Siting and Land Use Considerations for Data Centers

Oregon Data Center Advisory Committee

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Introduction

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Presentation Overview

1. Discuss siting considerations for data centers at different scales,
2. Compare with siting considerations with other industrial use categories,
3. Review land use processes in urban and rural zones,
4. Highlight sustainability and innovation in the industry and how that affects design and siting considerations.

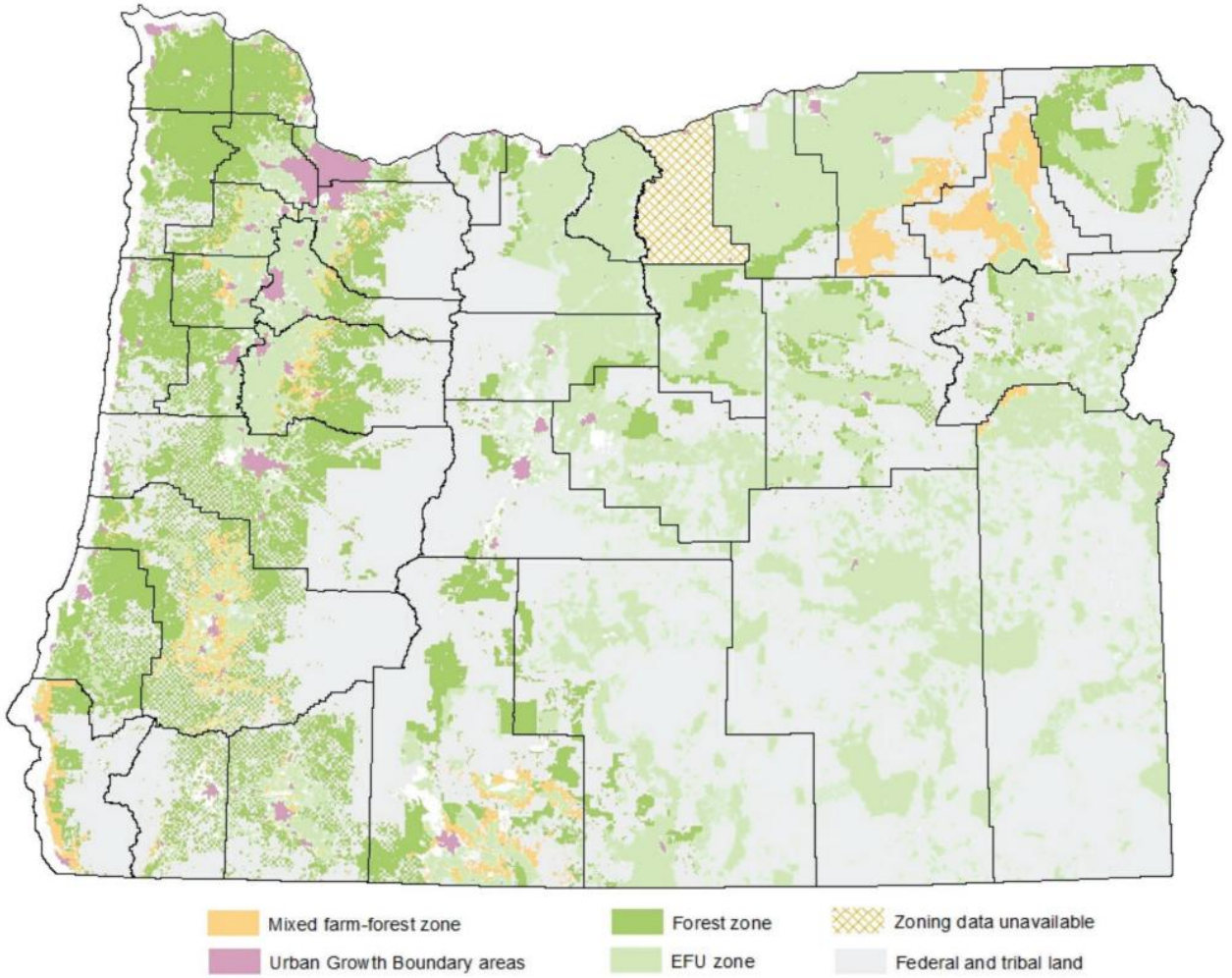
Industrial Land Planning and Development

Mackenzie's experience:

- Industrial land use planning and development strategy in Oregon.
- Land use entitlements for a broad range of industrial uses in urban and rural areas.
- Sustainability and innovation in industrial development.
- Data center specific planning and analysis:
  - Economic Opportunities Analyses (EOA)
  - Buildable Land Inventories (BLI)
  - Business Oregon Industrial Development Competitiveness Matrix

Oregon's Industrial Land Supply

- Limited supply, difficult to increase (especially larger sites)
- Urban and rural areas present different challenges:
  - Urban - may have infrastructure and workforce, but few large, contiguous sites.
  - Rural - may have land availability, but less infrastructure and more restrictive land use policies.
- Oregon's state and local land use regulations are designed to balance:
  - Economic development and job creation
  - Conservation of agricultural and forest lands



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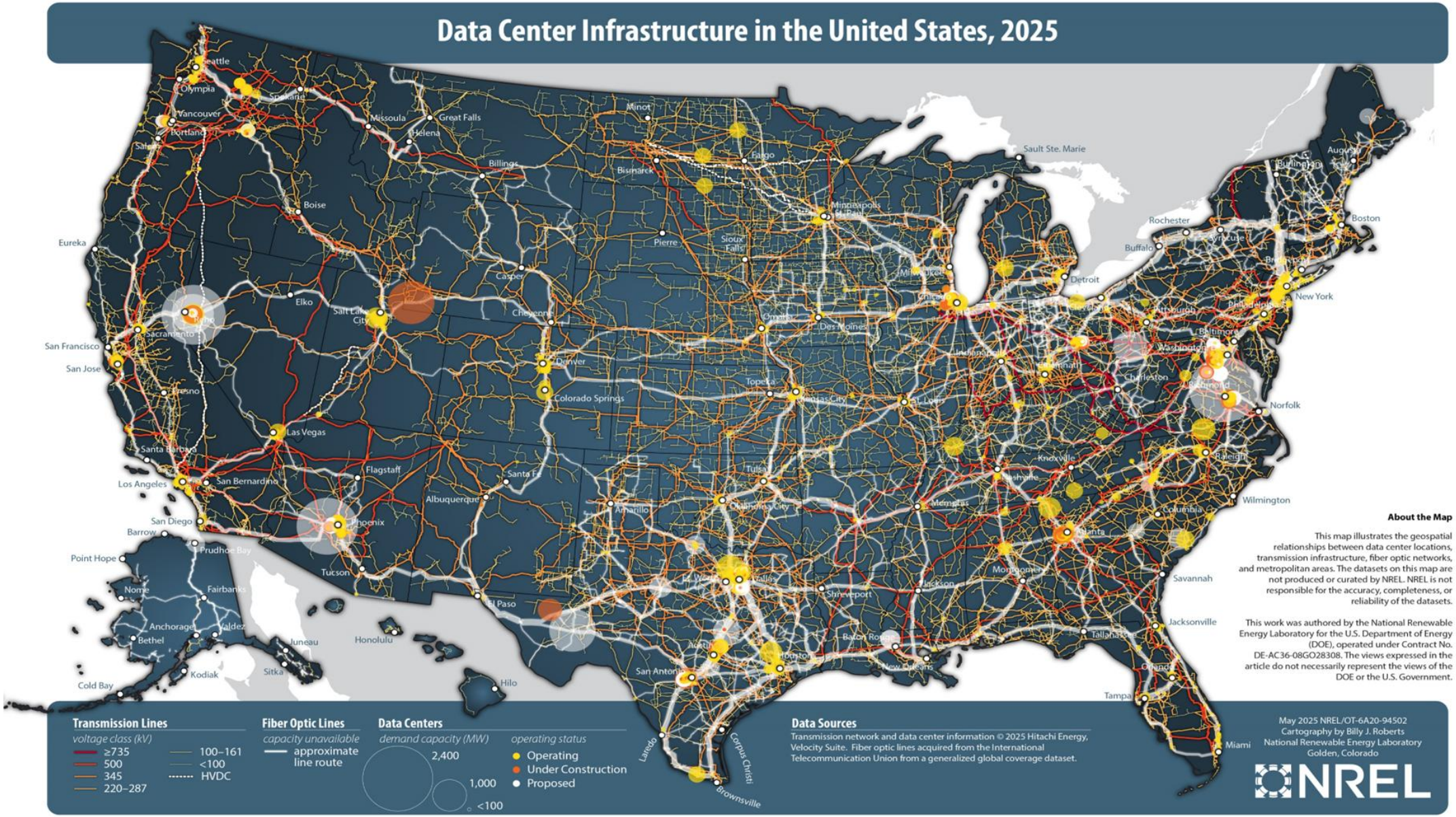
Data Center Infrastructure in the United States, 2025
Transmission Lines
voltage class (kV)
≥735
500
345
220–287
100–161
<100
HVDC
Fiber Optic Lines
capacity unavailable
approximate line route
Data Centers
demand capacity (MW)
2,400
1,000
<100
operating status
Operating
Under Construction
Proposed
Data Sources
Transmission network and data center information © 2025 Hitachi Energy, Velocity Suite. Fiber optic lines acquired from the International Telecommunication Union from a generalized global coverage dataset.
About the Map
This map illustrates the geospatial relationships between data center locations, transmission infrastructure, fiber optic networks, and metropolitan areas. The datasets on this map are not produced or curated by NREL. NREL is not responsible for the accuracy, completeness, or reliability of the datasets.
This work was authored by the National Renewable Energy Laboratory for the U.S. Department of Energy (DOE), operated under Contract No. DE-AC36-08GO28308. The views expressed in the article do not necessarily represent the views of the DOE or the U.S. Government.
May 2025 NREL/OT-6A20-94502
Cartography by Billy J. Roberts
National Renewable Energy Laboratory
Golden, Colorado
NREL

Siting Considerations for Data Centers

- Scale and type of development drive specific needs.
- Universal needs:
  - Power supply
  - Access to fiber
  - Water supply
  - Transportation access
  - Flat sites, free of natural hazards

Siting Considerations for Data Centers

- Smaller-scale developments
  - Enterprise and colocation facilities
  - Typically in urban/infill locations
  - Often in existing industrial zones
  - May compete for the same sites as other industrial uses

Siting Considerations for Data Centers

- Larger-scale developments
  - Hyperscale and campus-style facilities
  - Typically in rural locations or at the outer edge of UGBs
  - Need for larger sites, economies of scale
  - High-capacity transmission lines

Industrial Development Competitiveness Matrix

			Production Manufacturing			Value-Added Manufacturing and Assembly		Light / Flex Industrial			Warehousing & Distribution		Specialized			
		PROFILE	A	B	C	D	E	F	G	H	I	J	K	L	M	N
			Heavy Industrial / Manufacturing	High-Tech Manufacturing	Clean-Tech Manufacturing	Food Processing	Advanced Manufacturing & Assembly	General Manufacturing	Industrial Business Park and R&D Campus	Business / Admin Services	Regional Warehouse / Distribution	Local Warehouse / Distribution	Uncrewed aerial vehicles (UAV) Manufacturing / Research	Data Center	Hyperscale Data Center	Rural Industrial
		DESCRIPTION	Processing and/or production of raw materials and/or transformation of material substances in plants, factories, or mills.	Computerized and automated manufacturing and processing of raw products into technology products (e.g., semiconductors); not assembly.	Computerized and automated manufacturing and processing of raw products into clean energy technologies (e.g. batteries, solar panels, wind, timber etc.); not assembly.	Manufacturing, production, or processing of foods and beverages for human or animal consumption.	'Value-added' manufacturing and assembly with products transformed, upgraded, or used to create new product, typically higher-value product, by a specific process.	Less intensive manufacturing with emphasis on assembly activities and direct transfer to wholesale and retail markets.	Planned campuses with diversified facilities of general, light, or heavy industrial users, manufacturing, warehouse / distribution, office, and/or business support services.	Business functions such as call centers or broadcasting studios; often multi-story, employee-intensive, and parking heavy.	Large-scale warehousing, logistics, storage, freight consolidation, wholesale, and distribution of goods. May include inventory tracking, packaging, and customer service functions, serving regional or national markets.	Smaller scale warehousing, logistics, storage, freight consolidation, wholesale, and distribution of goods supporting last-mile or local delivery services.	Assembly, manufacturing, and testing of UAV; a type of advanced 'value-added' manufacturing that requires large open areas for testing.	Smaller-scale warehouse type facility for off-site storage of information technology infrastructure, computer systems, and associated components (applications and secure data). May include maintenance and office areas and can be single or multiple tenant occupied.	Large-scale warehouse type facility for off-site storage of information technology infrastructure, computer systems, and associated components (applications and secure data). May include maintenance and office areas and can be single or multiple tenant occupied.	Less intensive manufacturing processes with emphasis on assembly activities and direct transfer to wholesale and domestic consumer uses. Typically not high tech industries in rural areas.
		CRITERIA														
1	**GENERAL REQUIREMENTS**		**Use is permitted outright, located in Urban Growth Boundary (UGB) or equivalent. Site is outside floodplain and does not contain contaminants, wetlands, protected species, or cultural resources or has mitigation plan(s) that can be implemented in 180 days or less.**													
	PHYSICAL SITE															
2	TOTAL SITE SIZE*	Competitive Acreage**	10 - 100+	5 - 100+	5 - 100+	5 - 25+	5 - 25+	5 - 15+	20 - 100+	5 - 15+	20 - 100+	10 - 25+	10 - 25+	10 - 50+	50 - 100+	10 - 50+

Industrial Development Competitiveness Matrix

business oregon

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	PHYSICAL SITE															
2	TOTAL SITE SIZE*	Competitive Acreage**	10 - 100+	5 - 100+	5 - 100+	5 - 25+	5 - 25+	5 - 15+	20 - 100+	5 - 15+	20 - 100+	10 - 25+	10 - 25+	10 - 50+	50 - 100+	10 - 50+
3	COMPETITIVE SLOPE:	Maximum Slope	0 - 5%	0 - 5%	0 - 5%	0 - 5%	0 - 7%	0 - 5%	0 - 7%	0 - 12%	0 - 5%	0 - 5%	0 - 7%	0 - 7%	0 - 7%	0 - 5%
	TRANSPORTATION															
5	TRIP GENERATION:	Average Daily Trips per Acre	40 to 60 (ADT / acre)	40 to 80 (ADT / acre)	40 to 80 (ADT / acre)	50 to 65 (ADT / acre)	30 to 60 (ADT / acre)	30 to 50 (ADT / acre)	60 to 150 (ADT / acre)	170 to 180 (ADT / acre)	20 to 80 (ADT / acre)	20 to 80 (ADT / acre)	30 to 50 (ADT / acre)	20 to 30 (ADT / acre)	20 to 30 (ADT / acre)	30 to 50 (ADT / acre)
6	MILES TO INTERSTATE OR OTHER PRINCIPAL ARTERIAL:	Miles	w/in 10	w/in 10	w/in 10	w/in 30	w/in 15	w/in 20	N/A	N/A	w/in 5 (only interstate or equivalent)	w/in 5 (only interstate or equivalent)	N/A	w/in 30	w/in 30	w/in 60
7	RAILROAD ACCESS:	Dependency	Preferred	Avoid	Preferred	Preferred	Not Required	Preferred	Preferred	Not Required	Preferred	Preferred	Not Required	Avoid	Avoid	Preferred
8	PROXIMITY TO MARINE PORT:	Dependency	Preferred	Not Required	Preferred	Preferred	Not Required	Preferred	Preferred	Not Required	Preferred	Preferred	Not Required	Not Required	Not Required	Preferred
9	PROXIMITY TO REGIONAL COMMERCIAL AIRPORT:	Dependency	Preferred	Competitive	Competitive	Preferred	Competitive	Preferred	Required	Preferred	Preferred	Preferred	Preferred	Competitive	Competitive	Not Required
		Distance (Miles)	w/in 60	w/in 60	w/in 60	w/in 60	w/in 30	w/in 60	w/in 30	w/in 60	w/in 60	w/in 60	w/in 30	w/in 60	w/in 60	N/A
10	PROXIMITY TO INTERNATIONAL AIRPORT:	Dependency	Preferred	Competitive	Competitive	Preferred	Competitive	Preferred	Competitive	Preferred	Preferred	Preferred	Competitive	Preferred	Preferred	Not Required
		Distance (Miles)	w/in 300	w/in 30	w/in 30	w/in 300	w/in 30	w/in 300	w/in 30	w/in 300	w/in 300	w/in 300	w/in 100	w/in 300	w/in 300	N/A
11	PROXIMITY TO TRAINED LABOR FORCE:	Dependency	Preferred	Competitive	Competitive	Not Required	Competitive	Preferred	Preferred	Not Required	Not Required	Not Required	Competitive	Not Required	Not Required	Not Required
12	PROXIMITY TO EXISTING SUPPLY CHAIN:	Dependency	Preferred	Competitive	Competitive	Not Required	Competitive	Preferred	Preferred	Not Required	Not Required	Not Required	Competitive	Not Required	Not Required	Not Required

Industrial Development Competitiveness Matrix

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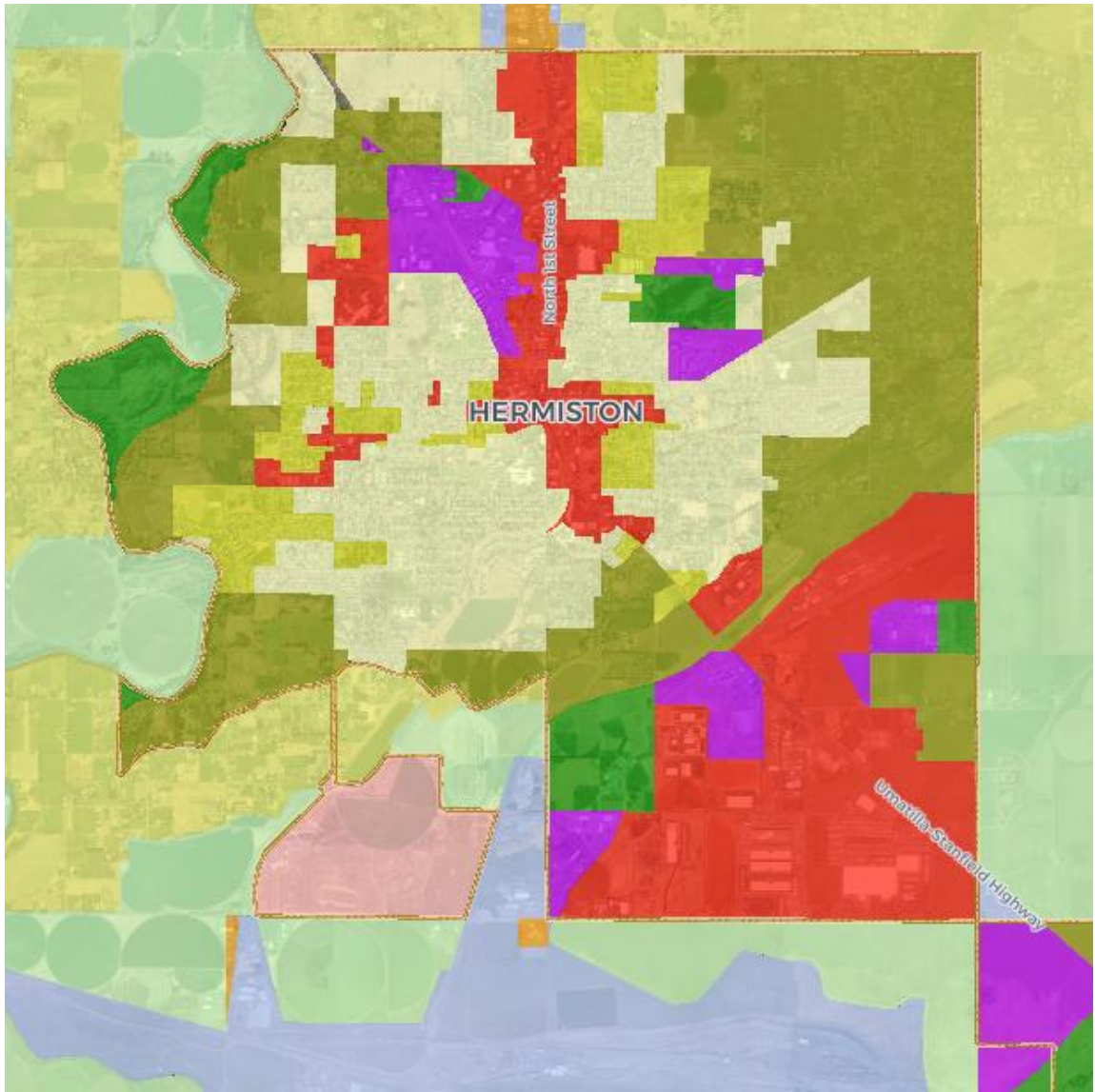
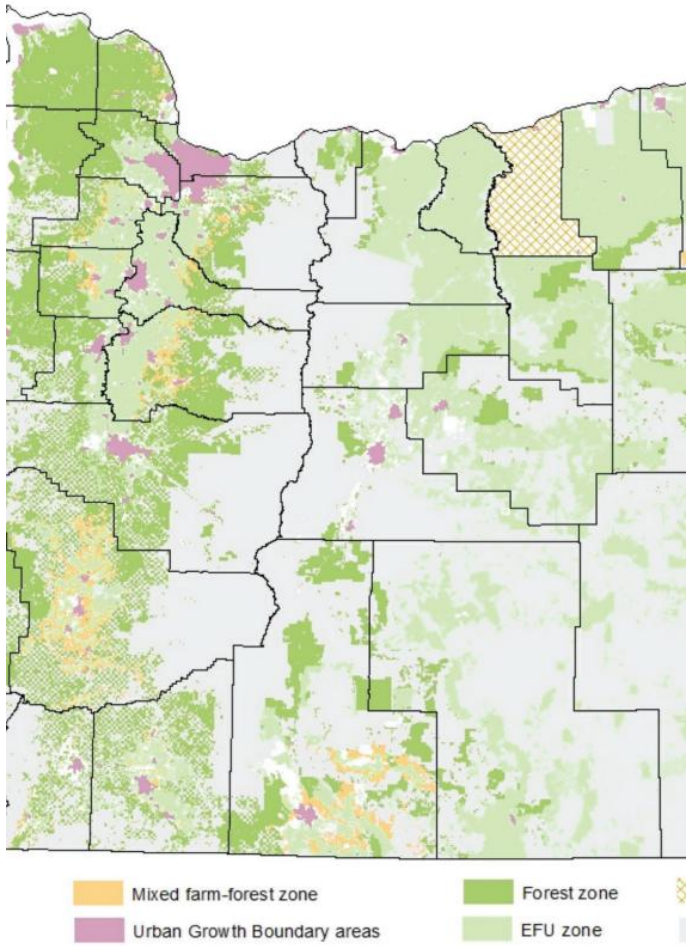
	UTILITIES															
13	WATER: (private lateral, public main connection must be at least same diameter or larger)	Min. Line Size (Inches Diameter)	8" - 12"	12" - 16"	8" - 12"	12" - 16"	8" - 12"	6" - 10"	8" - 12"	4" - 6"	4" - 8"	4" - 6"	4" - 8"	16"	16" - 24"	4" - 8"
		Min. Fire Line Size (Inches Diameter)	10" - 12"	12" - 18"	10" - 12"	10" - 12"	10" - 12"	8" - 10"	8" - 12"	6" - 10"	10" - 12"	6" - 8"	6" - 10"	10" - 12"	10" - 12"	6" (or alternate source)
		High Pressure Water Dependency	Preferred	Required	Preferred	Required	Preferred	Not Required	Preferred	Not Required	Not Required	Not Required	Not Required	Required	Required	Not Required
		Flow (Gallons per Day per Acre)	1600 (GPD / Acre)	5200 (GPD / Acre)	1600 (GPD / Acre)	3150 (GPD / Acre)	2700 (GPD / Acre)	1850 (GPD / Acre)	2450 (GPD / Acre)	1600 (GPD / Acre)	500 (GPD / Acre)	500 (GPD / Acre)	1600 (GPD / Acre)	7000 - 11700 (GPD / Acre) †	7000 - 11700 (GPD / Acre) †	1200 (GPD / Acre)
14	SANITARY SEWER: (private lateral, public main connection must be at least same diameter or larger)	Min. Service Line Size (Inches Diameter)	6" - 8"	12" - 18"	6" - 8"	10" - 12"	10" - 12"	6" - 8"	10" - 12"	6" - 8"	4"	4"	6"	8" - 10"	8" - 10"	4" - 6" (or on-site source)
		Flow (Gallons per Day per Acre)	1500 (GPD / Acre)	4700 (GPD / Acre)	1500 (GPD / Acre)	2600 (GPD / Acre)	2500 (GPD / Acre)	1700 (GPD / Acre)	2000 (GPD / Acre)	1600 (GPD / Acre)	500 (GPD / Acre)	500 (GPD / Acre)	1300 (GPD / Acre)	1000 (GPD / Acre) ‡	1000 (GPD / Acre) ‡	1000 (GPD / Acre)
15	NATURAL GAS:	Preferred Min. Service Line Size (Inches Diameter)	4" - 6"	6"	6"	4"	6"	4"	6"	2"	2"	2"	2"	4" - 6"	6" - 12"	N/A
		On Site	Competitive	Competitive	Competitive	Preferred	Competitive	Competitive	Competitive	Preferred	Preferred	Preferred	Preferred	Competitive	Required	Preferred
16	ELECTRICITY:	Minimum Service Demand	2 MW	4-6 MW	4-6 MW	2-6 MW	1-2 MW	0.5 MW	0.5 -1.5 MW	0.5 MW	1 MW	1 MW	0.5 MW	5-100 MW	100 MW - 5 GW	1 MW
		Close Proximity to Substation	Competitive	Competitive	Competitive	Not Required	Competitive	Preferred	Competitive	Preferred	Not Required	Not Required	Not Required	Required, could be on site	Required, could be on site	Not Required
		Redundancy Dependency	Required	Preferred	Preferred	Not Required	Required	Not Required	Competitive	Required	Not Required	Not Required	Not Required	Required	Required	Not Required
17	TELECOMMUNICATIONS:	Major Communications Dependency	Preferred	Required	Required	Preferred	Required	Required	Required	Required	Preferred	Preferred	Required	Required	Required	Preferred

Land Use Entitlement Process

- Urban areas
  - Data centers often permitted or conditional uses in industrial zones.
  - Design and performance standards (screening, buffering, noise, glare, vibration, odors) to ensure compatibility.
  - UGB expansions are sometimes needed to accommodate growth; very extensive process.
  - Large sites (50+ acres) are scarce.



Land Use Entitlement Process



- Rural areas
  - Larger sites may be available but allowed uses are much more restricted.
  - Entitlement may require zoning text and/or map amendments, goal exceptions.
  - Process is rigorous and often involves a team of experts (e.g. soils scientists, natural resource experts, transportation engineers, civil engineers, economic analysts)
  - Extensive public process involved, including state agencies, service providers, tribes, and other interested parties.

Land Use Entitlement Process

- Rural areas (continued)
  - Statewide Planning Goals commonly implicated:
    - Goal 3 – Agricultural Lands
    - Goal 11 – Public Facilities and Services
    - Goal 12 – Transportation
    - Goal 14 – Urbanization
  - Required analyses may include:
    - Alternative areas analysis
    - Economic, Social, Environmental, and Energy Analysis (ESEE)

Land Use Considerations

- Beyond revenue generation, public benefits can include:
  - Transportation (Street and sidewalk) improvements
  - Improvements to power, water, and sanitary infrastructure

Sustainability and Innovation

- Sustainability is an operational and financial driver for data center developers/operators.
- Water and power are major costs, so the industry is investing in innovation and new approaches to:
  - Reduce water and energy use, strategies to incorporate reclamation
  - Invest in efficiency and creating innovation
- Emerging practices
  - Water recovery and reuse
  - Heat recovery and reuse
- Sustainability and technology innovation will continue to influence siting considerations and facility design.

Aligned PDX-01

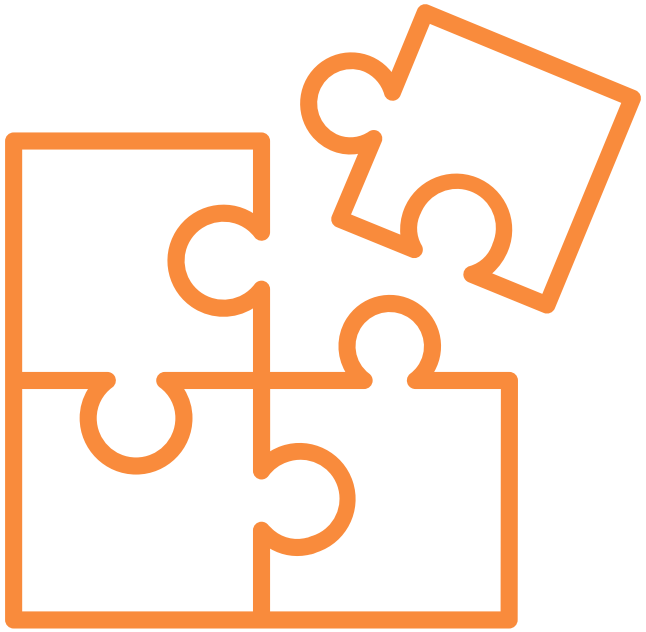
Hillsboro, OR

27- Acre Campus
24x7x365 accessibility

- ENERGY STAR Score of 97
- Closed-loop water system design (near zero WUE)
- 100% renewable power
- EPDs (≥40%) for core & shell materials

ECarbon tracking
Targeting carbon-neutral footprint by 2040

Summary



1. Type and scale impact siting considerations.
2. Urban and rural settings have different opportunities and constraints.
3. Data centers function like utility infrastructure.
4. Oregon's land use system offers strong tools for evaluating data center projects.
5. Sustainability and innovation are major drivers for current and future development.

Questions?