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Session 2C Agrivoltaics: Exploring the Opportunities & Barriers to Combined Solar and Agriculture Systems

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Agrivoltaics: Exploring the Opportunities & Barriers to Combined Solar and Agriculture Systems

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Y.E.A.H. Global Virtual Conference
SDGs for the SDGs
December 9, 2020

Michigan Technological University

Meet the Researcher

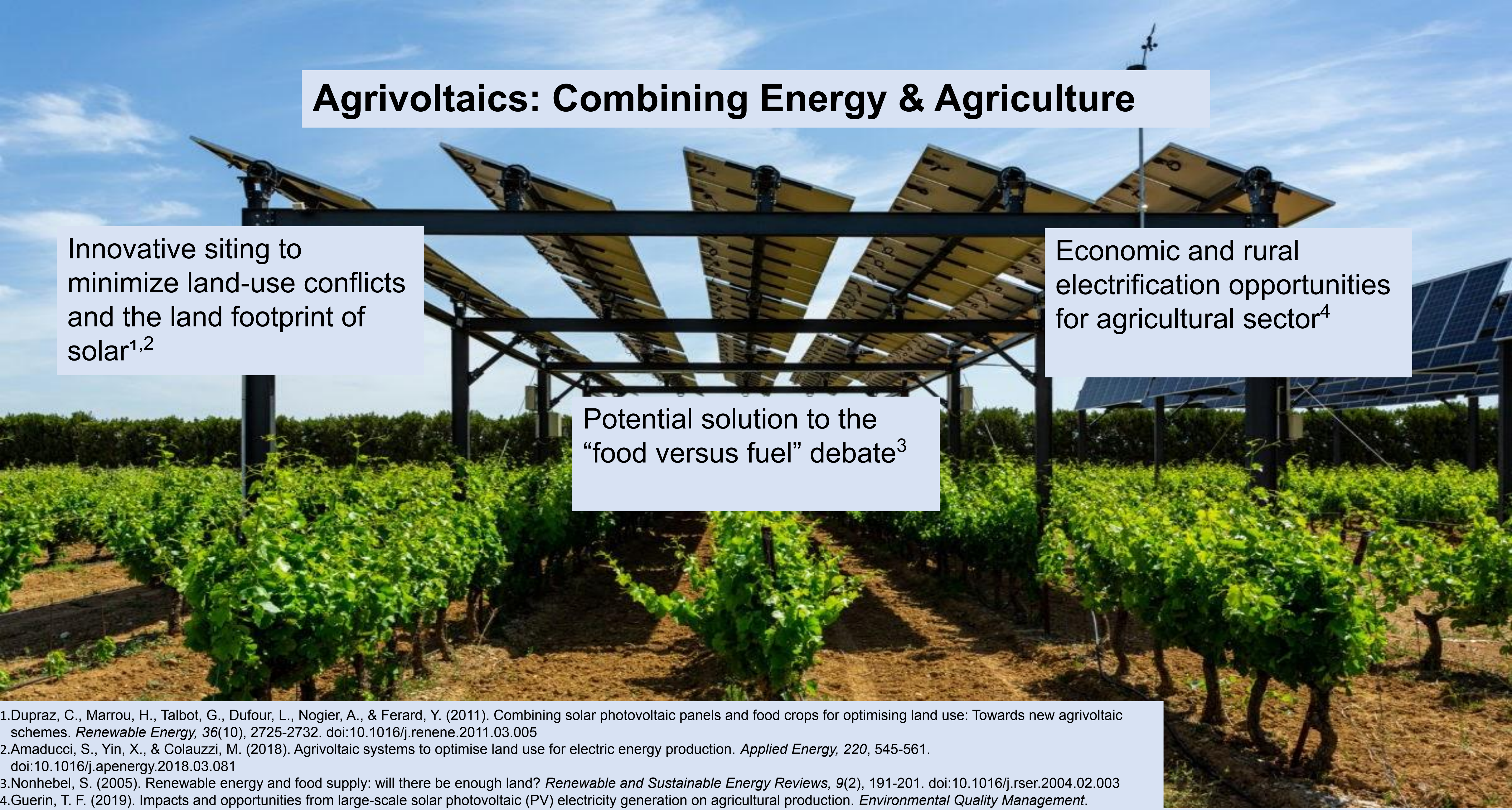
Alexis Pascaris

- M.S. in Environmental & Energy Policy (expected spring 2021)
  - Michigan Tech
- Research interests: Agrivoltaics, Solar PV, Renewable energy transitions, Sustainable communities, Environmental protection, Land conservation, Climate law & governance
- B.S. in Environmental Studies & Sustainability
  - Michigan State University

Presentation Outline

- Introduction to Agrivoltaics
- Research Strategy
- Preliminary Findings
- Concluding Discussion

Agrivoltaics: Combining Energy & Agriculture



Innovative siting to minimize land-use conflicts and the land footprint of solar[1,2]

Economic and rural electrification opportunities for agricultural sector[4]

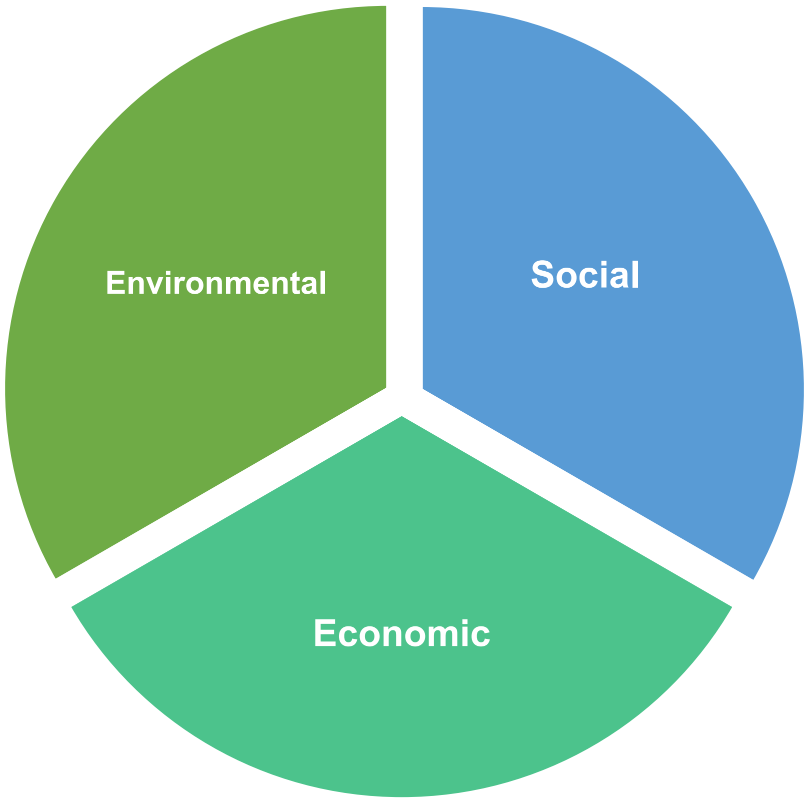
Potential solution to the "food versus fuel" debate[3]

1. Dupraz, C., Marrou, H., Talbot, G., Dufour, L., Nogier, A., & Ferard, Y. (2011). Combining solar photovoltaic panels and food crops for optimising land use: Towards new agrivoltaic schemes. *Renewable Energy, 36*(10), 2725-2732. doi:10.1016/j.renene.2011.03.005
2. Amaducci, S., Yin, X., & Colauzzi, M. (2018). Agrivoltaic systems to optimise land use for electric energy production. *Applied Energy, 220*, 545-561. doi:10.1016/j.apenergy.2018.03.081
3. Nonhebel, S. (2005). Renewable energy and food supply: will there be enough land? *Renewable and Sustainable Energy Reviews, 9*(2), 191-201. doi:10.1016/j.rser.2004.02.003
4. Guerin, T. F. (2019). Impacts and opportunities from large-scale solar photovoltaic (PV) electricity generation on agricultural production. *Environmental Quality Management*. doi:10.1002/tqem.21629

Image Source: PV Magazine

A Holistic Approach

- **Social**
  - Two in-depth interview studies
    - Agriculture sector[1]
    - Solar industry professionals[2]
- **Environmental**
  - Life Cycle Assessment[3]
- **Economic**
  - Pilot test study
  - Grazing pasture-fed rabbits in Lubbock, Texas, U.S.



1. Pascaris, A. S., Schelly, C., Pearce, J. M. (2020) A First Survey of Agriculture Sector Perspectives on the Opportunities & Barrier for Agrivoltaics. *Agronomy, 10,* 1885.
2. Pascaris, A. S., Schelly, C., Burnham, L., Pearce, J. M. (2020) Solar Industry Perspectives on the Socio-Political, Market, and Community Dimensions of Agrivoltaics. *In Review*
3. Pascaris, A. S., Pearce, J. M. (2020) Life Cycle Assessment of a Novel Agrivoltaic Concept: The Case of Pasture-Fed Rabbits and Solar PV. *Forthcoming*

Findings: Interviews

Agriculture Sector

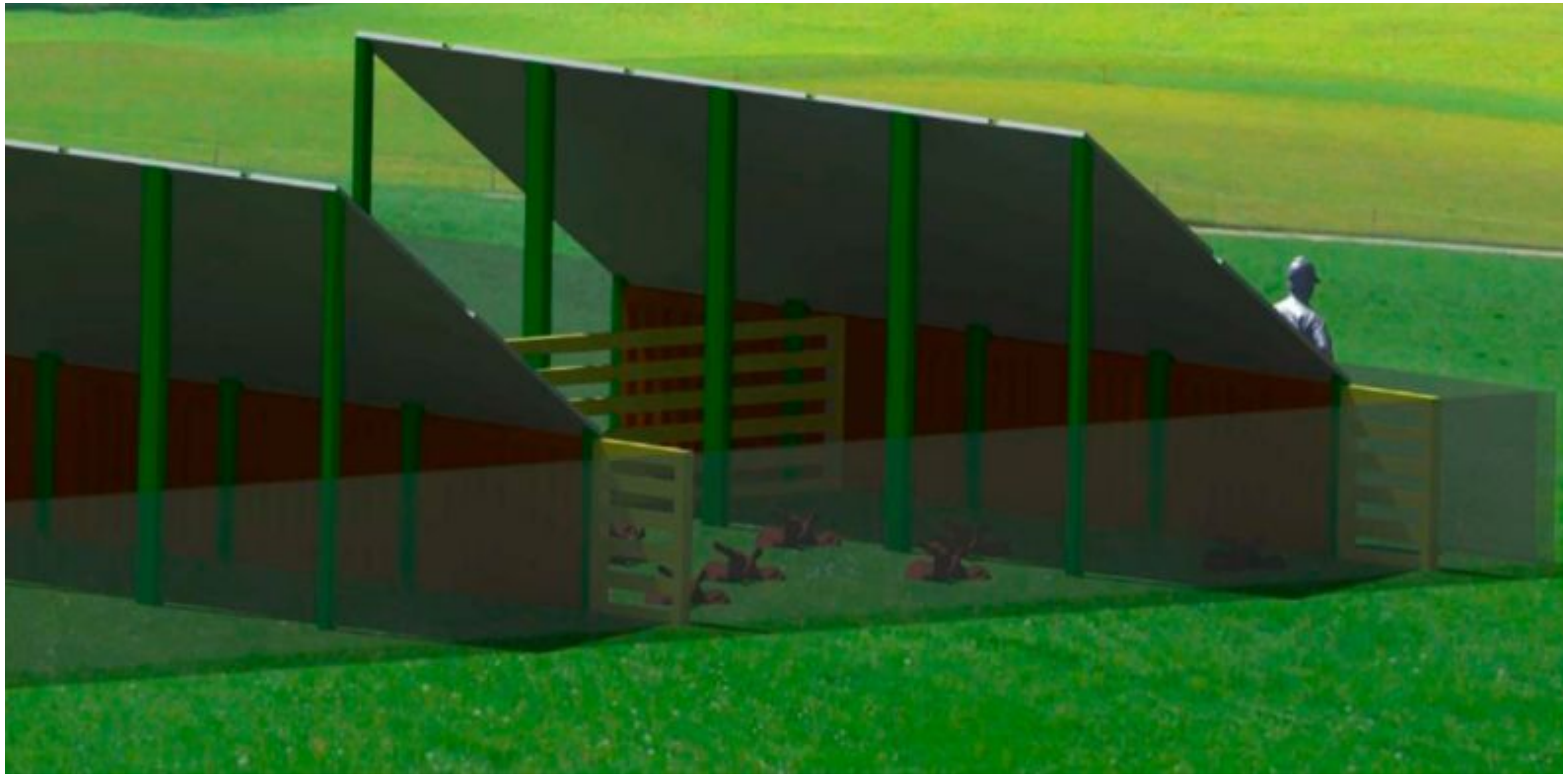
- Long-term land productivity
- Market certainty
- Just compensation
- Predesigned system flexibility

Solar Industry

- Accretive to the growth of solar
- Potential to soften social resistance to development
- Economic opportunities
- Local level policy support is key

1. Pascaris, A. S., Schelly, C., Pearce, J. M. (2020) A First Survey of Agriculture Sector Perspectives on the Opportunities & Barrier for Agrivoltaics. *Agronomy, 10,* 1885.
2. Pascaris, A. S., Schelly, C., Burnham, L., Pearce, J. M. (2020) Solar Industry Perspectives on the Socio-Political, Market, and Community Dimensions of Agrivoltaics. *In Review*

Life Cycle Assessment



1. Pascaris, A. S., Pearce, J. M. (2020) Life Cycle Assessment of a Novel Agrivoltaic Concept: The Case of Pasture-Fed Rabbits and Solar PV. *Forthcoming*

2. Lytle, W., Meyer, T. K., Tanikella, N. G., Burnham, L., Engel, J., Schelly, C., & Pearce, J. M. (2020). Conceptual design and rationale for a new agrivoltaics concept: Pastured-raised rabbits and solar farming. *Journal of Cleaner Production*, 124476.

- SimaPro LCA modeling software
- Modeled to achieve same level of service (electricity and meat output) through different means
- Three systems studied:
  1. Agrivoltaic model (pasture-fed rabbits + solar PV)
  2. Independent model (conventional rabbits + solar PV)
  3. Conventional rabbits + conventional electricity

Findings: Life Cycle Assessment

Scenario	Total Life Cycle		Manufacturing Stage		Use Stage	
	GHG Emissions (kg CO_2 equivalent)	Cumulative Energy Demand (MJ)	GHG Emissions (kg CO_2 equivalent)	Cumulative Energy Demand (MJ)	GHG Emissions (kg CO_2 equivalent)	Cumulative Energy Demand (MJ)
1	151,000	2,070,000	135,000	1,940,000	9,520	48,300
2	18,500,000	289,000,000	3,971,890	63,422,900	14,518,070	225,299,000
3	304,000,000	5,140,000,000	1,890	22,900	14,500,000	225,000,000

Scenario 1: Pasture-fed Rabbit Agrivoltaics

- Least total GHG emissions
- Least total Cumulative Energy Demand

Scenario 2: Independent Conventional Rabbits + Solar PV

- Rabbit feed production
- Herbicide application to PV site

Pasture-fed agrivoltaics produces dual synergy! No reliance on energy intensive rabbit feed and no vegetative maintenance required.

Concluding Remarks

- SDG 12: Responsible Consumption and Production
- Technically and economically viable- what’s next?
- Forthcoming: Legal Framework Analysis, Policy Action

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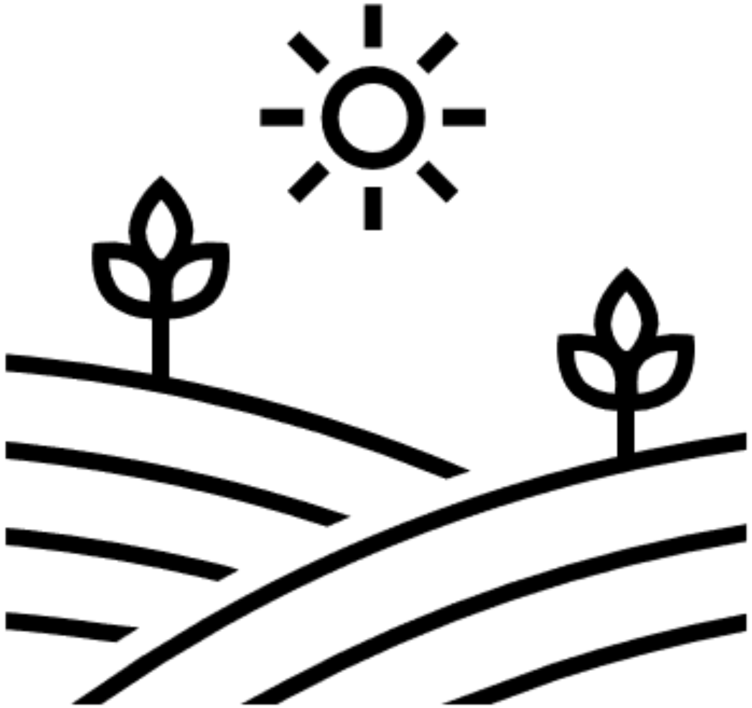

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