

Evaluating Shadow Flicker in the Current Regulatory Environment

Richard Lampeter, INCE

Senior Consultant

rlampeter@epsilonassociates.com

Epsilon
ASSOCIATES INC.

Massachusetts Wind Working Group Meeting: October 30, 2013

Evaluating Shadow Flicker

↳ *Why ? ? ?*

- Regulatory Compliance
- Address Concerns in the Community
 - Proactive – Layout Modifications
 - Reactive – Responding to Questions/Concerns during the Permitting Process



Regulations

↳ *Components*

- Range of Requirements
 - Minimize Shadow Flicker →
Evaluate with Respect to a Limit
- Limits
 - Duration
 - Hours per Year
 - Minutes per Day



Regulations

↳ *Components*

Location

- Residence
 - Occupied Building
 - Residential
 - Commercial
 - Institutional
- Property
- Public Road



Regulations

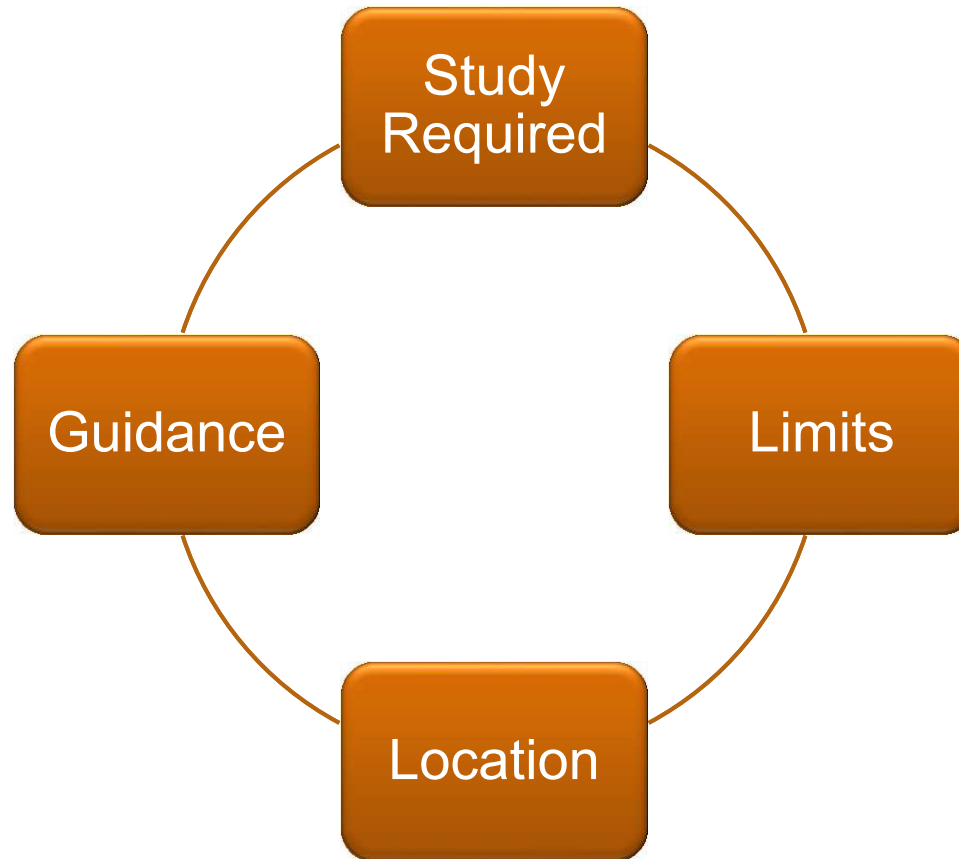
↳ *Components*

Guidance

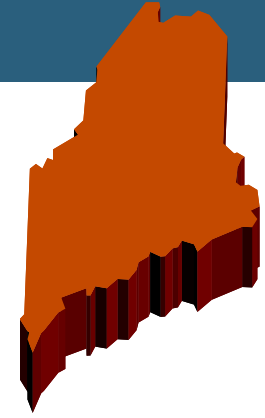
- Model
- Inputs
- Mitigation



▶ Regulations - Components



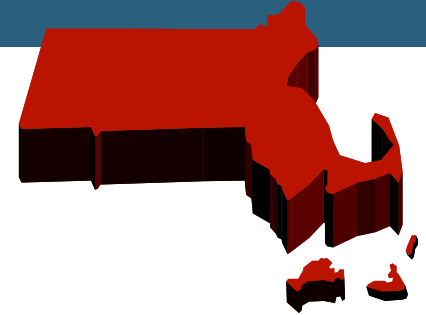
State Regulations



- Lack of shadow flicker regulations in **MA, NH, VT, RI, and CT**

- **Maine**
Revised Statutes Annotated (MRSA)
 - Title 38: Waters and Navigation, Chapter 3: Protection and Improvement of Waters, Subchapter 1: Environmental Protection Board, Article 6: Site Location of Development, Section 484: Standards for development, Subsection 10:
 - “Will be designed and sited to avoid unreasonable adverse shadow flicker effects;”

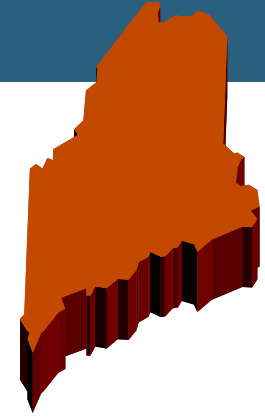
State Guidance



Massachusetts: Model Zoning Ordinance / Bylaw

- Prepared by Department of Energy Resources
- Revised March 2012
- “...shall be sited in a manner that minimizes shadowing or flicker impacts.”
- “The applicant has the burden of proving that this effect does not have significant adverse impact on neighboring or adjacent uses.”
- No specific limits

State Guidance

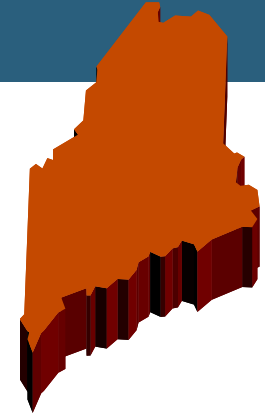


Maine:

Model Wind Energy Facility Ordinance

- Maine State Planning Office
(eliminated effective July 1, 2012)
- August 2009
- “...shall be designed to avoid unreasonable adverse shadow flicker effect at any Occupied Building located on a Non-Participating Landowner’s property.”
- No specific limits
- Require the use of software to calculate flicker

State Guidance



Maine

- Department of Environmental Protection Findings of Fact and Order
 - “Maine currently has no numerical regulatory limits on exposure to shadow flicker; however, the industry commonly uses 30 hours per year as a limit to reduce nuisance complaints.”

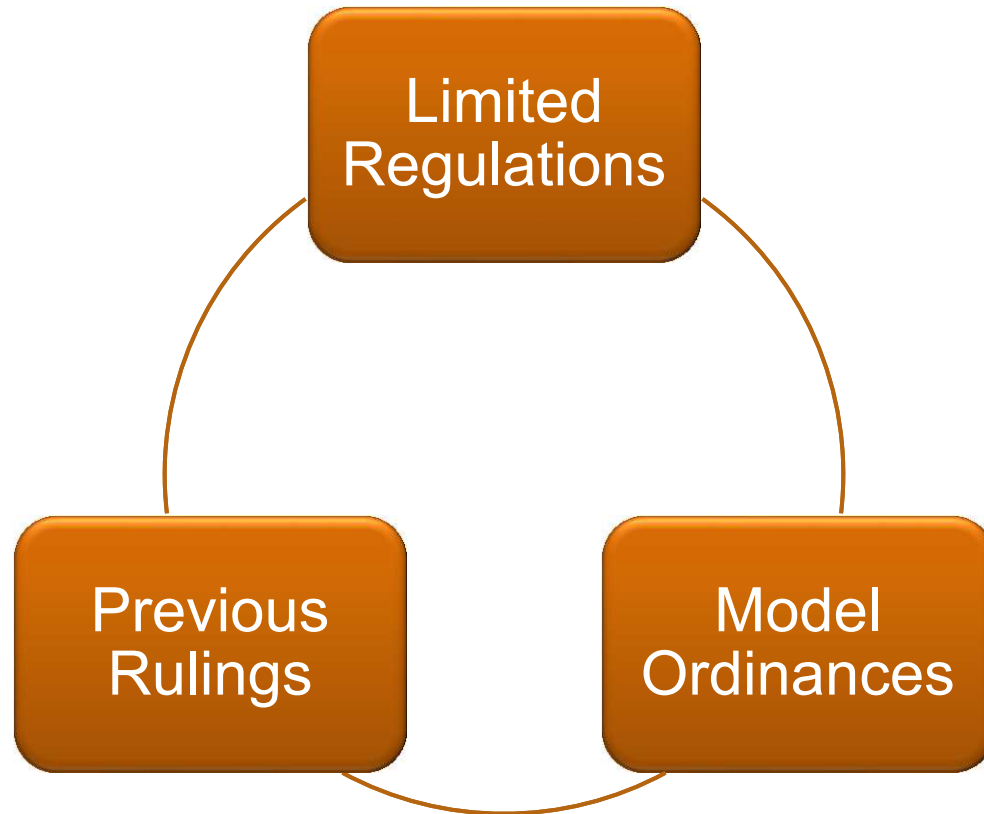
State Guidance

New Hampshire: Model Small Wind Energy Systems Ordinance



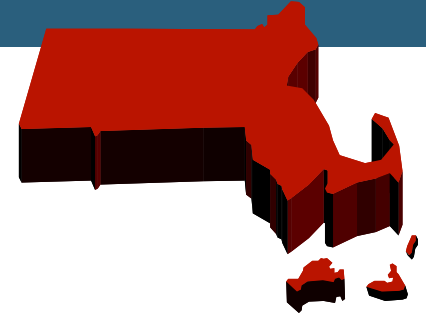
- New Hampshire Office of Energy and Planning
- September 2008
- “...shall be sited in a manner that does not result in significant shadow flicker impacts.”
- “Significant flicker is defined as more than 30 hours per year on abutting occupied buildings.”

▶ State Regulatory Overview



Local Regulations

↳ *Massachusetts*

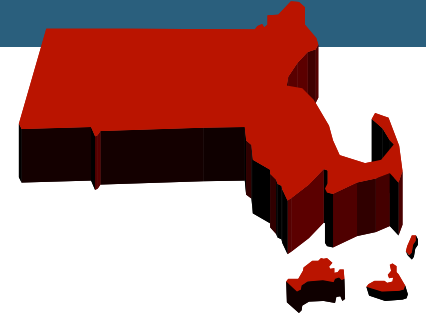


Worcester

- Zoning Ordinance
- Amended January 2013
- “The facility owner and operator shall make reasonable efforts to minimize shadow flicker to any occupied building on a non-participating landowner’s property.”
- “Shadow flicker assessment report required
- Plan showing the, “area of estimated wind turbine shadow flicker” required
- No limits specified

Local Regulations

→ *Massachusetts*



Beckett

- Zoning Bylaw
- “No large wind energy system shall cause more than thirty (30) shadow/flicker hours per year on any off-site inhabited building or undeveloped lot.
- Limit applicable to expected shadow flicker
- Worst-case scenario required to be presented as well
- Mandatory notification of property owners predicted to be above 30 hours per year (worst-case scenario)
- “Contingency Plan” required for mitigation

Local Regulations

→ *Massachusetts*



Ashburnham – Zoning Bylaw - May 2009

- “Wind facilities shall be sited in a manner that minimizes shadowing or flicker impacts. The applicant has the burden of proving that this effect does not have significant adverse impact on neighboring or adjacent uses through either siting or mitigation.”

Leominster – Zoning Ordinance - January 2013

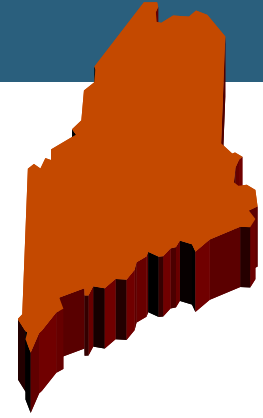
- “Wind facilities shall be sited in a manner that minimizes shadowing or flicker impacts. The applicant has the burden of proving that this effect does not have significant adverse impact on neighboring or adjacent uses.”

Local Regulations

→ *Maine*

Freedom

- Wind Turbine Ordinance – 2012
 - Receptors include property, homes, schools, churches, public buildings, and roads
 - Limit is 10 hours per year
 - Worst-case calculation required



Local Regulations

→ *New Hampshire*



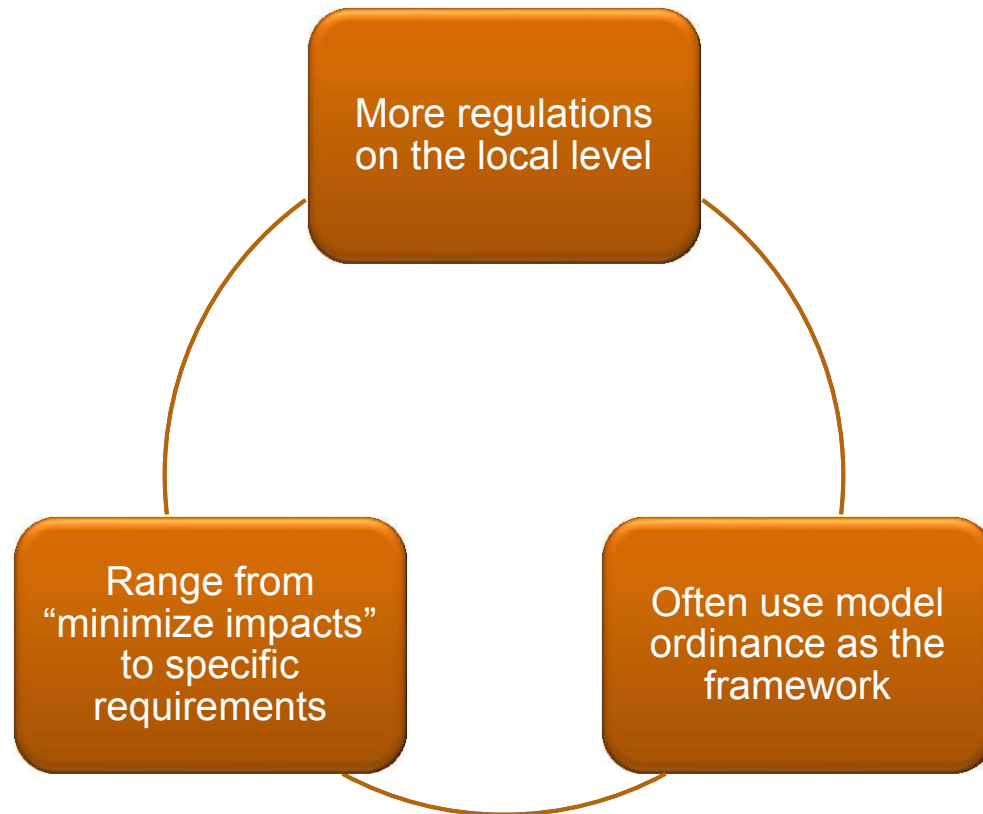
Windham

- Zoning Ordinance – 2013
- Small wind energy systems
- Limit is 30 hours per year

New Ipswich

- Zoning Ordinance – 2012
- Large wind energy systems
- No shadow flicker / tower shadowing on homes or roads
- Maximum of 20 hours per year on non-participating property and roads with less than 500 vehicles per day

▶ Local Regulatory Overview



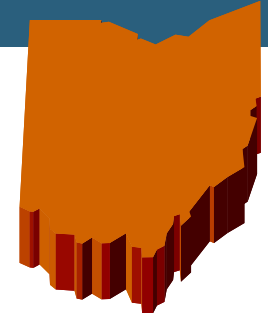
Regulations Outside New England



Wisconsin

- Chapter PSC 128 Wind Energy Systems
 - In effect as of March 2012
 - Limits applicable at nonparticipating residences, occupied community buildings, or for such buildings which have plans on file
 - “An owner shall design the proposed wind energy system to minimize shadow flicker... to the extent reasonably practicable.”
 - Limit is 30 hours per year
 - Mitigation if flicker duration is above 20 hours per year.
 - “... the owner... shall allow the owner of the nonparticipating residence or occupied community building to choose a preferred reasonable mitigation technique, including installation of blinds or plantings at the wind energy system owner’s expense.”

Regulations Outside New England



Ohio

- Power Siting Rules and Statutes
 - Chapter 4906-17 Application Filing Requirements for Wind-Powered Electric Generating Facilities
 - “The applicant shall evaluate and describe the potential impact from shadow flicker at adjacent residential structures and primary roads, including its plans to minimize potential impacts if warranted.”
- Although not specifically stated in Chapter 4906-17, the Ohio Power Siting Board has evaluated shadow flicker with respect to 30 hours per year at a residence.

Basis for Regulations



- German Guideline (WEA-Schattenwurf-Hinweise)
 - Maximum of 30 hours per year
 - Maximum of 30 minutes per day
 - Worst-case calculations (maximum astronomical shadow)
- German Court Case
 - Court ruled 30 hours per year was acceptable (Danish Wind Industry Association)
 - Applied as a guideline when evaluating expected shadow flicker
 - Typically referenced in shadow flicker analyses

Modeling to Evaluate Compliance with the Regulations

- Software Package
 - WindPRO
- Modeling Domain
- Worst-Case vs. Expected
- Results
 - Discrete Points
 - Flicker Map



Addressing Locations Above the Limit

- Vegetation
- Layout Modifications
- Curtailment



▶ Conclusions

- Minimal statewide regulations or guidance
- Growing number of local regulations but still limited in both number and scope
- Thirty (30) hours per year of expected shadow flicker is the general guideline value applied
- There are ways of minimizing the duration of shadow flicker at non-participating homes – best to address prior to construction