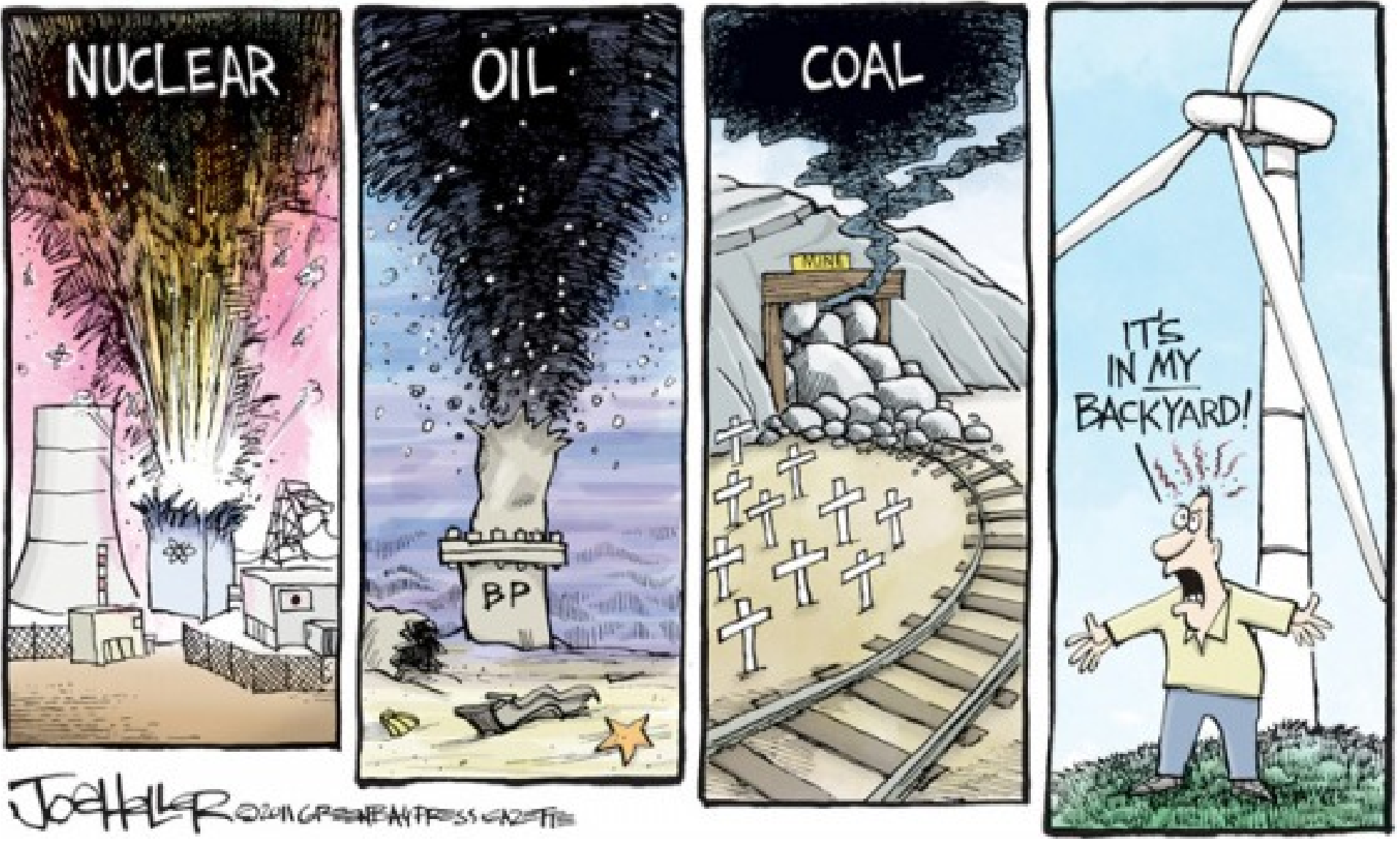
Renewable Energy Planning at the Community Level

Lessons Learned from Net Zero Projects

Tom Phelps
Principal Stantec

Dec 6, 2017

ARGUMENTS AGAINST-



Agenda

1 Introduction

2 Net Zero Overview

3 Planning Approaches

4 Lessons Learned

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1 Introduction

"Renewable energy technologies will account for two-thirds of new generation capacity installed in the Americas from 2014-2026."

2030 Market Outlook, Bloomberg New Energy Finance, July 2014

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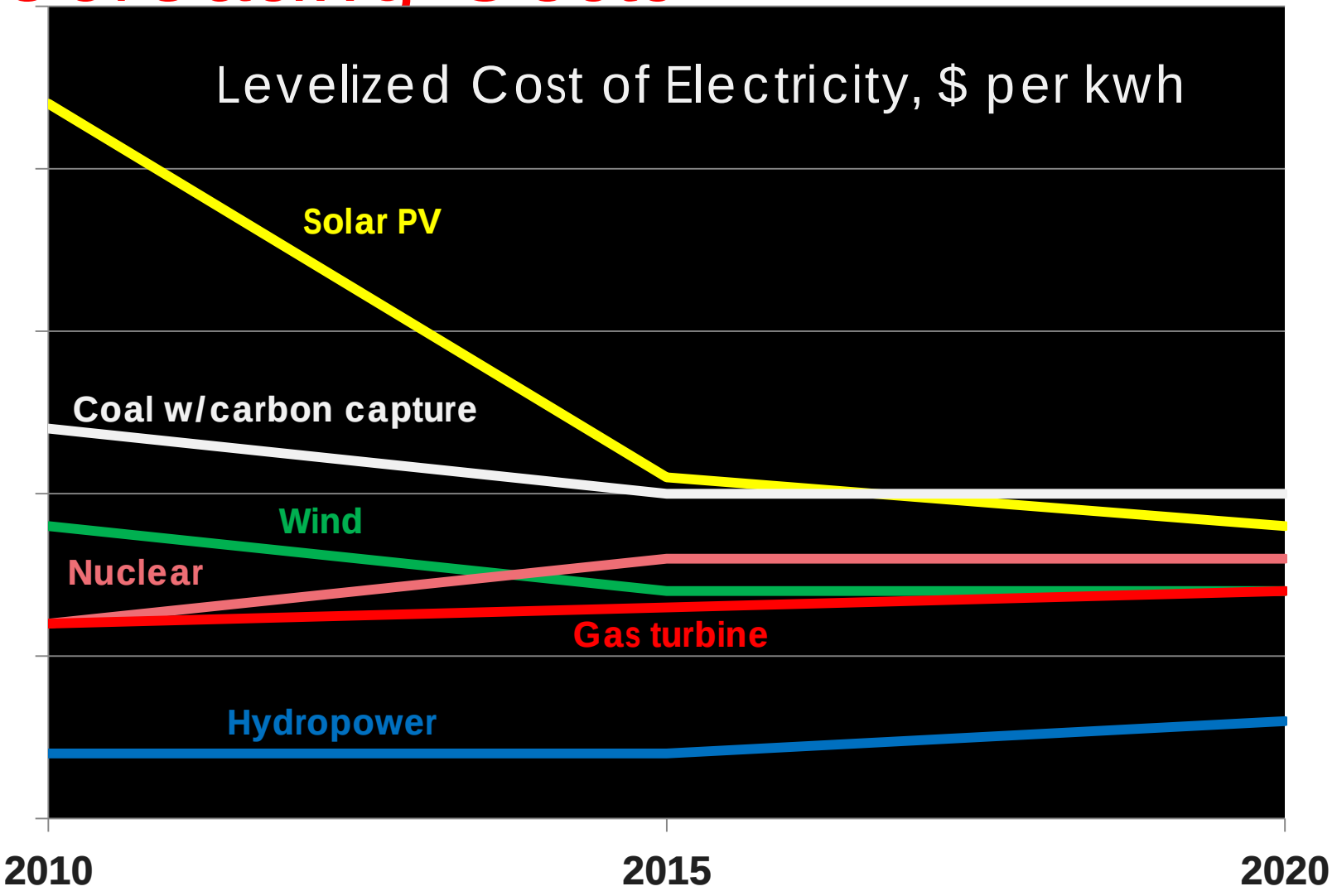
Decreasing Costs



Sources: Boston Consulting Group; Lazard; NREL; EIA; USDOE

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US Army Net Zero Program

- National Defense Authorization Act:

  The Army will produce or acquire 50% of its current energy needs from renewables by 2025

- Conservation and Generation across an entire system

- Energy security

- Community-scale Energy Planning

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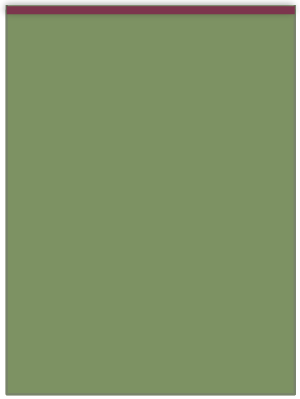
US Army Net Zero Program

Building consumption reduced 50 percent

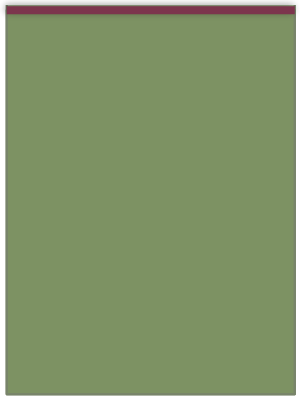


Energy Demand

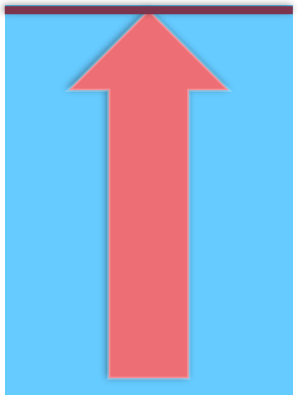
US Army Net Zero Program

Building consumption reduced 50 percent

100 Percent of energy demand met by renewable sources



Energy Demand

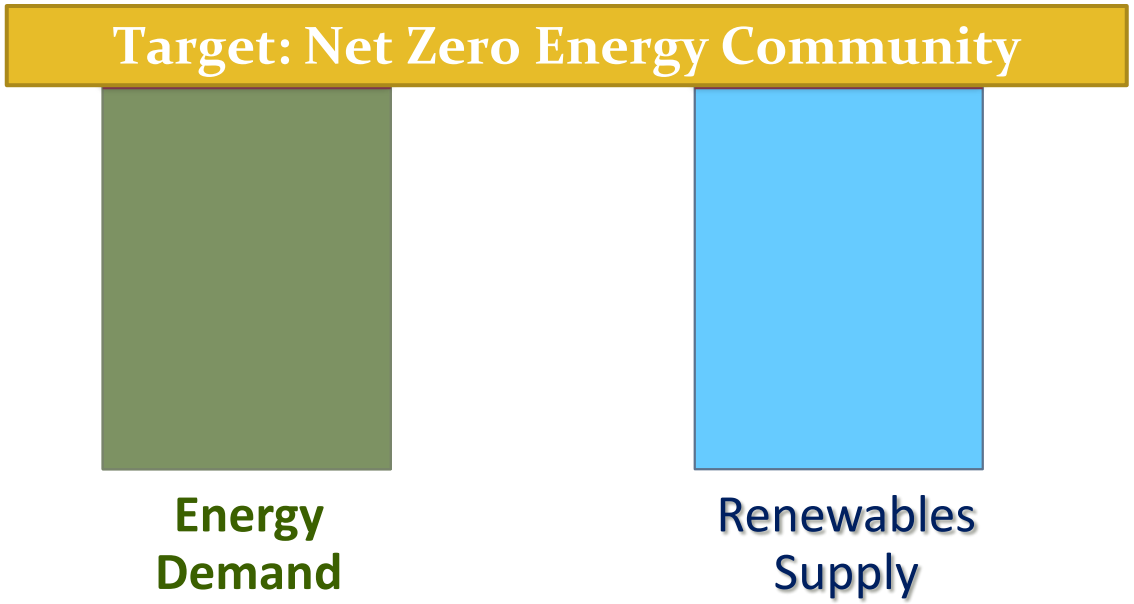


Renewables Supply

US Army Net Zero Program

Building consumption reduced 50 percent

100 Percent of energy demand met by renewable sources



Army Communities

- Community features
- Wide range of installation types
- Demographics = small city

Army Communities - Infrastructure

Army Communities - Residential

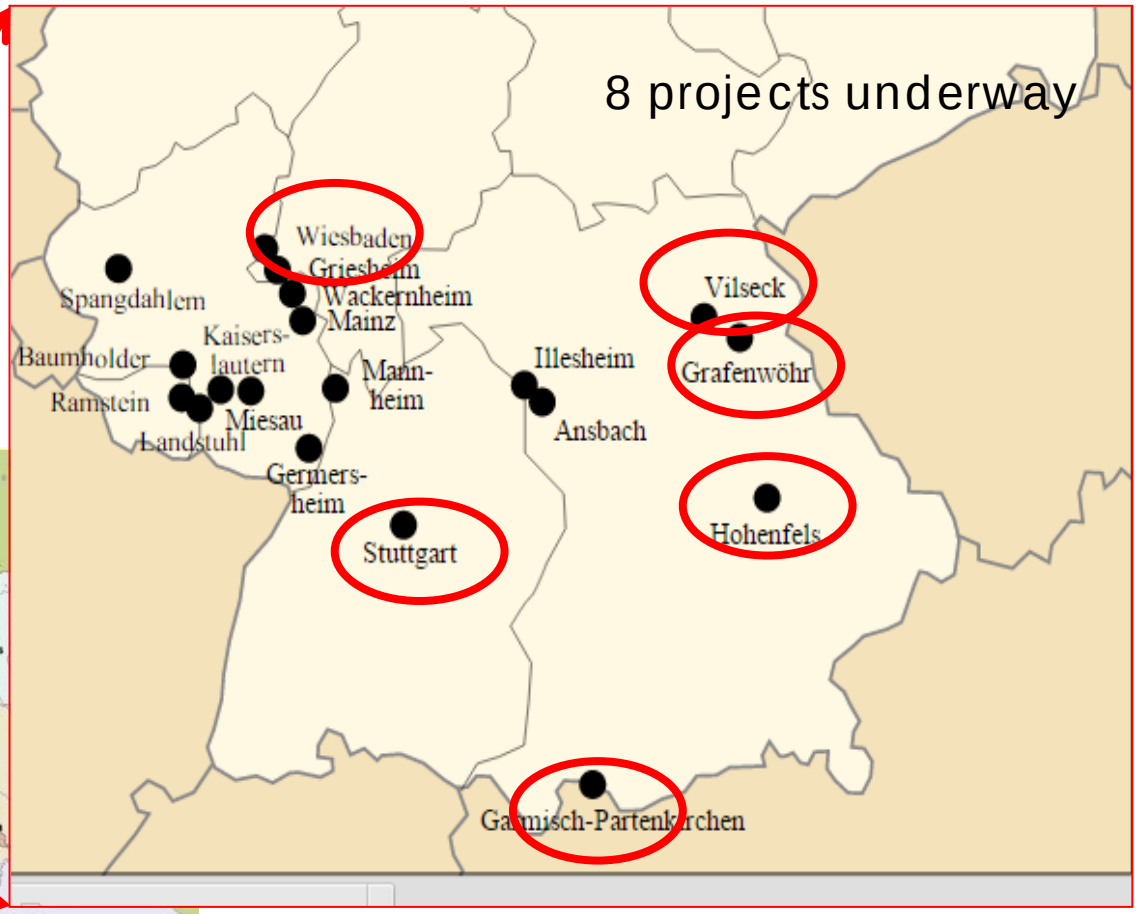
Army Communities - Schools

Army Communities - Commercial

Army Communities

Army Communities

Army Communities – Germany



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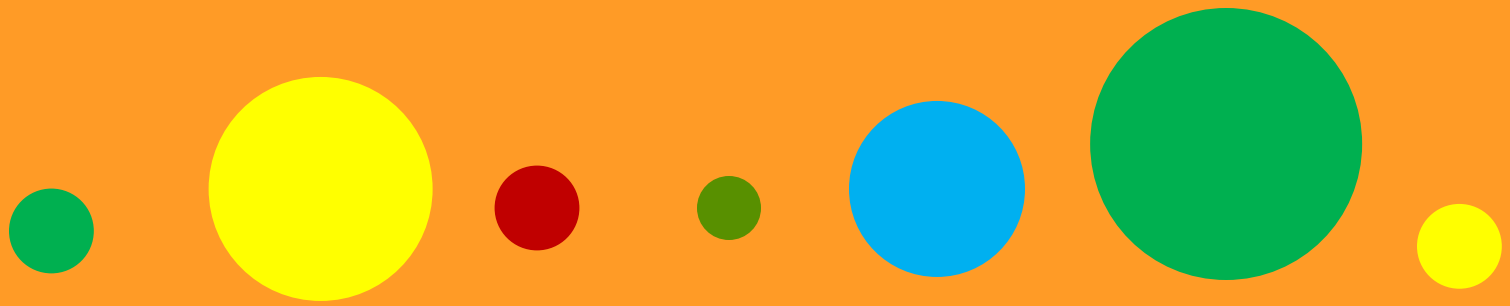
Net Zero at the Community Level



Diverse installations/Regions

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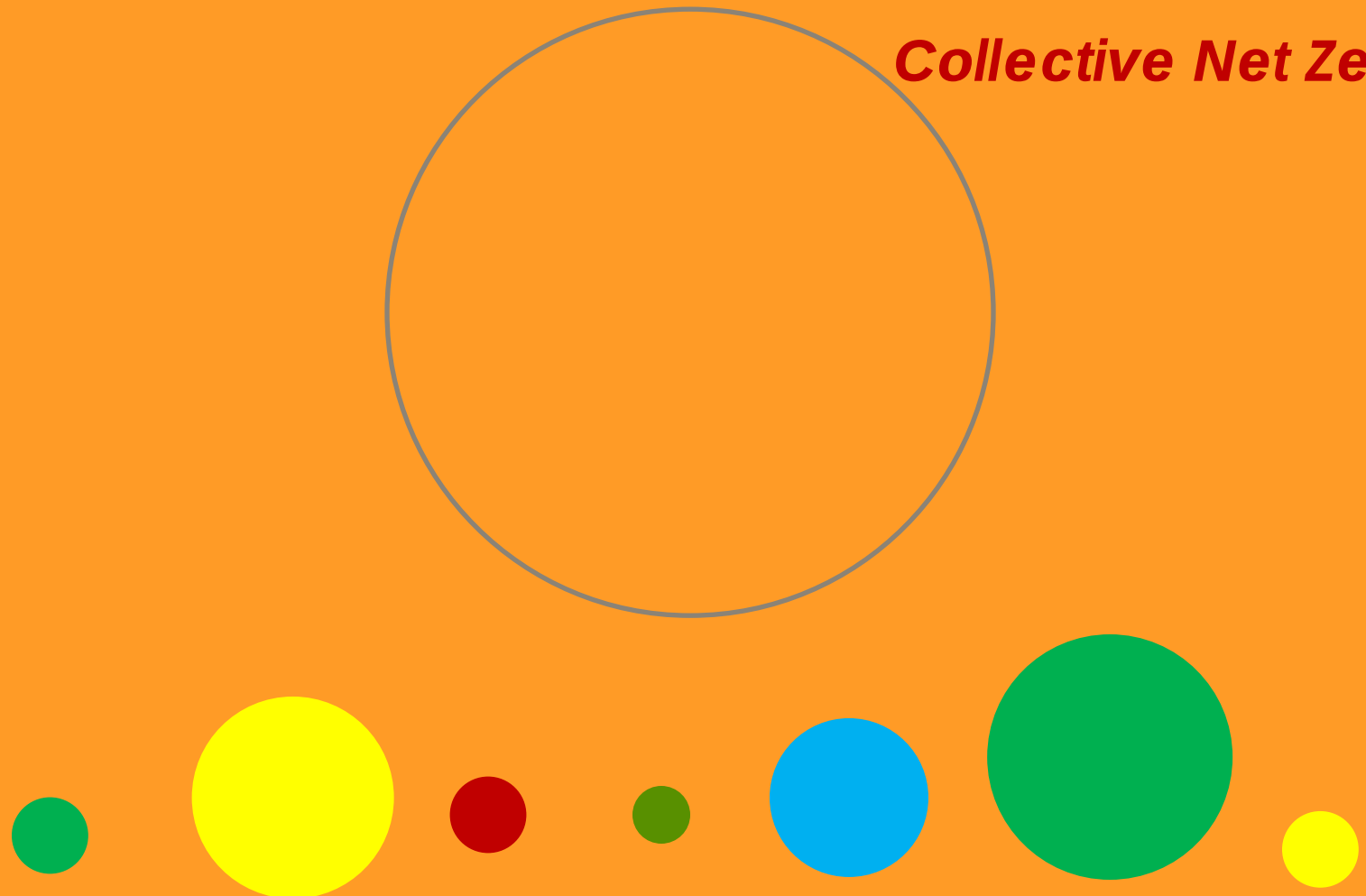
Net Zero at the Community Level



Diverse installations/Regions

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Net Zero at the Community Level

- Clustered Project planning and funding
- Geographic footprint
- Energy diversity
- Portfolio approach

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3 Planning Approaches

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Planning Approach

Resource analysis:

- Solar PV
- Wind
- Biomass/Biogas
- Geothermal
- Hydropower
- Solar thermal

Data collection

Planning Approach

Technology/resource analysis:

- Solar PV
- Wind
- Biomass/Biogas
- Geothermal
- Hydropower
- Solar thermal

Technical Feasibility/Site Suitability:

- Distributed rooftop PV
- Utility ground-mount PV
- Utility Wind power
- CHP retrofits to biomass
- Ground loop/heat pumps
- Biogas/Landfill gas
- Microhydro

Production Modeling

Planning Approach

Technology/resource analysis:

- Solar PV
- Wind
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- Geothermal
- Hydropower
- Solar thermal

Site Suitability/Energy Modeling:

- Distributed rooftop PV
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Impacts

Sustainability Analysis:

- Environmental constraints
- Social impacts
- Economic benefits/costs
- Stakeholders

Planning Approach

Technology/resource analysis:

- Solar PV
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Site Suitability/Energy Modeling:

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Sustainability Analysis:

- Environmental
- Social impacts
- Economic benefits/costs
- Stakeholders

Roadmap

Action Plan

- Project identification
- Funding
- Project ranking
- Community support

Planning Challenges

- Data adequacy
- Long-term plans and shared visions
- Available funding
- Balancing use of spaces
- Best financial returns
- Highest level of energy production
- Least environmental impact
- Least social/operational impact
- Highest sustainability rating

End Results – Real Action Plans

- Consistent approach
- Data and reasoning
- Community input
- Roadmap and projects

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End Results – Real Action Plans

Project Bundling and Ranking

Bldg #	Description	Date	Roof Type	Roof Azimuth	Available Roof Area (Sq M)	Capacity (kW)	Yield [MWh/yr]	Annual savings ($/yr)	Capital Cost (USD)	Simple Payback (Yrs)
141	Eng/Housing Mnt	1991	Metal	174	809	120	124	$19,607	$336,000	17
618	CO HQ Bldg/Billets	1991	Tile	202	464	32	32	$5,114	$88,200	17
616	Phys Fit Ctr	1991	Tile	223	881	111	109	$17,287	$309,960	18
607	Recreation Ctr	1991	Tile	223	274	36	36	$5,622	$100,800	18
400	Billets	2006	Tile	135	545	81	79	$12,565	$226,800	18
401	Billets	2007	Tile	135	545	81	79	$12,565	$226,800	18

P1

P 2

P 3

Bundle appropriate projects for Execution Plan

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HINDSIGHT

Those really were the droids you were looking for.

4 Lessons Learned

36 years

How long it takes to recoup the investment in a rooftop solar thermal system for a typical Army family housing unit in Bavaria

USAG Bavaria Net Zero studies

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Lessons Learned

1. Performance benchmarking
2. Master plan conflicts
3. Unintended consequences
4. Stakeholder opinions

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Lessons Learned

1. Performance benchmarking 
2. Master plan conflicts 
3. Unintended consequences 
4. Stakeholder opinions 

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1. Performance Benchmarking

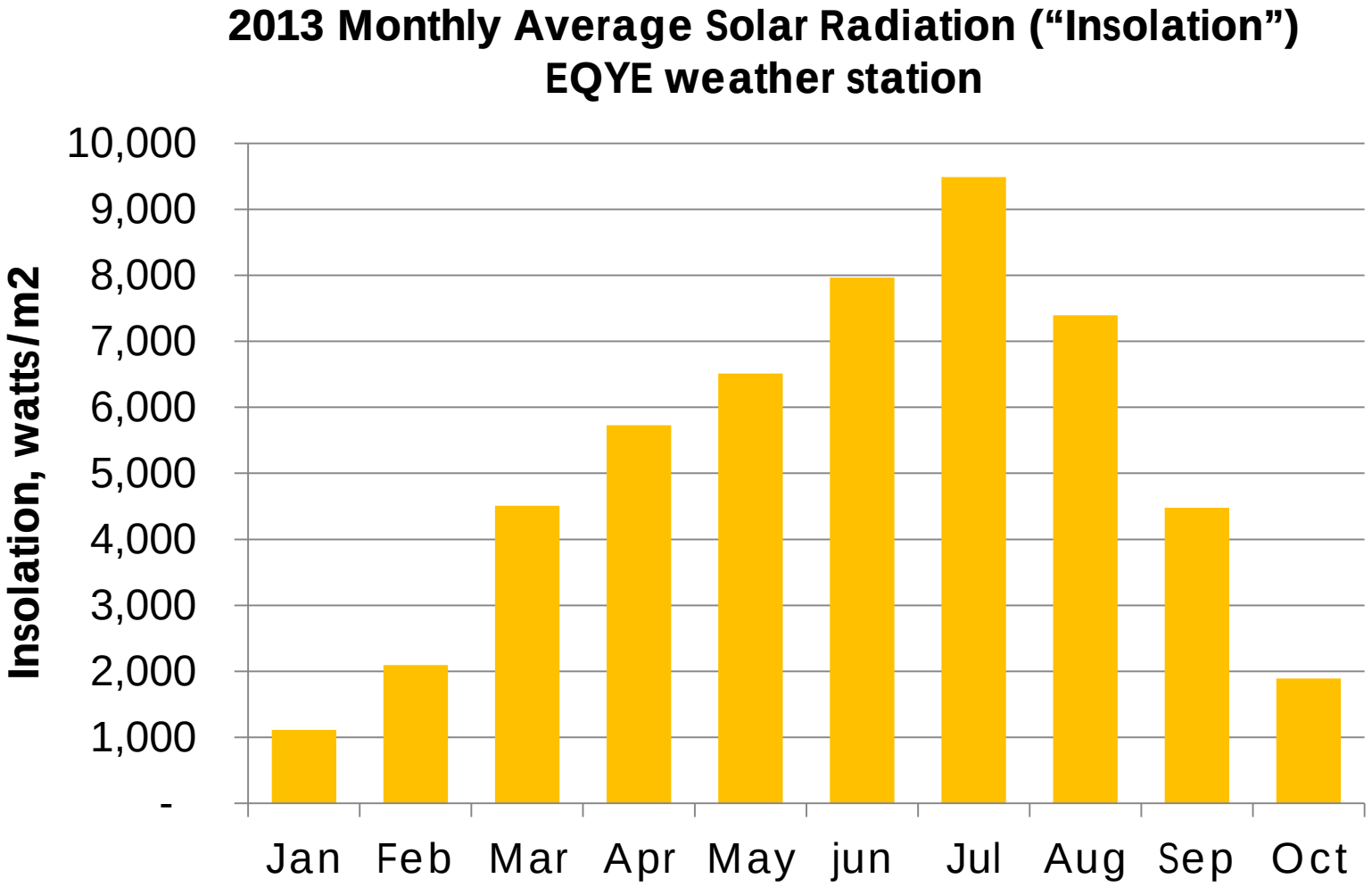
Need:

- *Diversity of energy*
- *Realistic look at resources*
- *Practicality of technologies*

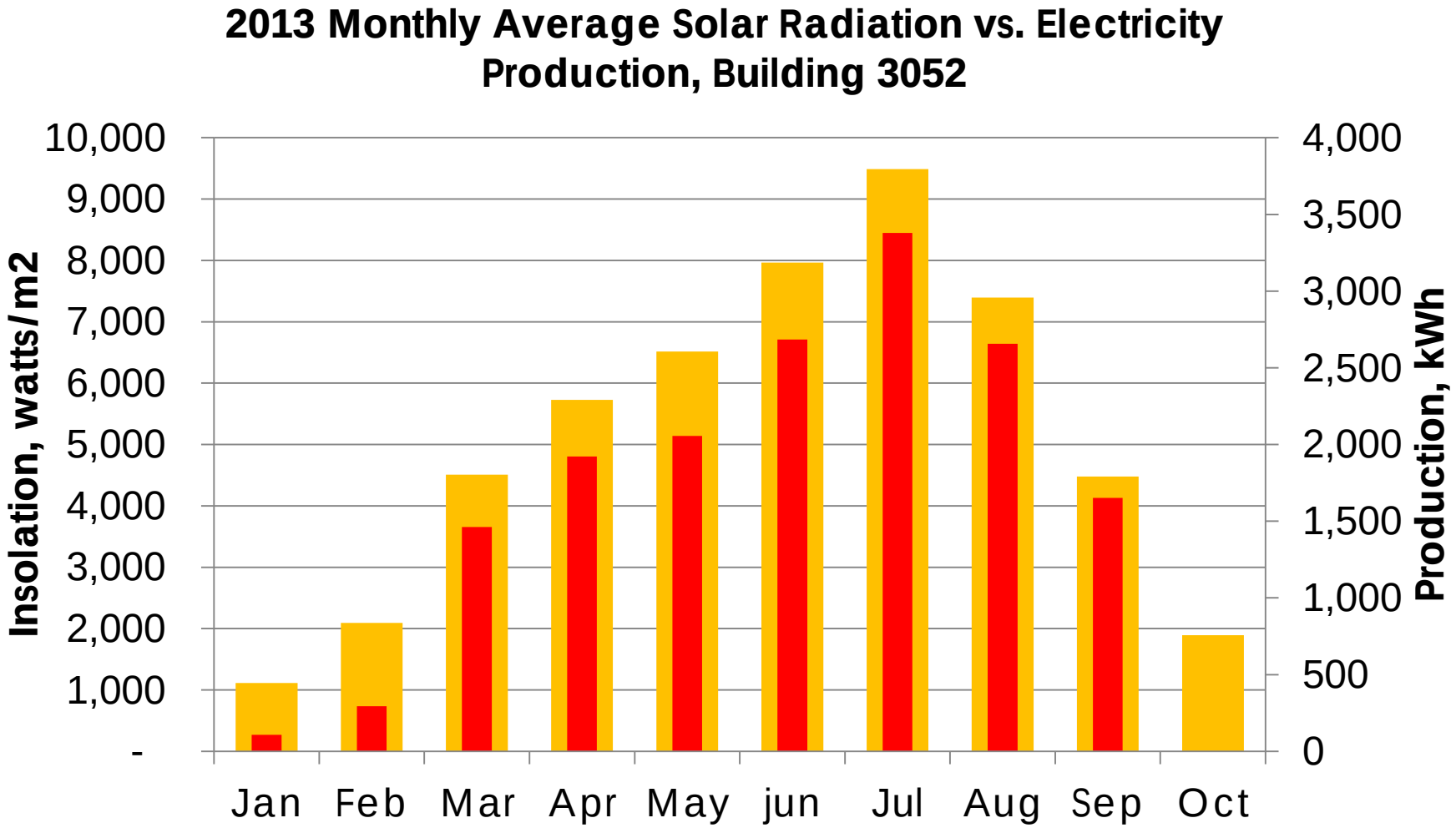
Do:

- *Performance benchmarking*

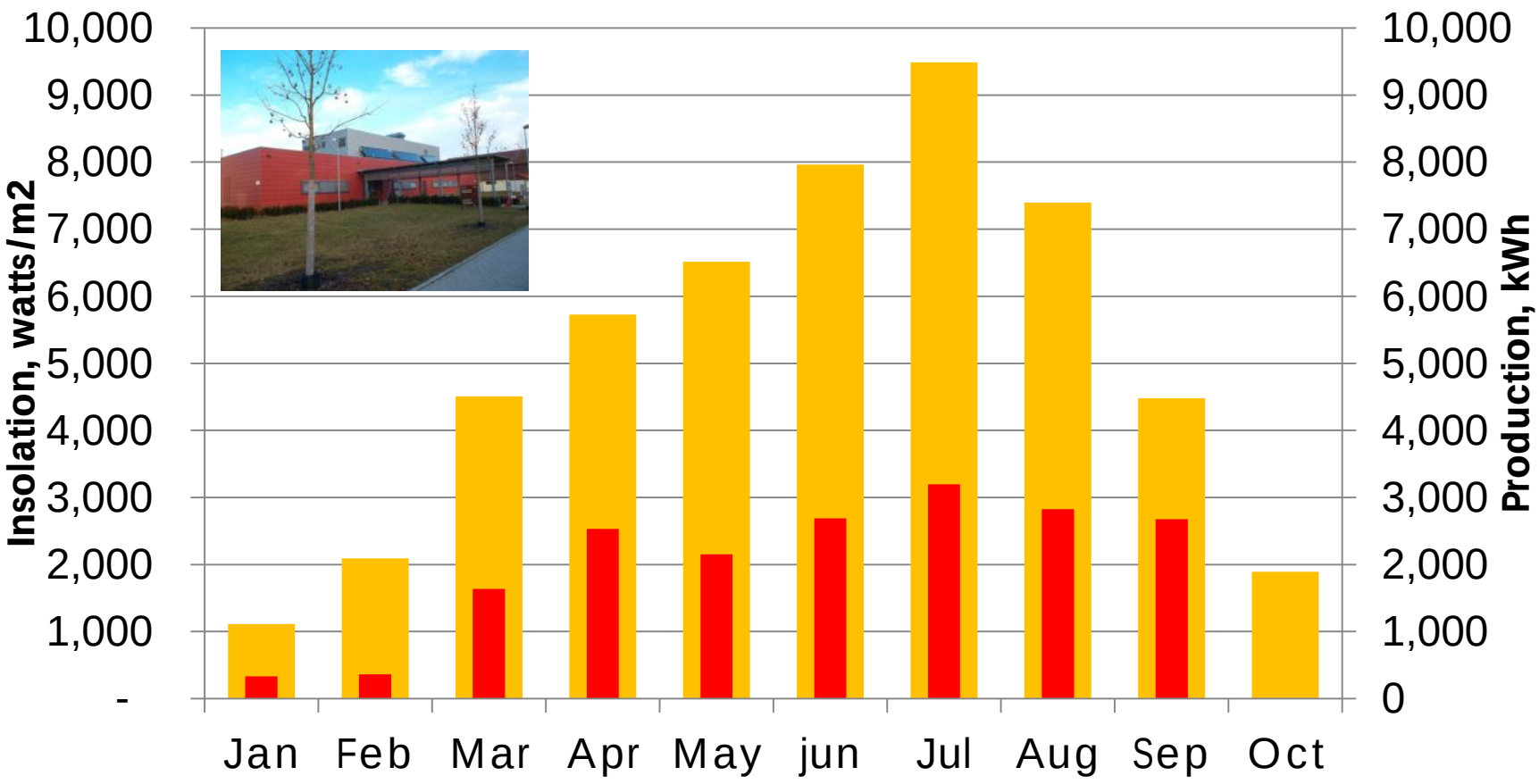
1. Performance Benchmarking



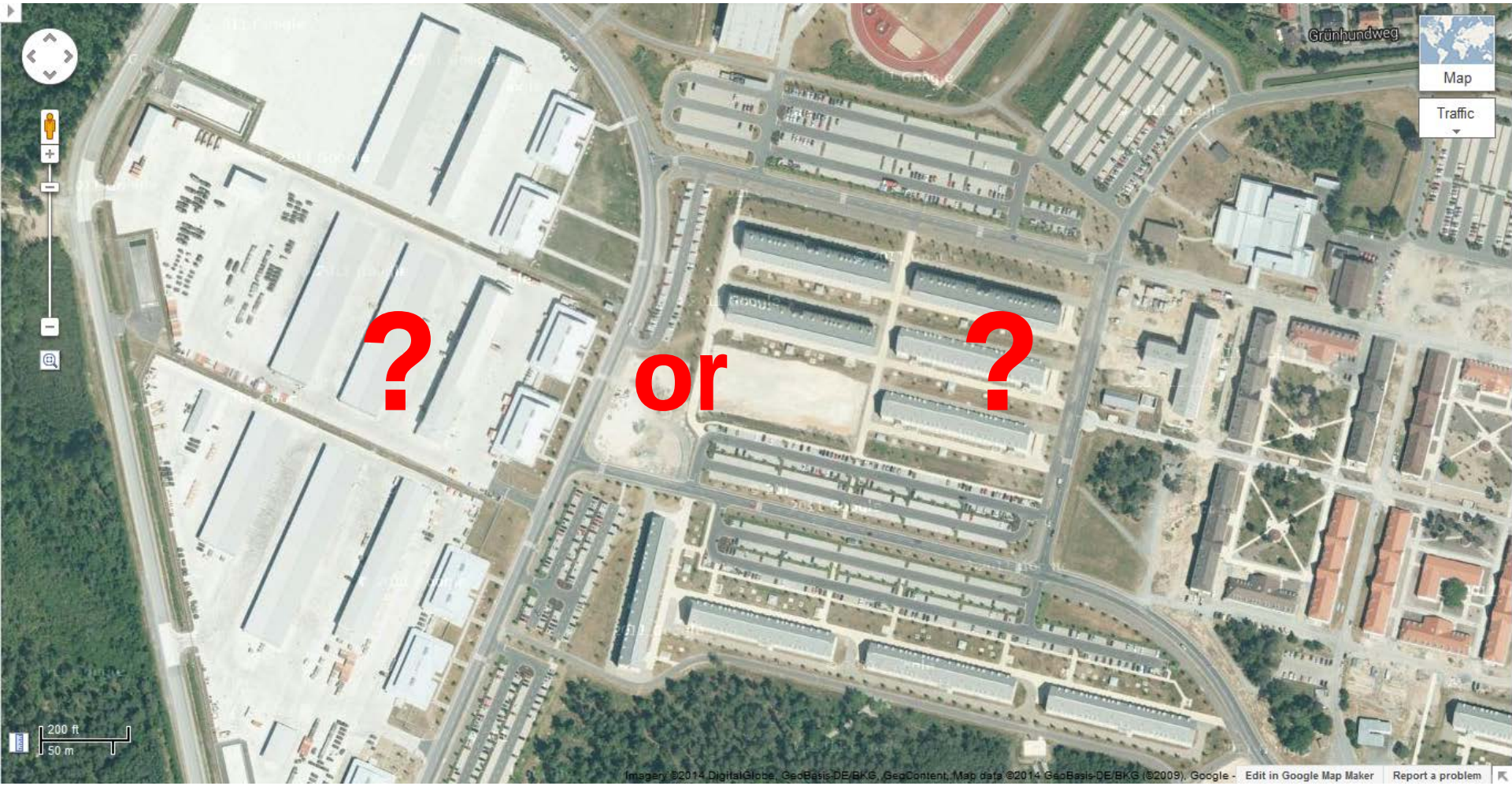
Performance Benchmarking



Performance Benchmarking



Roof-mounted Solar Siting



* Roofs are valuable real estate. Use wisely.

NREL Research Support Facility 1 and 2

- *222,000 square feet; LEED Platinum; 8 awards*
- *1.6 MW PV – generates more power than consumed*

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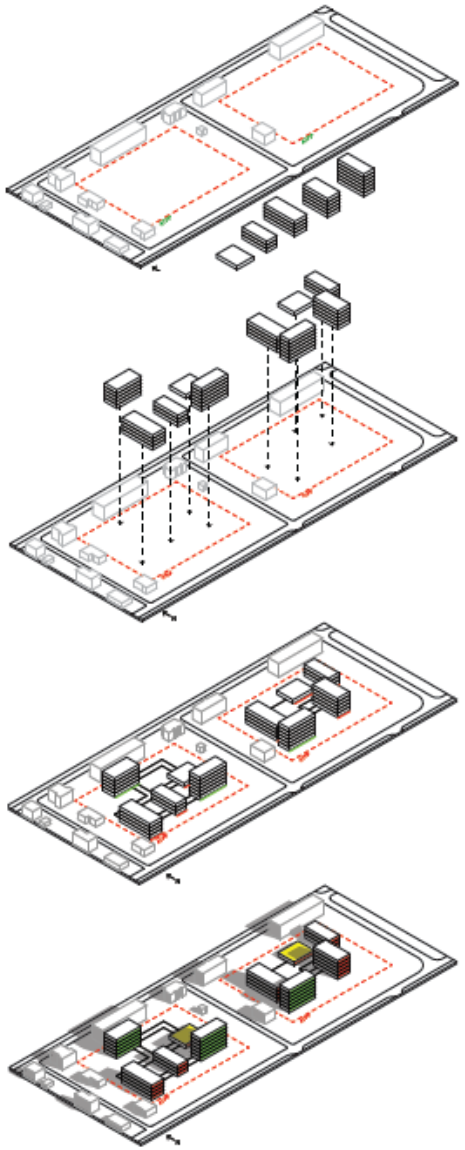
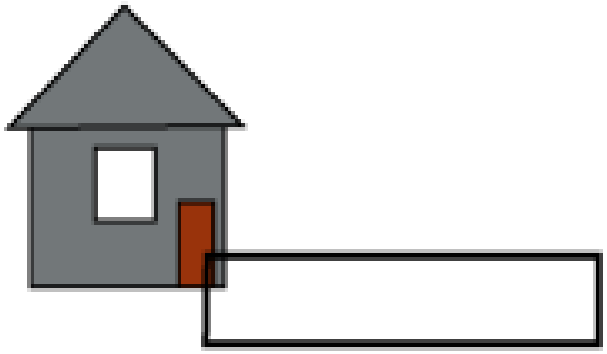
2. Master Plan Conflicts

Open Space Planning for Energy

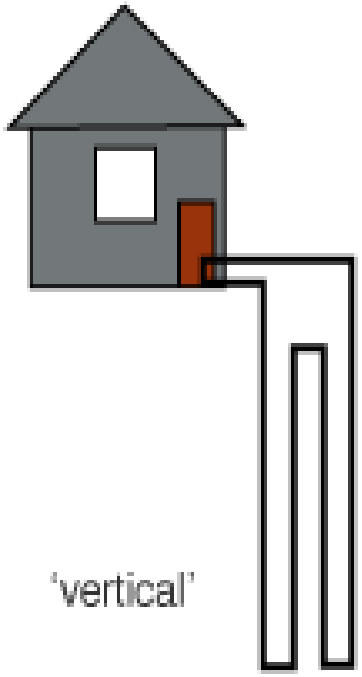
- Solar infill design
- Parking canopy PV
- Biomass fuel storage areas
- Energy storage battery arrays
- Geothermal open spaces



Geothermal Siting



'horizontal'



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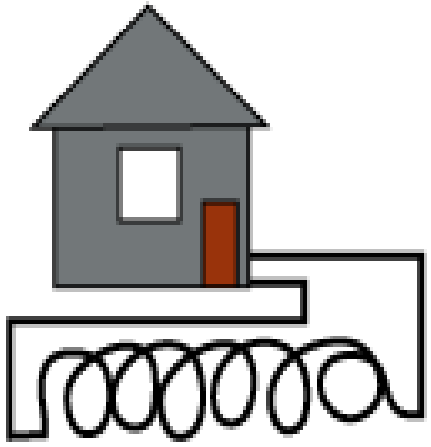

'Slinky'

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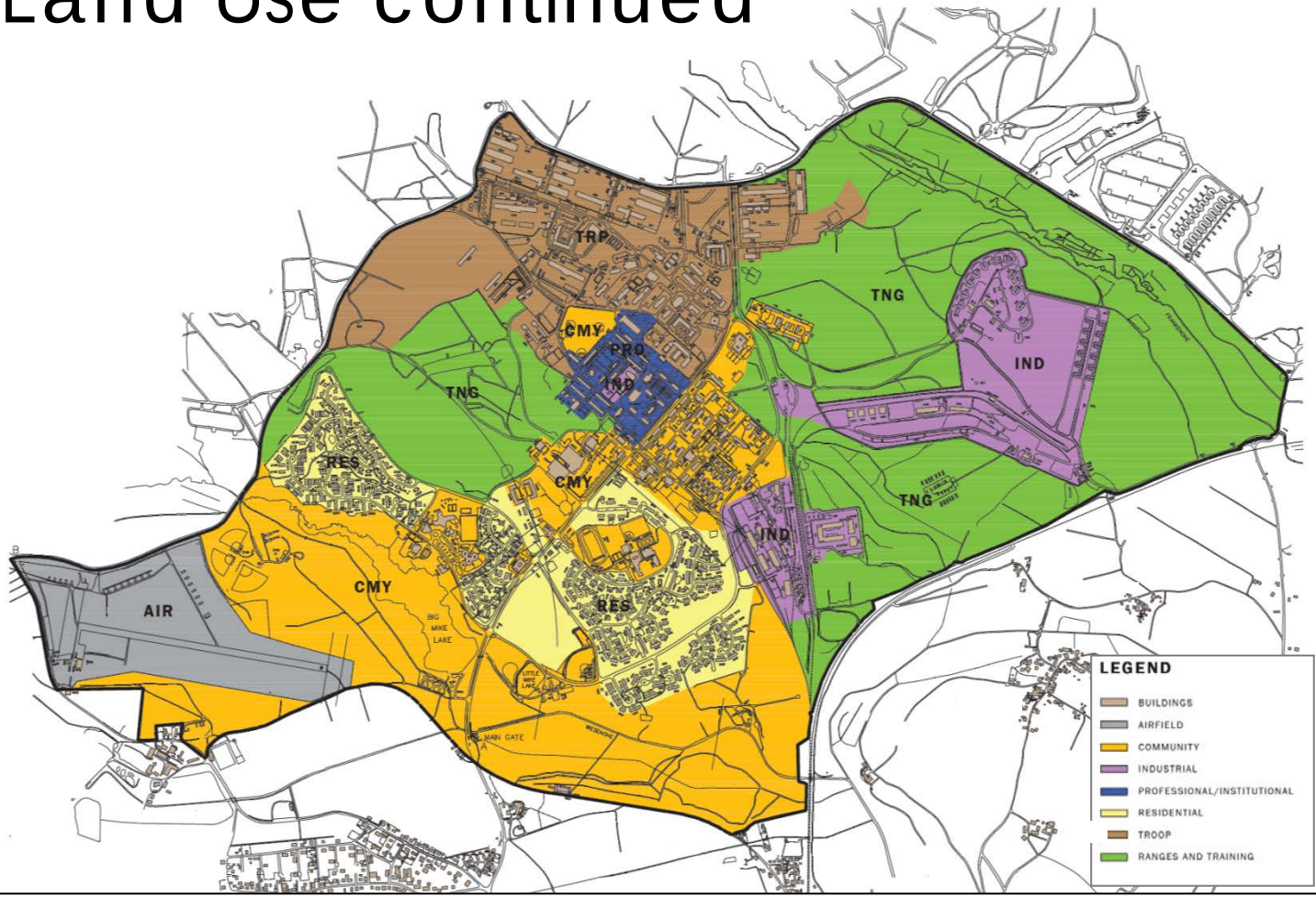
Geothermal Siting – Horiz Loop

Geothermal Siting - Slinky

Heat production rate (BTU/hr)	Potential annual heat production (MMBTU/yr)	Loop Length (m)	Surface area (m2)
12,000	10	200	100
120,000	100	2,000	1,000
240,000	200	4,000	2,000

Geothermal Siting Analysis

Land Use continued



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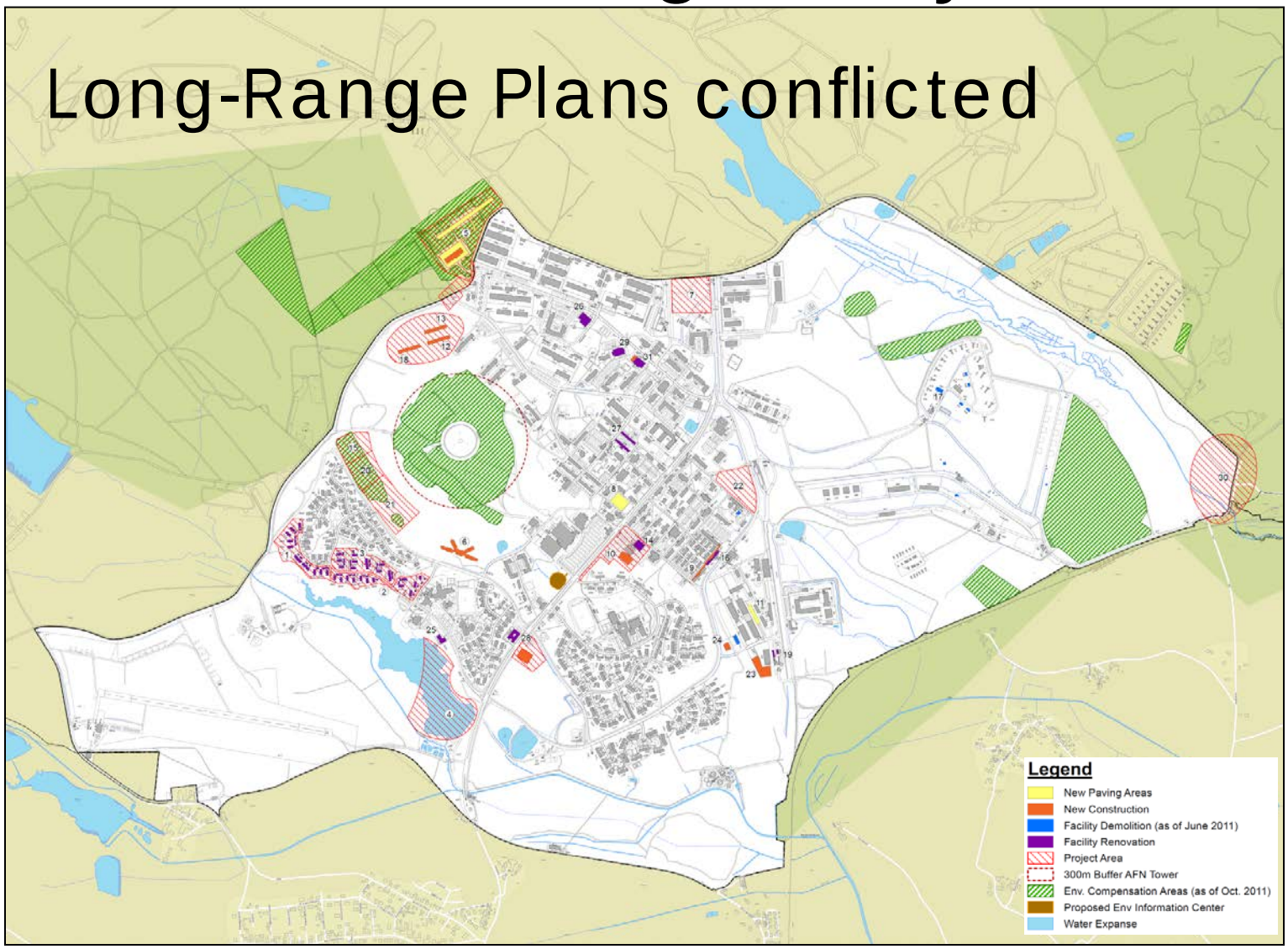
Geothermal Siting Analysis



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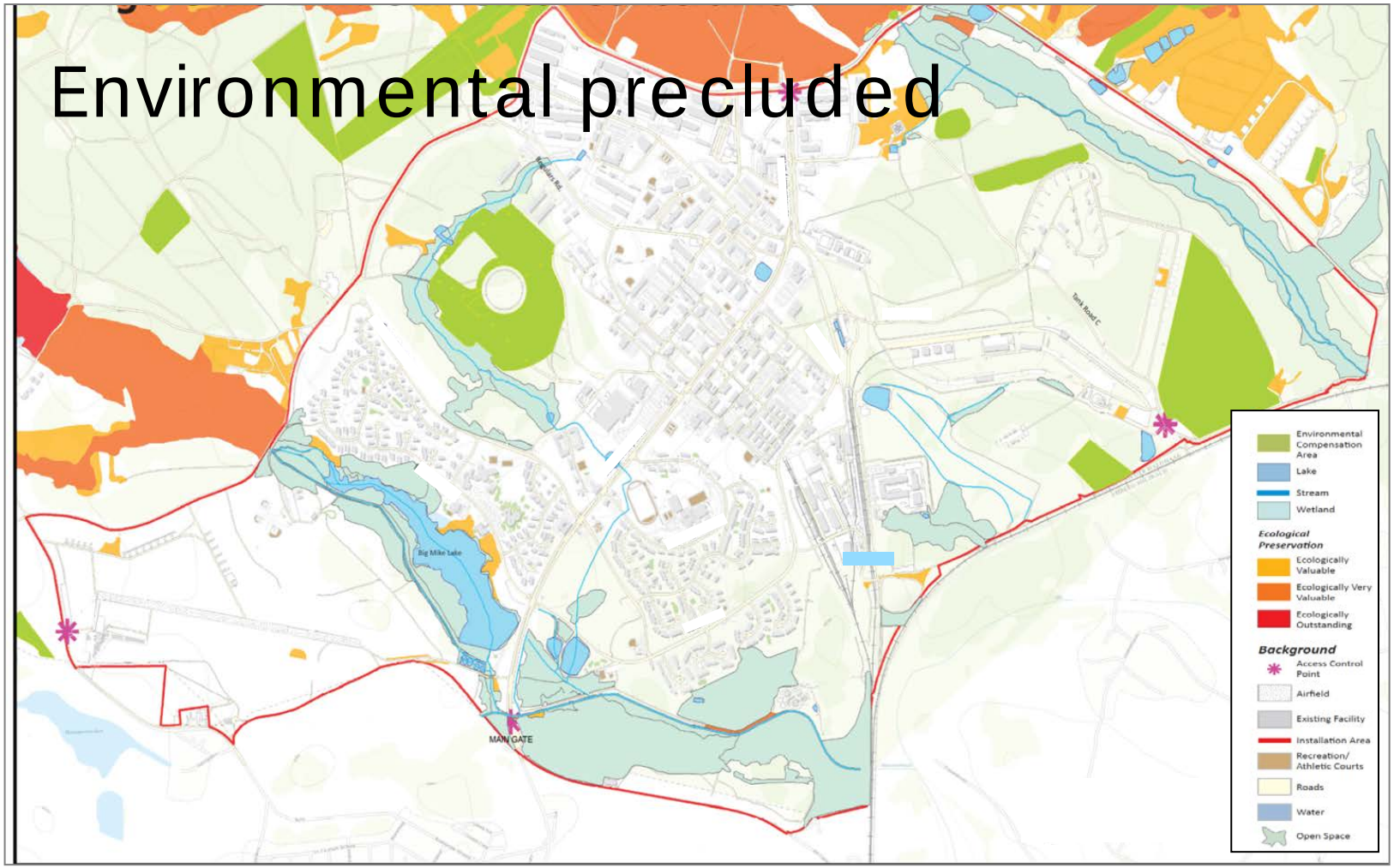
Geothermal Siting Analysis



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* Consider multiple technologies in planning. But you will <u>still</u> have conflicts.

This?

Or this?

Ideal = Both

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3. Unintended consequences

Biogas and Biomass options

- Agricultural feedstock
- Community owned and private facilities
- Plant siting is controversial

Unintended consequences - Biogas

- Odors, traffic, sourcing radius, transportation
- Corn production – monoculture
- Biogas price 2x natural gas
- Sustainability scoring is mixed

Biomass challenges–CHP/Cogen

- Feedstock analysis
  - Long term supply and pricing
  - Chips versus pellets
  - Transportation issues/traffic
  - Sustainable harvesting?

- Fuel management
  - Onsite storage/handling
  - Energy security
  - Noise impacts
  - Air emissions

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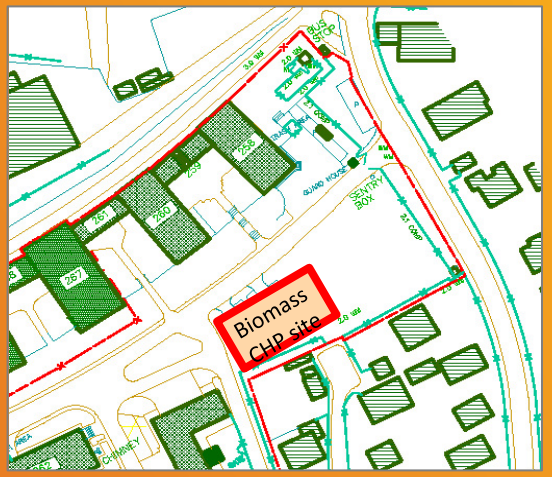
* Consider impacts beyond your own neighborhood.

- Sustainable harvesting?
- Agriculture effects?
- Fuel security?
- Noise and traffic?
- Air emissions/odors?



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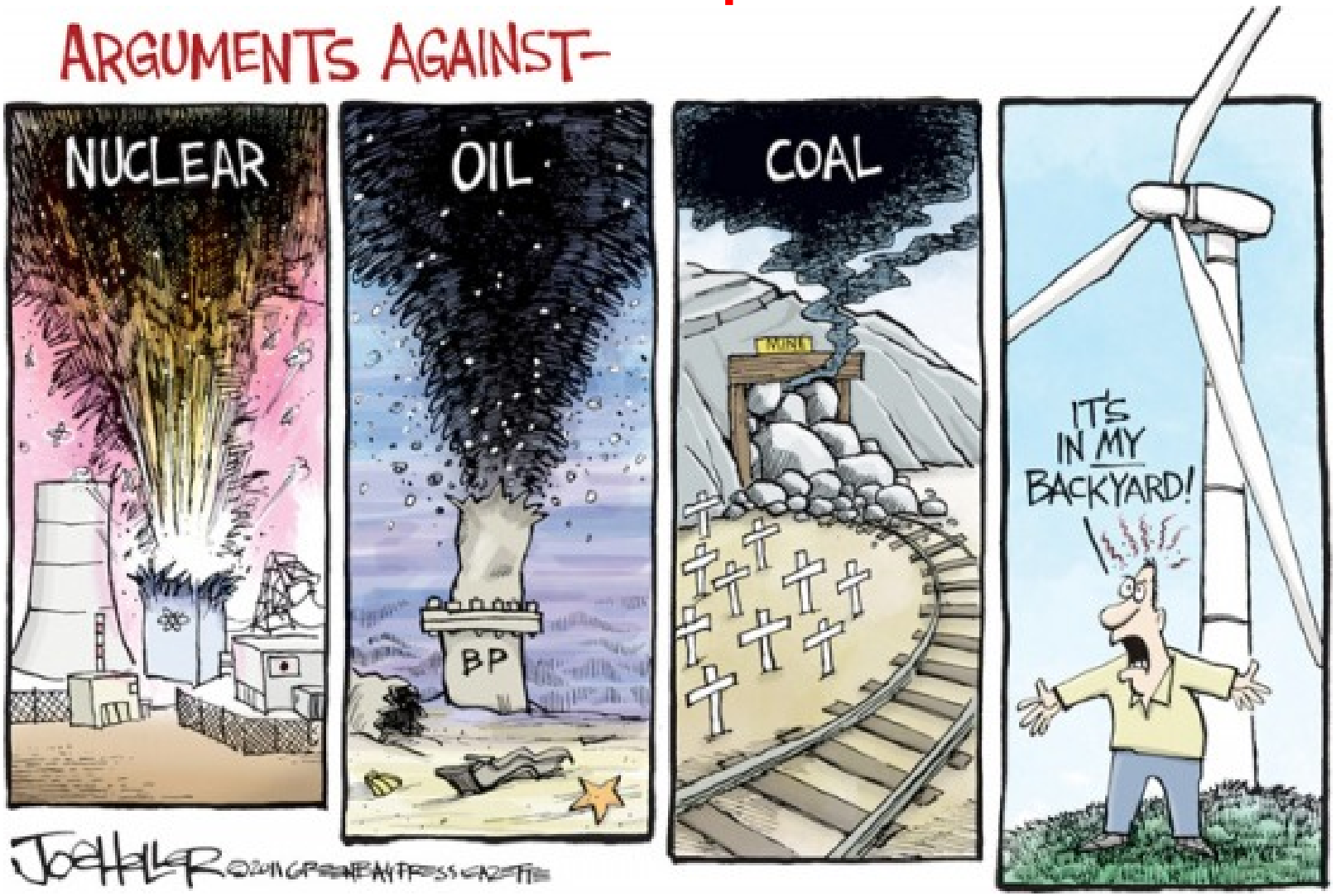
4. Stakeholder Opinions



Appropriate Siting

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Not Appropriate Siting

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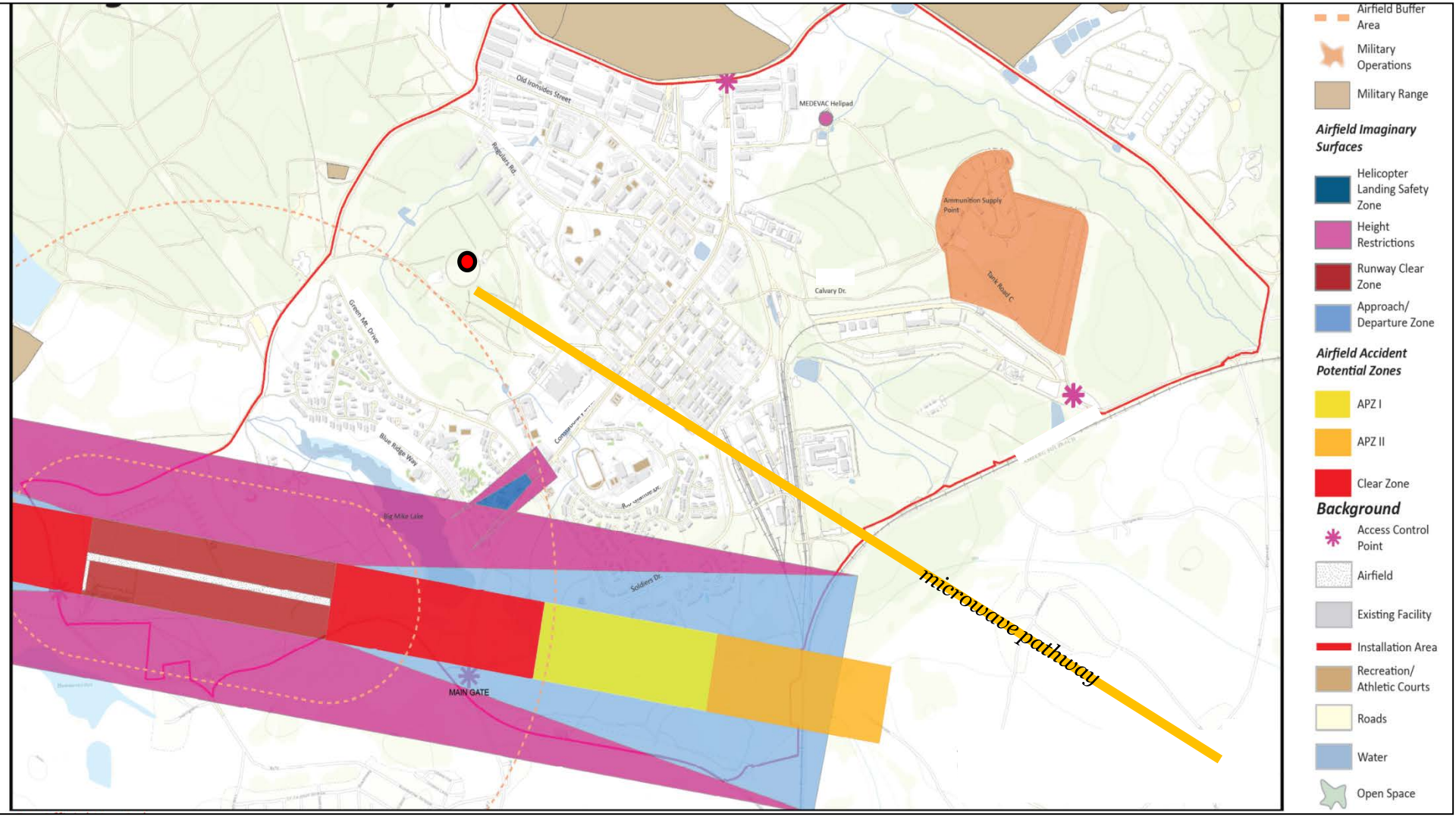
Wind Power Siting Challenges

- Turbulence
- Noise/setbacks
- Wildlife mortality
- Constructability/foundations
- Regulatory restrictions
- Visual impacts/NIMBYism
- Operational conflicts - Air Ops

Wind Power Siting Challenges

Military Operations/Communications



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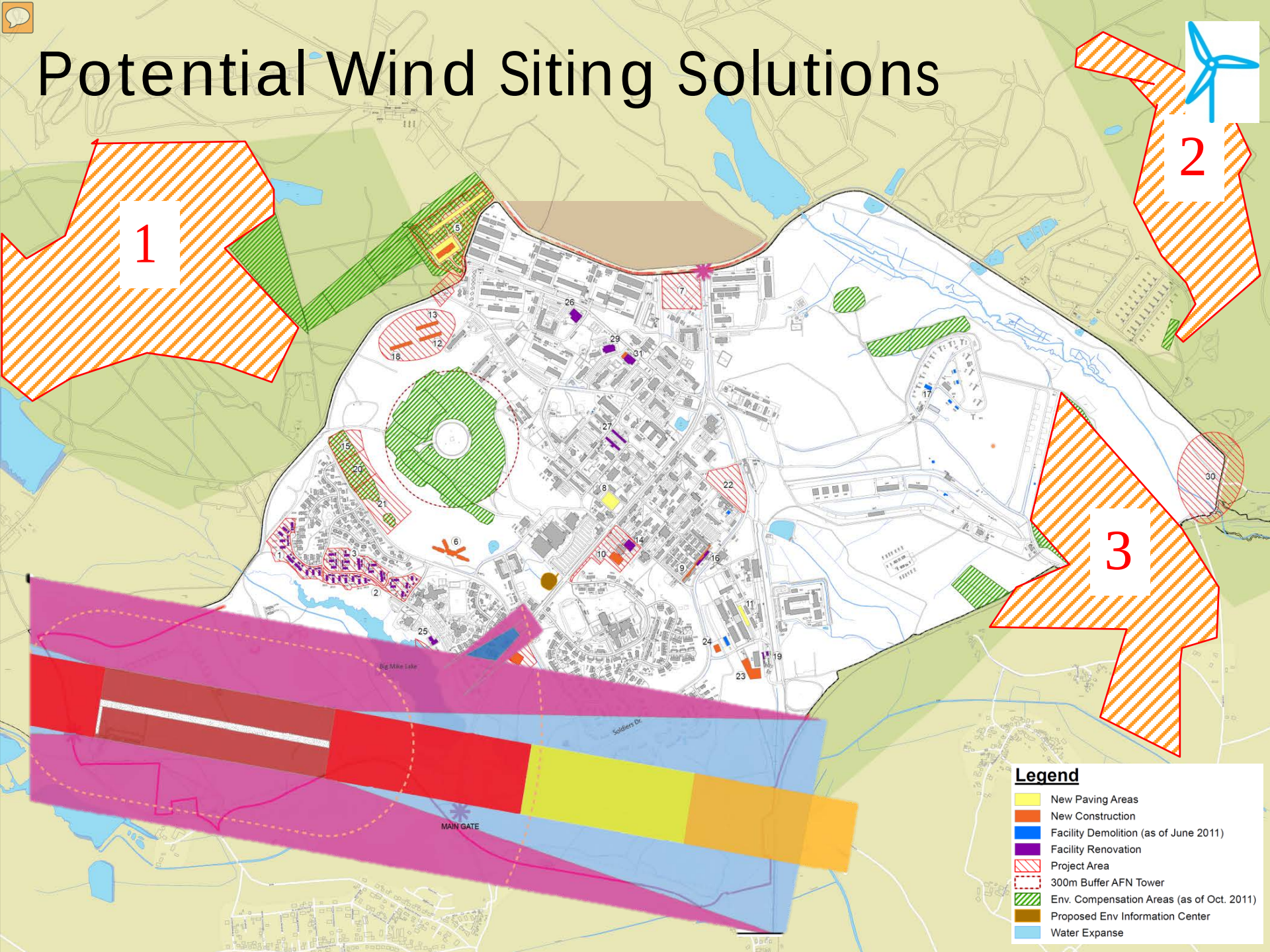
Potential Wind Siting Solutions



* *Engage and Educate Stakeholders. They may have solutions.*

- Get Leadership buy-in
- Educate planners
- Respect local knowledge
- Challenge conventional wisdom
- All options on the table initially
- Iterative process – reality checks and feedback

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Making Choices – Process is Key

- Consistent methods of analysis
- Stakeholder engagement and education
- Broad community perspective
- Long-term vision
- Shared roadmap to success

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Questions?

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