeast U.S. dairy cropping systems." *Agriculture, Ecosystems & Environment* 204: 83-84.
- Malcolm, G.M., G.G.T. Camargo, V.A. Ishler; **T.L. Richard** and H.D. Karsten. 2015. Energy and greenhouse gas analysis of northeast U.S. dairy cropping systems. *Agriculture, Ecosystems and Environment* 199:407-417.
- Bukowski, N., J.L. Pandey, L. Doyle, **T.L. Richard**, C.T. Anderson and Y. Zhu. 2014. Development of a clickable designer monolignol for interrogation of lignification in plant cell walls. *Bioconjugate Chemistry*. 25(12): 2189-2196.
- Dale, B.E., J.E. Anderson, R.C. Brown, S. Csonka, V.H. Dale, G. Herwick, R.D. Jackson, N. Jordan, S. Kaffka, K.L. Kline, L.R. Lynd, C. Malmstrom, R.G. Ong, **T.L. Richard**, C. Taylor and M.Q. Wang. 2014. Take a closer look: Biofuels can support environmental, economic and social goals. *Environmental Science and Technology* 48(13):7200-7203. DOI: 10.1021/es5025433.
- Camargo, G.T.T., M.R. Ryan and **T.L. Richard**. 2013. Energy use and greenhouse gas emissions from crop production using the Farm Energy Analysis Tool. *Bioscience* 63(4):263-273.
- Feyereisen, G.W., G.T.T. Camargo, R.E. Baxter, J.M. Baker and **T.L. Richard**. 2013. Cellulosic biofuel potential of a winter rye double crop across the U.S. corn-soybean belt. *Agronomy Journal* 105(3):631-642.
- Glanville, T.D., H.K. Ahn, **T.L. Richard**, J.D. Harmon, D.L. Reynolds, and S. Akinc. 2013. Effect of envelope material on biosecurity during emergency bovine mortality composting. *Bioresource Technology* 130:543–551.
- Tanjore, D., **T.L. Richard** and M.N. Marshall. 2012. Experimental methods for laboratory-scale ensilage of lignocellulosic biomass. *Biomass and Bioenergy* 47:125-133.
- Brownell, D.K., J. Liu, J.W. Hilton, **T.L. Richard**, G.R. Cauffman, B.R. Macafee. 2012. Evaluation of two forage harvesting systems for herbaceous biomass harvesting. *Transactions of the ASABE* 55(5): 1651-1658.
- Chen, Q., M.N. Marshall, S.M. Geib, M. Tien and **T.L. Richard**. 2012. Effects of laccase on lignin depolymerization and enzymatic hydrolysis of ensiled corn stover. *Bioresource Technology* 117:186-193.

- Speer, M.A. and **T.L. Richard**. 2011. Amplified insert assembly: an optimized approach to standard assembly of BioBrick™ genetic circuits. *Journal of Biological Engineering* 5:17.
- Lee, R.L., R.A. Aziz, C.H. de Brito Cruz, A.F.A. Chimphango, L.A.B. Cortez, A. Faaij, N. Greene, M. Keller, P. Osseweijer, **T.L. Richard**, J. Sheehan, A. Chugh, L. van der Wielen, J. Woods, and W.H. van Zyl. 2011. A global conversation about energy from biomass: the continental conventions of the global sustainable bioenergy project. *Interface Focus* 1(2):271-279.
- Baxter, R., G. Feyereisen, Y. Yu, and **T.L. Richard**. 2011. Winter crop and residue biomass potential in China. *Biofuels* 2(5):503-513.
- Durre, P and **T. Richard**. 2011. Microbial energy conversion revisited. *Current Opinion in Biotechnology* 22(3): 309-311.
- Webber, D.F., S.K. Mickelson, B.D. Whitman **T.L. Richard**, and H.K. Ahn. 2011. Livestock manure composting runoff and infiltration characteristics from laboratory rainfall simulations. *Compost Science and Utilization* 19(1):6-14.
- Richard, T.L.** 2010. Challenges in scaling up biofuels infrastructure. *Science* 329: 793 – 796.
- Webber, D.F., S.K. Mickelson, L.W. Wulf, **T.L. Richard**, and H.K. Ahn. 2010. Hydrologic modeling of runoff from a livestock manure windrow composting site with a fly ash pad surface and vegetative filter strip buffers. *Journal of Soil and Water Conservation* 65(4): 252-260.
- Chaoui, H., F. Montes, C. A. Rotz, and **T. L. Richard**. 2009. Volatile ammonia fraction and flux from thin layers of buffered ammonium solution and dairy cattle manure. *Transactions of the ASABE* 52(5):1695-1706.
- Chianese, D.S., C. A. Rotz, and **T. L. Richard**. 2009. Simulation of nitrous oxide emissions from dairy farms to assess greenhouse gas reduction strategies. *Transactions of the ASABE* 52(4): 1325-1335.
- Chianese, D.S., C. A. Rotz, and **T. L. Richard**. 2009. Simulation of methane emissions from dairy farms to assess greenhouse gas reduction strategies. *Transactions of the ASABE* 52(4): 1313-1323
- Chianese, D.S., C. A. Rotz, and **T. L. Richard**. 2009. Simulation of carbon dioxide emissions from dairy farms to assess greenhouse gas reduction strategies. *Transactions of the ASABE* 52(4): 1301-1312
- Chianese, D.S., C. A. Rotz, and **T. L. Richard**. 2009. Whole-farm greenhouse gas emissions: A review with application to a Pennsylvania dairy farm. *Applied Engineering in Agriculture* 25(3):431-442.

- Rezaei, F., D. Xing, R. Wagner, J.M. Regan, **T.L. Richard**, and B.E. Logan. 2009. Simultaneous cellulose degradation and electricity production by *Enterobacter cloacae* in a microbial fuel cell. *Applied and Environmental Microbiology* 75(11):3673–3678.
- Rezaei, F., **T.L. Richard**, and B.E. Logan. 2009. Analysis of chitin particle size on maximum power generation, power longevity, and Coulombic efficiency in solid–substrate microbial fuel cells. *Journal of Power Sources* 192:304–309
- Webber, D.F., S.K. Mickelson, **T.L. Richard**, and H.K. Ahn. 2009. Effects of a livestock manure windrow composting site with a fly ash pad surface and vegetative filter strip buffers on sediment, nitrate, and phosphorus losses with runoff. *Journal of Soil and Water Conservation* 64(2):163-171.
- Ahn, H.K., T.J. Sauer, **T.L. Richard**, and T.D. Glanville. 2009. Determination of thermal properties of composting bulking materials. *Bioresource Technology* 100:3974-3981.
- Glanville, T.D., H.K. Ahn, **T.L. Richard**, and J.D. Harmon. 2008. Soil contamination caused by emergency bio-reduction of catastrophic livestock mortalities. *Water, Air, and Soil Pollution* 198(1):285-296.
<http://www.springerlink.com/content/0741054891354460/fulltext.html>)
- Rezaei, F., **T.L. Richard**, and B.E. Logan. 2008. Enzymatic hydrolysis of cellulose coupled with electricity generation in a microbial fuel cell. *Biotechnology and Bioengineering* 101(6): 1163-1169.
- Weiss LE, J.P. Badalamenti, L.J. Weaver, A.R. Tascone, P.S. Weiss, **T.L. Richard**, and P.C. Cirino. 2008. Engineering motility as a phenotypic response to LuxI/R-dependent quorum sensing in *Escherichia coli*. *Biotechnology and Bioengineering* 100(6):1251-1255.
- Norman, H., H.M. Hanna, and **T.L. Richard**. 2008. Solid manure distribution by rear- and side-delivery spreaders. *Transactions of the ASABE*. 51(3):831-843.
- Ahn, H.K., **T.L. Richard** and T.D.Glanville. 2008. Optimum moisture levels for biodegradation of mortality composting envelope materials. *Waste Management* 28(8):1411-1416.
- Ahn, H.K., **Richard, T.L.**, Glanville, T.D., 2008. Laboratory determination of compost physical parameters for modeling of airflow characteristics. *Waste Management* 28(3):660-670.
- Leuer, E.R., J. Hyde, and **T.L. Richard**. 2008. Investing in methane digesters on Pennsylvania dairy farms: implications of scale economies and environmental

- programs. *Agricultural and Resource Economics Review* 37(2): 1-16
- Murphy, P.T., K.J. Moore, **T.L. Richard**, and C.J. Bern, and T.J. Brumm. 2007. Use of swine manure to improve solid-state fermentation in an integrated storage and conversion system for corn stover. *Transactions of the ASABE* 50(5):1901-1906.
- Badalamenti, J.P., L.E. Weiss, C.J. Buckno, **T.L. Richard**, P.S. Weiss, and P.C. Cirino. 2007. Synthetic sports: a bacterial relay race. *IET Synthetic Biology* 1(1.2):61-63
- Rezaei, F., **T.L. Richard**, R.A. Brennan, and B.E. Logan. 2007. Substrate-enhanced microbial fuel cells for improved remote power generation from sediment-based systems. *Environmental Science and Technology* 41(11):4053-4058.
- Ren, H., **T.L. Richard**, and K.J. Moore. 2007. The impact of enzyme characteristics on corn stover fiber degradation and acid production during ensiled storage. *Appl. Biochem. Biotechnol.* 136-140:221-238.
- Murphy, P.T., K.J. Moore, **T.L. Richard**, and C.J. Bern. 2007. Enzyme enhanced solid-state fermentation of kenaf core fiber for storage and pretreatment. *Bioresource Technology* 98(16):3106-3111.
- Ahn, H.K., **T.L. Richard**, and H.L. Choi. 2007. Mass and thermal balance during composting of a poultry manure - wood shavings mixture at different aeration rates. *Process Biochemistry* 42 (2): 215-223.
- Bennett., A.S., C.J. Bern, **T.L. Richard**, and R.P. Anex. 2007. Corn grain drying using corn stover combustion and CHP systems. *Transactions of the ASABE* 50(6):2161-2170.
- Richard, T.L.**, L.P. Walker, and J.M. Gossett. 2006. Effects of oxygen on aerobic solid-state biodegradation kinetics. *Biotechnology Progress* 22(1):60-69
- Richard, T.L.** and L.P. Walker. 2006. Modeling the temperature kinetics of aerobic solid-state biodegradation. *Biotechnology Progress* 22(1):70-77.
- Sadaka, S.S., **T.L. Richard**, T.D. Loecke, and M. Liebman. 2006. Determination of compost respiration rates using pressure sensors. *Compost Science and Utilization* 14 (2): 124-131.
- Ren, H., **T.L. Richard**, Z. Chen, M. Kuo, Y. Bian, K.J. Moore, and P. Patrick. 2006. Ensiling Corn Stover: Effect of Feedstock Preservation on Particleboard Performance. *Biotechnology Progress* 22(1):78-85.
- McAndrews, G.M., M. Liebman, C.A. Cambardella, and **T.L. Richard**. 2006. Residual effects of composted and fresh solid swine (*Sus scrofa* L.) manure on soybean [*Glycine max* (L.) Merr.] growth and yield. *Agronomy Journal* 98 (4): 873-882.

- Rosentrater, K.A., **T.L. Richard**, C.J. Bern and R.A. Flores. 2005. Small-scale extrusion of corn masa by-products. *Cereal Chemistry* 82(4):436-446.
- Persyn, R.A., T.D. Glanville, **T.L. Richard**, J.M. Laflen, P.M. Dixon. 2005. Environmental effects of applying composted organics to new highway embankments – Part 3– Rill erosion. *Transactions of the ASAE*, 48(5):1765-1772.
- Garrison, M.V. and **T.L. Richard**. 2005. Methane and manure: Feasibility analysis of price and policy alternatives. *Trans. ASAE* 48(3): 1287-1294.
- Richard, T.L.**, A.H.M. Veeken, V. De Wilde, and H.V.M. Hamelers. 2004. Air-filled porosity and permeability relationships during solid-state fermentation. *Biotechnology Progress* 20(5):1372-1381.
- Liang, Y., H. Xin, S.J.Hoff, **T.L. Richard** and B.J. Kerr. 2004. Performance of single point monitor in measuring ammonia and hydrogen sulfide gases. *Applied Engineering in Agriculture* 20(6):863-872.
- Persyn, R.A., T.D. Glanville, **T.L. Richard**, J.M. Laflen, and P.M. Dixon. 2004. Environmental effects of applying composted organics to new highway embankments - Part 1 - Interrill runoff and erosion. *Trans. ASAE* 47(2): 463–469.
- Glanville, T.D., R.A. Persyn, **T.L. Richard**, J.M. Laflen, and P.M. Dixon. 2004. Environmental effects of applying composted organics to new highway embankments - Part 2 - Water quality. *Trans. ASAE* 47(2): 471-478.
- Singer, J.W., K.A. Kohler, M. Liebman, **T.L. Richard**, C. Cambardella, and D.D. Buhler. 2004. Tillage and compost affect yield of corn, soybean, and wheat and soil fertility. *Agronomy Journal* 96:531-537.
- Loecke, T.D., M. Liebman, C.A. Cambardella, and **T.L. Richard**. 2004. Time of application and composting affect corn (*zea mays* L.) yield response to solid swine (*sus scrofa* L.) manure. *Agronomy Journal* 96: 214-223.
- Loecke, T.D., M. Liebman, C.A. Cambardella, and **T.L. Richard**. 2004. Corn growth responses to composted and fresh solid manures. *Crop Science* 44:177-184.
- Liebman, M., F. Menalled, D. Buhler, **T.L. Richard**, D. Sundberg, C. Cambardella, and K. Kohler. 2004. Impacts of composted swine manure on weed and corn nutrient uptake, growth, and seed production. *Weed Science* 52:365-375.

- Richard, T.L.** and C.C. Hinrichs. 2003. Management and maintenance of earthen manure structures: implications and opportunities for water quality protection. *Applied Engineering in Agriculture* 18(6):727-734.
- Cambardella, C.A., **T.L. Richard**, and A. Russell. 2003. Compost mineralization in soil as a function of composting process conditions. *European Journal of Soil Biology* 39:117-127.
- Rosentrater, K.A., **T. L. Richard**, C. J. Bern, and R. A. Flores. 2003. Economic simulation modeling of reprocessing alternatives for corn masa byproducts *Resources, Recycling and Conservation* 39(4):341-367.
- Richard, T.L.**, H.V.M. Hamelers, A.H.M. Veeken and T. Silva. 2002. Moisture relationships in composting processes. *Compost Science and Utilization* 10(4):286-302.
- Tiquia, S.M., **T.L. Richard** and M.S. Honeyman. 2002. Carbon, nutrient and mass loss during composting. *Nutrient Cycling in Agricultural Ecosystems*. 62(1):15-24.
- Choi, H.L., **T.L. Richard**, and H.K. Ahn. 2001. Composting high moisture materials: biodrying poultry manure in a sequentially fed reactor. *Compost Sci. and Util.* 9(4):303-311.
- Honeyman, M.S., J.D. Harmon, J.B. Kliebenstein, and **T.L. Richard**. 2001. Feasibility of hoop structures for market swine in Iowa: pig performance, pig environment, and budget analysis. *Applied Engineering in Agriculture* 17(6):869-874.
- Tiquia S.M., **T.L. Richard** and M.S. Honeyman. 2000. Effect of windrow turning and seasonal temperatures on composting of hog manure from hoop structures. *Environ. Technol.* 20(9):1037-1046.
- Richard, T.L.**, and H.L. Choi. 1999. Eliminating Waste: Strategies for sustainable manure management. *Asian-Aus. J. Anim. Sci.* 12(7):1162-1169.
- Richard, T.L.**, L.P. Walker, and J.M. Gossett. 1999. The effects of oxygen on solid-state biodegradation kinetics. *Proceedings of the Inst. of Biological Engineering* 2:A10-A30. IBE Publications, Athens, GA.
- Rosentrater, K.A., R. A. Flores, **T. L. Richard**, and C. J. Bern. 1999. Characterization of agribusiness residues: physical and nutritional properties of corn masa byproduct streams. *Applied Engineering in Agriculture* 15(5):515-523.
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- Choi, H.L., **T.L. Richard** and H.T. Kim. 1996. Composting high moisture materials: bio-drying poultry manure in a sequentially fed reactor. *Korean J. of Anim. Sci.* 38(6):649-658.
- Richard, T.L.** 1992. Municipal solid waste composting: physical and biological processing. *Biomass and Bioenergy* 3(3-4):163-180.
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INVITED LECTURES

Richard, T.L. Making the Numbers Count: Toward a general framework for bioeconomy carbon accounting. University of Freiburg. June 8, 2015. Freiburg, Germany.

Richard, T.L. Five myths? A look “under the hood” and common assumptions about biofuels. University of California Berkeley, Energy Biosciences Institute. Sept. 9, 2014. Berkeley, CA.

Richard, T.L., M. Jahn and D. Lazaks. Knowledge Systems for Sustainability: Lessons learned from a global community of practice. Annual Meeting, Ecological Society of America. August 13, 2014, Sacramento, CA.

Richard, T.L. Food vs. Fuel: Ecological Intensification and the Diet Nexus. University of California Berkeley, Energy Biosciences Institute. June 13, 2013. Berkeley, CA.

Richard, T.L. Double Crops: Linking Sustainable Energy and Sustainable Agriculture. Michigan State University. May 13, 2013. East Lansing, MI.

Richard, T.L. NEWBio: Growing Sustainable Bioenergy Crops in the Northeast. Pennsylvania Association of Environmental Professionals Annual Conference. May 8, 2013. State College, PA.

Richard, T.L. The NEWBio Consortium – Scaling-up for the Region. Northeast Biomass Heating Seminar. April 3, 2013. Saratoga Springs, NY.

Richard, T.L. Smart Energy. American Physical Society March Meeting. March 18, 2013. Baltimore, MD.

Richard, T.L. NEWBio: The Northeast Woody/Warmseason Biomass Consortium. Washington State University. January 22, 2013. Pullman, WA.

Richard, T.L. Diversity Just in Time: Winter Crops as Energy Crops. January 8, 2013. New Brunswick, NJ.

Richard, T.L. The Northeast Woody/Warmseason Biomass Consortium – New Business Models for Perennial Biofuels. ASA, CSSA, and SSSA International Annual Meetings. October 21, 2012. Cincinnati, OH.

- Richard, T.L.** Global sustainable bioenergy: Project overview. North American Convention of the Global Sustainable Bioenergy Project. September 15, 2010. Minneapolis, MN.
- Richard, T.L.** Biomass Energy: Feast or Famine in a Carbon-Constrained World. Babcock and Wilcox Energy Summit. September 14, 2010. Akron, OH.
- Richard, T.L.** Re-imagining Northeast Farms and Forests for Sustainable Bioenergy. NE Sun Grant Annual Conference. May 16, 2010. Syracuse, NY
- Richard, T.L.** Windows of opportunity: Re-imagining agriculture for Food, Fuel, and the Environment. University of California Berkeley. May 4, 2010. Berkeley, CA.
- Richard, T.L.** Synthetic silage: Engineering a Microbial Platform for Biomass Pretreatment. DOE Lawrence Berkeley National Lab. May 4, 2010. Berkeley, CA.
- Richard, T.L.** Global sustainable bioenergy: Project overview. European Convention of the Global Sustainable Bioenergy Project. March 18, 2010. Stellenbosch, South Africa.
- Richard, T.L.** Global sustainable bioenergy: Project overview. European Convention of the Global Sustainable Bioenergy Project. February 25, 2010. Delft, The Netherlands.
- Richard, T.L.** Sustainable Cellulosic Biofuels 101. February 15, 2010. Ag 160 class. University Park, PA.
- Richard, T.L.** Managing Motility: A Bacterial Relay Race. February 12, 2010. NSF Synthetic Biology Lecture Series. Missouri Western University. St. Joseph, MO.
- Richard, T.L.** Penn State's Bioenergy Bridge. RETECH Annual Conference. February 5, 2010. Washington, DC.
- Richard, T.L.** Bioenergy: Science, technology, sustainability. Renewable Natural Resources Foundation. December 9, 2009. Reston, VA.
- Richard, T.L.** Biofuels and the Bay – an Update. Chesapeake Bay Program Science and Technology Advisory Board. December 8, 2009. Annapolis, MD.
- Richard, T.L.** Energy and environmental impacts of on-farm bioenergy production. Reimagining Sustainable Bioenergy Landscapes. December 3, 2009. University Park, PA.

- Richard, T.L.** Energy and environmental impacts of on-farm bioenergy production. Growing the Bioeconomy: Solutions for Sustainability conference. December 1, 2009, East Lansing, MI.
- Richard, T.L.** Bioenergy and sustainability. World Energy Engineering Conference. November 5, 2009. Washington, DC.
- Richard, T.L.** Biomass conversion 101. Cooperative Extension In-service. Cornell University. November 4, 2009, Ithaca, NY.
- Richard, T.L.** Challenges and Opportunities for Bioenergy Production in Maine and the Northeast. University of Maine. October 8, 2009, Orono, ME.
- Richard, T.L.** Sustainable feedstock infrastructure. Biofuels for Aviation Summit. September 1, 2009. Arlington, VA.
- Richard, T.L.** Harvest, storage and transportation; Pretreatment; Fermentation; Systems Analysis (four lectures). US-Brazil Fulbright Short Course. August 1-10, 2009. Sao Paulo, Brazil.
- Richard, T.L.** Feedstock infrastructure: another gathering storm. Keystone Symposium: The Future of Biofuels. April 4-8, 2009. Snowmass, CO.
- Richard, T.L.** After abundance: sustainable biofuel production in a carbon-constrained world. Feb. 16, 2009. West Virginia University. Morgantown, WV.
- Karsten, H., E. Sanchez, **T.L. Richard**, and E. Swackhamer. Using organic nutrient sources and interpreting soil and compost analysis. PASA Annual Farming for the Future Conference. Feb. 5-7, 2009. University Park, PA.
- Richard, T.L.**, and John Esslinger. Using organic nutrient sources. NOFA-NY Annual Organic Farming and Gardening Conference. Jan. 23-35, 2009. Rochester, NY.
- Richard, T.L.** and G. Roth. New renewable energy technologies and their impact on agriculture. 2009 Pennsylvania Agronomic Education Conference. Jan. 21-23, 2009. State College, PA.
- Richard, T.L.** After abundance: multi-functional agriculture for a carbon-constrained world. Geography Coffee Hour. Jan. 16, 2009. University Park, PA.
- Richard, T.L.** Lean and Green: Reimagining agriculture for the 21st century. Maine Agricultural Trade Show. Jan. 13-14, 2009. Augusta, ME.
- Richard, T.L.** After Abundance: multi-functional agriculture for a carbon-constrained world. Northeast Weed Science Society Annual Meeting. January 5-8, 2009. Baltimore, MD.

- Richard, T.L.** Sustainable strategies for biofuel production. AIChE Annual Meeting. Nov. 16-21, 2008. Philadelphia, PA.
- Richard, T.L.** Biofuel opportunities and impacts for NY farms, NYS, and the Northeast. Empire Chapter of the Soil and Water Conservation Society Annual Meeting. Nov. 13, 2008. Waterloo, NY.
- Richard, T.L.** Compost engineering: linking microbial kinetics with transport phenomena. CEMAGREF Symposium. Oct. 20, 2008. Rennes, France.
- Richard, T.L.** Compost by design. Veolia Environnement Research Centre. Oct. 16, 2008. Lemay, France.
- Logan, B.E. and **T.L. Richard**. Energy sustainability of the water infrastructure and agriculture. KAUST Global Research Partnership Technical Symposium. May 28. Jeddah, Saudi Arabia.
- Richard, T.L.** Penn State Institutes of Energy and the Environment: building bridges for transformative research. University of Kentucky Environmental Initiative. May 14, 2008. Lexington, KY
- Richard, T.L.** Materials, energy and the environment: what matters? Materials Day, Penn State. April 15, 2008. State College, PA.
- Richard, T.L.** Roadmap for a clean energy future: sustainable agriculture for a sustainable society. New American Farm Conference. March 25-27, 2008. Kansas City, MO.
- Richard, T.L.** Biofuels: tapping Nature's abundance. Frontiers of Science Lecture Series. Feb. 16, 2008. University Park, PA.
- Richard, T.L.** Science and entrepreneurship in alternative energy technologies. Pennsylvania Biotechnology Center Seminar Series. Feb. 29, 2008. Doylestown, PA.
- Richard, T.L.** Biomass to biofuels: innovations for the next generation. Energy from Biomass from Waste Conference. Sept. 26-27, 2007. Pittsburgh, PA.
- Richard, T.L.** Biofuels: agriculture's ticket to the head of the table? American Forage and Grassland Council Annual Meeting. June 25, 2007. State College, PA.
- Richard, T.L.** Challenging technologies: toward a sustainable bioenergy system. DOE Workshop on Economic, Environmental, and Societal Implications of Bioenergy. June 21-22, 2007. Washington, DC.

- Richard, T.L.** Sustainable Energy and Sustainable Agriculture. Annual International Meeting of the American Society of Agricultural and Biological Engineers. July 9-12, 2006. Portland, OR.
- Richard, T.L.** Biomass use in energy production: new opportunities for agriculture. United States Senate Committee on Agriculture, Nutrition, and Forestry. May 6, 2004
- Richard, T.L.** Composting wood and fish waste: applications to Alaska. USDA Forest Service Conference – Linking Healthy Forests and Communities: Successful Strategies and Future Directions. Oct. 19-21, 2003. Anchorage, AK.
- Richard, T.L.** Aerobic bioprocess concepts. European Summer School on Biotechnology in Organic Waste Management. June 29 - July 4, 2003. Wageningen, The Netherlands.
- Richard, T.L.** Innovations in Fermentations: Ecological Engineering on a Microbial Scale. Midwest Rural Energy Council. Sept. 12, 2003. Redwing, MN.
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Sanchez, E., and **T.L. Richard**. 2008. *Using Organic Nutrient Sources*. Publication UJ256. 16 pp. Penn State Cooperative Extension, University Park, PA.

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Dickson, N., V. Wishart and **T.L. Richard**. "Home composting." 1989. A set of seven posters. Cornell Resource Center, Ithaca, NY.

Richard, T.L. and G. Ferenz. 1988. Composting landscape wastes. *Grounds Maintenance* 23(9). 4 pp.

Richard, T.L. 1988. Composting on the farm deserves a fresh look. Agricultural News Service, Cornell Cooperative Ext.

Richard, T.L. 1983. *Rebound: a model for community based building materials recycling*. Central Area Motivation Program. Seattle, WA.

PROFESSIONAL ACTIVITIES

Technical Reviewer

Advances in Environmental Research

American Journal of Alternative Agriculture

Applied Engineering in Agriculture

Transactions of the ASABE (Editorial Board 2003 - 2006)

BioCycle (Editorial Board)

Biofuels (Editorial Board)

Biomass and Bioenergy (Guest Editor, Vol.3 (3-4))

Bioprocessing of Solid Waste and Sludge (Editorial Board 2000 - 2002)

Biotechnology Progress

Compost Science and Utilization (Editorial Board 1993 - present)

Environmental Practice

Geomicrobiology

Journal of Biological Engineering (Editorial Board 2007 - present)

Journal of Environmental Quality

Waste Management (Editorial Board 2000 - 2012)

Waste Management and Research

Water Resources Research

Professional Affiliations

American Society of Agricultural and Biological Engineers (ASABE)

Institute Of Biological Engineering (President-Elect 2006; President 2007; Treasurer, 1998-2001, 2004-2005; Council, 2003)

Sigma Xi

Consulting

City of San Jose, California
County of Santa Clara, California
Federal Trade Commission
Iowa State University
McDonalds Corporation
Montana State University
Organic Recycling Inc.
Seoul Dairy Cooperative, Korea
State of Arkansas
State of Texas
University of Florida
University of Wisconsin
University of Minnesota
United States Department of Agriculture
United States Department of Energy
United States Environmental Protection Agency
United States Forest Service
World Bank

HONORS AND AWARDS

Fellow, Institute of Biological Engineering (2008)
Honorary Scientist, Korean Rural Development Administration (1996-2008)
ASABE – Blue Ribbon Awards (1991, 1993, 2001, 2003, 2005)
Iowa State University College of Agriculture Team Award (2002)
AAAS – Science NetLinks On-line (2001)
ASABE – Newcomer Engineer of the Year, Iowa Section (2001)
New York State Assoc. of County Agricultural Agents – Special Citation (1993)
Cornell Community and Rural Development Institute – Innovator Award (1992)
New York State Assoc. of County Agricultural Agents – Award for outstanding new extension publication (1990)

GRANTS AND CONTRACTS

Lynd, L.R. and **T.L. Richard**. Cotreatment With Bacterial Processing for Low-Cost Production Conversion of Cellulosic Biomass to Biofuels. USDA-BRDI. \$1,849,840. 8/1/2016-7/31/2019.

- Comer, K., D. Karlen, V. Dale, R. Hess, D. Muth, **T.L. Richard**, A. Kemanian, M. Wu and J. Dunn. Enabling Sustainable Landscape Design for Continual Improvement of Operating Bioenergy Supply Systems. DOE. \$9,000,000. 11/1/15 to 10/31/20.
- Owens, V., Rials, T., Hunke, R., Talbot, J., Thompson, G. and **T.L. Richard**. USDA-NIFA. Advancing the National Bioeconomy through Existing Regional Sun Grant Centers. \$2,328,672. 10/1/15 to 9/30/20.
- Richard, T.L.** USDA - Borlaug (Colombia) Fellowship Proposal – 2015. USDA-Foreign Agricultural Service. \$29,891. 9/30/2015-12/31/2017.
- Zipp, K, C. Burgess-Clifford, L. Fowler and **T.L. Richard**. FAA-ASCENT. PSU’s Role in the Techno-Market Analysis of U.S. Biorefinery Supply Chains from Feedstock to Alternative Jet Fuels \$280,000. 8/01/2015 – 7/31/2017.
- Hankoua, B., and **T.L. Richard**. Transgenic Self-Processing Energy Grasses for Efficient and Cost-Effective Production of Biofuels. USDA-NIFA. \$47,000. 10/1/15 to 6/30/17.
- Owens, V., Rials, T., Hunke, R., Talbot, J., Thompson, G. and **T.L. Richard**. USDA-NIFA. Advancing the National Bioeconomy through Regional Sun Grant Centers. \$2,328,120. 10/1/14 to 9/30/19
- Demirci A. D. Ciolkosz, **T.L. Richard**, J. Liu, J. Carlson and S. Wurzbacher. Course Development for Innovative Online Bioenergy Education. USDA-NIFA. \$136,500. 9/1/2014 to 8/31/2017.
- Smith, P., **T.L. Richard** and Caroline Burgess Clifford. PSU’s Role in the Techno-Market Analysis of U.S. Biorefinery Supply Chains from Feedstock to Alternative Jet Fuels. FAA. \$200,000. 8/1/2014 to 7/31/2015.
- Chopra, S., J. Carlson and **T.L. Richard**. Advanced Development of Novel Maize and Sorghum Bioenergy Plants Using Lignolink Technology. NSF-SBIR prime contract to LignoLink, Inc. Penn State subcontract \$62,442. 4/1/14 – 3/31/17.
- Shortle, J. et al. (**T.L. Richard** one of 12 Penn State co-PIs, Penn State prime). Center for Multi-Scale Nutrient Pollution Solutions. USEPA. \$2,220,649. 9/1/13-8/31/17.
- Richard, T.L.** et al. (Project Director T.L. Richard) NorthEast Woody/warmseason Biomass Consortium. USDA-NIFA Sustainable Bioenergy Coordinated Agricultural Project. \$9,998,000. 9/1/12 – 8/31/18.
- Ruark, M. et al. (**T.L. Richard** one of five Penn State co-PIs, U. Wisconsin prime). Climate Change Mitigation and Adaptation in Dairy Production Systems of the Great Lakes Region. USDA-NIFA Climate Change Coordinated Agricultural Project. \$10,000,000. 2/15/13 – 2/14/18.

Tuana, N., **T.L. Richard**, E. Schienke. Graduate Pedagogy for Ethical Dimensions of Coupled Natural and Human Systems Research. National Science Foundation. \$296,736. 8/15/11-6/30/14.

Richard, T.L., G.W. Roth and P. Adler. Biomass Feedstock Regional Partnership – Corn Stover Residue Removal. DOE subcontract through South Dakota State University. \$254,153. 10/01/07-9/30/14.

Richard, T.L. National Risk Assessment Partnership (NRAP) Deputy Technical Director. DOE-NETL. \$180,730. 1/1/2012-1/29/2017.

Cosgrove, D. et al. (**T.L. Richard** one of 18 Co-PIs). Energy Frontiers Research Center for Lignocellulose Structure and Formation. DOE EFRC DE-SC0001090. \$21,000,000. 8/1/09 – 7/31/14.

Karsten, H.K., **T.L. Richard**, W. Curran, J. Tooker, C. Altenose, D. Beegle, R. Hoover, V. Ishler, T. Beck. Integrating Strategies and Institutions for Investigating the Long-Term Sustainability of Cropping Systems. Northeast Sustainable Agriculture Research and Education/LNE09-291. \$800,000. 5/15/09-10/31/17.

Karsten, H.K., D. Beegle, **T.L. Richard**, and W. Curran. Promoting adoption of innovative conservation cropping systems on livestock farms. USDA-NRCS Conservation Innovation Grant. \$223,927. 10/1/2009-9/30/2010.

Richard, T.L. Keystone Innovation Starter Kit: Bioenergy Production Systems. Pennsylvania DCED. \$130,000. 3/15/09 – 3/14/10.

Richard, T.L. Keystone Innovation Starter Kit: Electrical Storage Technologies. Pennsylvania DCED. \$150,000. 3/15/09 – 3/14/10.

Richard, T.L. PSIEE Energy Faculty Recruitment Program. Ben Franklin Technology Development Authority. \$750,000. 1/1/08 – 6/30/10.

Richard, T.L., L. Lynd and R.P. Anex. Sustainable Bioenergy Agroecosystems. Morgan Family Foundation. \$220,000. 4/1/08 – 3/31/10.

Richard, T.L. and R. Wallace. Business plan for the BioEnergy Bridge. R.K. Mellon Foundation. \$40,000. 2/15/09 – 8/14/09.

Richard, T.L. and R. Wallace. Business plan for the BioEnergy Bridge. Heinz Endowments. \$20,000. 12/15/08 – 5/1/09.

Richard, T.L. Biofuels Fermentation Facility. Heinz Endowments. \$150,000. 6/1/08 – 5/31/09.

- Heinrichs, A.J., G. Zanton, and **T.L. Richard**. Use of distiller's grains in dairy diets: Effects on milk components in lactating cows and maximizing the use in calf and heifer diets. Pennsylvania Dept. of Agriculture. \$106,500. 1/1/08 – 12/31/10.
- Richard, T.L.**, M. Tien and D. Cosgrove. Biocatalytic approaches to biomass pretreatment. Morgan Family Foundation. \$150,000. 5/1/07 – 4/30/08.
- Richard, T.L.**, P. Woodbury, G. Hansen, B. Dale, S. Joshi, K Harting, R. Ready, P. Norris and M. Sarrantonio. Biomass feedstock production in the Northeast: economic and environmental implications. NE Sun Grant contract pending. \$439,000. 8/1/07 to 7/30/09.
- Logan, B.E. and **T.L. Richard**. Treatability study of American Eagle Paper effluent stream for use as feedstock for Microbial Fuel Cell operation. American Eagle Paper Mill. \$7,500. 7/1/08 – 12/31/08.
- Richard, T.L.** Solid state fermentation for biomass storage. DOE Idaho National Laboratory. \$20,000. 9/7/07 – 9/30/08.
- Sanchez, E.E., H.D. Karsten, **T.L. Richard** and R.C. Stehouwer. Whole farm nutrient planning for organic farms. USDA- SARE. \$96,756 5/1/07 – 5/31/10
- Brown, N., J. Catchmark, **T.L. Richard**, et al. USDA national needs fellowship for nanoscale science and engineering in forest resources. USDA. \$229,500. 1/1/07 – 12/31/11.
- Hyde, J., J. Shortle, **T.L. Richard**, J. Regan, and R.E. Graves. Improving profitability and performance of dairy manure digesters. USDA Dairy Farm Profitability Program. \$462,110. 8/1/06 to 07/31/08.
- Wheeler, E.F., R. Brandt, **T.L. Richard**, G. Varga, J. Heinrichs, R. Graves, M.A. Bruns, and C. Abdalla. Odor emission evaluations of dairy nutrient management strategies. USDA Improving Dairy Management Practices Program. \$325,325. 8/1/06 to 07/31/08.
- Richard, T.L.**, E. F. Wheeler, J. P. Kaye, M. A. Bruns, and G. A. Varga. Integrated strategies for reducing gas emissions from dairy farms. USDA Improving Dairy Management Practices Program. \$328,726. 8/1/05 to 07/31/07.
- Richard, T.L.** and K.M. Bryden. Development of computational mass and energy balance models for animal waste treatment processes. \$48,000. Korean Rural Development Administration. 4/1/2005 to 3/31/2007.
- Richard, T.L.**, R.P. Anex, K. Lamkey, K. Shinnors, S. Birrell, R. Coors, K. Moore, R. Muck, P. Scott, J. Euken, and S Greenhaugh. Integrated feedstock supply systems

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