Jodi C. Guerin

From: Gaye Stockman [GStockman@laramiewy.org]
Sent: Wednesday, July 25, 2012 4:39 PM
To: Jodi C. Guerin
Subject: Microsoft's message

Jodi,
Below is the message we received from Microsoft when we asked why we were eliminated from the search.
Gaye
=====

Gaye Stockman, CEcD
President & CEO
Laramie Economic Development Corporation
P.O. Box 1250
2523 East Garfield Street, Suite B
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From: Kevin Williams (DCS)
Sent: Tuesday, February 07, 2012 12:12 AM
To: Gaye Stockman
Subject: RE: Project Summit Spreadsheet

Actually there were no concerns whatsoever with the information you presented.
It was clear/concise...!

Although I cannot speak for all other data center teams, in general we are all looking for sites that have the least amount of effort/time required to get a DC up and running...
So the key is to have a site "pad ready" in terms of graded flat with utilities stubbed to the edge (fiber, water, sewer)... and fiber to the edge of the site is really about having ample conduit in a duct bank – ready for fiber to be pulled back to a major carrier like level 3.

From this standpoint it is less about the presentation and more about how quickly a user can get out of the ground with foundations.
The Laramie site is a good one; maybe take a look at the master plan to see if there are ways to keep less compatible uses away from the industrial parcels (move schools and residential as far away as possible)

If not for the latency issue (unique possibly to us) we would still be evaluating.

Thanks again... great options...!

From: Gaye Stockman [mailto:GStockman@laramiewy.org]
Sent: Monday, February 06, 2012 7:43 PM
To: Kevin Williams (DCS)
Subject: RE: Project Summit Spreadsheet

Kevin,
Thank you so much for letting us know.
Of course, we are disappointed, but we understand the need for speed in the data center world.
May we ask you one more favor?
We would like to utilize every opportunity to improve our process and/or presentations. We won't know what we need to improve unless we hear it from the decision makers.
If at all possible, would you be willing to provide us some feedback of how we could do a better job of presenting Laramie to future clients?
We would truly appreciate your input.
Thank you again for your kind words.
Until later,
Gaye
=====

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From: Kevin Williams (DCS)
Sent: Monday, February 06, 2012 6:06 PM
To: Gaye Stockman
Cc: sean.stevens@wyo.gov; tom.johnson1@wyo.gov
Subject: RE: Project Summit Spreadsheet

Gaye, I am traveling again this week, but I did want to reach out to you to let you know that we are narrowing our search for the western US.
At this time, we will be placing the Laramie site options on hold – while we continue to evaluate Cheyenne.
The rational here has nothing to do with the fantastic options in Laramie, rather it is a factor of our internal latency requirements for the various business units that will eventually be housed at the data center.
Some of those business units will need to serve other target markets (outside Wyoming) in 5ms or less and our networking team has determined that only Cheyenne has that "reach" at this time.

I do want to thank you and your team for a fantastic effort and for all the support you provided. Laramie is still a very attractive location (as is Wyoming in general) and I have no doubt that another company will eventually land a data center in your location.

Thanks so much…!

From: Gaye Stockman [mailto:GStockman@laramiewy.org]
Sent: Thursday, December 22, 2011 11:45 AM

Wyoming

Statewide assessment of infrastructure necessary to support data centers throughout the State

Prepared for:

The Wyoming Business Council

Prepared by:

TMNG Global, Inc.

March 2012

Table of Contents

This Study was undertaken to determine the ability of Wyoming and it's communities to attract Medium to Very Large Data Centers generally requiring:

- **30 to 200 contiguous acre single square or rectangular sites**
- **100,000 to 900,000+ square foot building**
- **Minimum start-up power consumption of 5MW (MegaWatts) up to 75MW**
  - **Power delivered at Transmission Level (generally on looped or "protected" lines and lower cost) with customer provide substation**
- **Multiple and Diverse Fiber Cable routes and/or Providers**

NOTE: ***There are many communities and sites throughout the state that can accommodate the needs of small data centers of 0.5MW to 4MW power demand (with local "unprotected" distribution lines) with single fiber path/ provider***

Executive Summary

Over the last few years Wyoming has experienced a significant increase in the number of companies interested in evaluating the potential of building data centers in the State. Indeed The National Center of Atmospheric Research (NCAR) and Verizon Business both recently selected Wyoming for data center sites. There have been several other companies that have looked at Wyoming but have chosen other locations to build their new facilities – with the associated high salary jobs and significant infrastructure.

The Wyoming Business Council has been working on developing a program for recruiting data centers to the State. The common but significant points for site selection boil down to costs and infrastructure. This is generally no different than in years past but in recent years there have been many changes that now make Wyoming a more viable if not ideal location for data centers and other high technology operations. One needs to look at these changes individually as well as collectively to fully understand this new interest.

The last five to ten years have seen significant alterations in modern corporate, small & medium business strategies, methods and practices of computing and communicating as well as unparalleled transformations in personal communications and social networking. There have also been substantial technology, network, thought, social communications and environmental modifications that are driving unprecedented modifications in everyday life. Besides the impacts to our everyday lives this transformation has substantially modified the how, what and where of data center operations and site selection.

One result of these changes is that many individual site developers in several states have recognized the importance of technology in general, and information technology in particular, as a fundamental driver of economic progress and growth and have been developing data center, "power parks" and "energy parks' with the specific intention of attracting data centers and other information technology oriented companies to their sites. As a matter of "fact" the importance of technology has risen to a level of general acceptance by the financial community and economic strategists (and recently discussed often during the Republican Presidential Candidate debates) that wealth generation and economic stability as well as most future economic growth are very closely associated with the capacity to increase productivity, offer new services and add value using IT products and services. Without doubt data centers play a key role in IT product and services delivery.

Transformations

These transformations include:

Conversion of mobile telephones into high powered multi-functional devices such as smartphones, notebooks and personal communication devices like iPads, Nooks and Kindles that replace or perform as secondary "PCs or Laptop" and the ubiquitous distribution and utilization of such devices.

- Besides their substantial impact on the wireless carrier networks these multi-function devices and all their related services are driving the need for huge amounts of real time network based "cloud" stored data – much of which is replicated between and amongst search engines, network operators and application providers.

Blade Server Technology with 2 Processors with 8 Cores and up to 8 VMS Per Core (128 Compute Instances) in a 1 & ¾ inch rack space.

- A single rack of about 40 such units can often replace several hundred square feet of traditional computing systems. This new server technology when coupled with virtual machine (VM) software is a driver in new data center design criteria.

- Most large companies today have two (2) to five (5) year plans to replace existing traditional computing and data storage systems with the new blade technology and virtualization software. This will, often, require substantial site renovations or new sites to be developed to accommodate the new denser systems as well as new cooling strategies and/or technologies. Many companies will be looking at developing new data center sites that will be smaller but more efficient while re-purposing significant real estate (usually in major metropolitan areas) to be sold off or re-tasked at a cost saving.

Virtualization software running on new servers are replacing unique or specialized function computing systems. When coupled with orchestration software applications compute resources can be used to perform many diverse functions therefore becoming much more efficient and versatile then just a few years ago.

Advancements in network technologies and data security have caused a major shift in determining the location of where, how and what is processed and stored.

- Substantial bandwidth increases and improved/reduced Latency on Fiber Networks – at Lower Costs - is another major driver in determining location of data centers. A data center hundreds of miles away from the users can now offer virtually unlimited volumes of data transfer at effectively the same speed as if the computing systems were in the same building.

- During the last 10 years optical fiber cable has been extended into thousands of smaller communities making many second, third and fourth tier communities as fiber and bandwidth rich as Tier 1 Cities. Long haul and Regional fiber routes now meet in thousands of locations throughout the country providing smaller communities greater access to national and international "protected" or "ring" routes that offer virtually unlimited bandwidth and services in a much more secure and reliable fashion than just a few years ago.

It doesn't need to be in immediate proximity of Corp HQ anymore.

- Enterprise IT executives and senior management are being bombarded with thought provoking alternatives to maintaining the traditional corporate owned IT assets and resources. Virtually every IT industry conference or seminar (not to mention financial conferences/seminars that focus on operating efficiency) are driving senior executives to look at collocation, managed IT services and most recently "cloud" and "private cloud" options. There is significant acceptance today, by IT professionals, for locating IT assets in telecom or data center "hotels" under professional management with access to several network carriers and application providers. This was not the case just a few years ago.

Threat Avoidance/Survival or Business Continuity Planning – Get Away From High Profile "Target" Areas/Large Cities.

- One of the many long range results of the September 11th terrorist attaches on the US was how it affected the way corporations now look at where, what and how they operate and maintain their IT assets, data and especially ensuring business continuity should any catastrophic event impact their business. Data back up and disaster recovery planning has now shifted to business continuity planning i.e.: separating the IT assets, data, databases and support systems from the same physical facilities as the users (generally employees). For public or high profile companies to only have data backed up is no longer an acceptable mode of operation. Often fully mirrored systems, databases and network connectivity are the new "standard" for operating. Advancements in communications technology, discussed above, have played a significant role in current business continuity planning.

Environmentally Friendly or "Green" Initiatives in Most Major Enterprises.

- Virtually every major corporation and most other enterprises have been developing and implementing "green" initiatives. Indeed almost every architectural and facilities engineering and/or construction firms boast about how many LEEDS certified personnel are on their staffs. Most major corporations now have a senior executive assigned to or dedicated to environmentally responsible initiatives and compliance with corporate or governmental policies. Chief Environmental Officers and Vice President for Environment positions are now not uncommon. From both an ecological and financial point of view the goals of green initiatives should significantly reduce overall power consumption, minimize water consumption, reduce waste water output and virtually eliminate pollutants that are released into the air. To this end building new data centers will often be less costly than trying to retrofit old facilities to targeted environmental goals.

Social Media, Networking and Communications.

- We are currently going through a phase of unprecedented change in social communication with access to and the demand for virtually unlimited supplies and sources of information at any time and from anywhere. All the major wireless carriers report a quadrupling of the use of Wireless to access search engines in the past 2 to 3 years – indeed they are the drivers of this trend.
- Social Communications and Social Media is driving heretofore unheard of growth in the need for data storage and retrieval – on demand – with immediate delivery driven by the likes of Facebook, Twitter, My Space, Bebo, LinkedIn, Plaxo, Orkut and others.
  - Over 50% of electronic social communications has moved from email to social services
  - Over 45% of news is now delivered via the internet and social communications service providers

All of these points and more are driving changes in our everyday business and personal lives. One result of these changes is a significant shift in where data centers are likely to be located as well as who builds and owns them. Large enterprises, network operators, search engine & social media companies and cloud services providers as well as the federal and state governments are all building new facilities at a significant rate and in many cases far away from large metropolitan (potentially high risk) areas – out of sight out of mind (OSOM)!

Financially and technically feasible network options now allow physical data center assets to be significantly separated from the majority of IT operations staff and all users. Today's data center is more of a warehouse for computing hardware, data storage and communications systems with fewer support personnel than a similar "sized" site would have required just five years ago.

Data Center site selection is definitely not a cut and dry, right or wrong, decision. In the past data centers were built at or close to the company headquarters or customer base. Today there are many more variables that come into play depending upon the owners overall strategy, services offered, ability or willingness to accept outages (conversely referred to as Up Time), security (physical as well as communications), ability to attract, recruit or transfer suitable resources, CapEx and OpEx as well as, in many cases, adapting or utilizing environmentally responsible or "green" technologies into the facility design. Data center site selection criteria has different priorities for different owners and may even have differences within a single company depending upon timing, use or security requirement. For example, today, there are several cloud computing and social media companies that are building several centers a year - for them, a "shovel ready site" may have more priority then another, lower cost, site that is not immediately ready to start construction.

There are several criteria by which data centers are categorized or sized – one being power demand in MegaWatts (MW). This assessment addresses medium to large data centers that will need eight (8) MW of power demand or higher.

Primary Drivers for Site Selection

The primary drivers for site selection today are aligned with what Wyoming has to offer in numerous communities:

- Locations with population of 50,000 or smaller but with access to technology resources – people.
- Power
  - Price of Power – usually at "Transmission Level" if over 8 MW load
  - Loop or ring power supply available or
    - Multiple sources available
    - Dual path feeds – from separate substations
  - Ability to meet initial and long term load requirements with minimal up charges
  - Quick construction time
- Multiple Communications Options
  - Broadband Services from multiple and diverse service providers usually via
  - Fiber Optic Cable
    - Dual Path
    - Possibly multiple providers with dual path
    - Diverse paths
  - Regional or National Ring Network access
- Water
  - Potable – drinking, cleaning and typical office type use
  - Cooling water supply – doesn't need to be Potable
  - Fire Suppression Systems
- Natural Gas
  - Office space/personnel heating
  - Fuel for Backup power – Generators
- Cool Ambient Air
  - Free Air Cooling Strategy to reduce power and water consumption
- Available spaces with minimal restrictions to zoning, permitting and building

Why are Data Centers Good for Wyoming?

- Current Economic development programs and policies are energy and power generation friendly.
  - Data Centers will provide a level of diversity
- Environmentally Friendly – Little or No Impact on Environment after Construction.
  - Low visual or aesthetic impact compared to many other industry facilities
- High Paying Non Energy/Petroleum/Coal Employment
- Helps Keep State Educated People in Wyoming
  - Reduces the "Brain Drain" of high tech resources
- Interconnections with Long Haul Fiber Networks will directly improve local access to high speed internet and broadband services in general
- Substantial Economic Benefit to the State and Local Community Sales tax on construction and data center materials
- Huge investment in computing and support systems that generate property taxes
  - A $100M building could house $1/2B in computing personal property

Is Wyoming Ideal for All Data Centers?

There are several "types" of data centers but not all would consider Wyoming as the Ideal location.

- **Wyoming should be good for:**
  - Unique purpose data centers
    - Like NCAR, NSA, network control centers
  - Large enterprise data centers
  - Managed services data center sites
  - Large back-up or recovery sites
  - Mass data storage sites & social media companies(Google, Facebook, Twitter, Amazon)
  - Public & private cloud data centers
  - Federal government data centers
  - Any owner looking to be low-profile or desiring significant protective space
- **Wyoming may not be good for:**
  - Corporate data centers that "must" be near other corporate facilities
  - Research data center that must be near research personnel
  - Some colocation data centers that usually need to be within 60-100 Miles of other corporate computing assets – corporate preference not technical restriction.

Statewide Assessment of Current Infrastructure for Data Center Recruitment

This Statewide assessment was done in general for the State overall and in four (4) quadrants based along county line The Assessment Quadrants are:

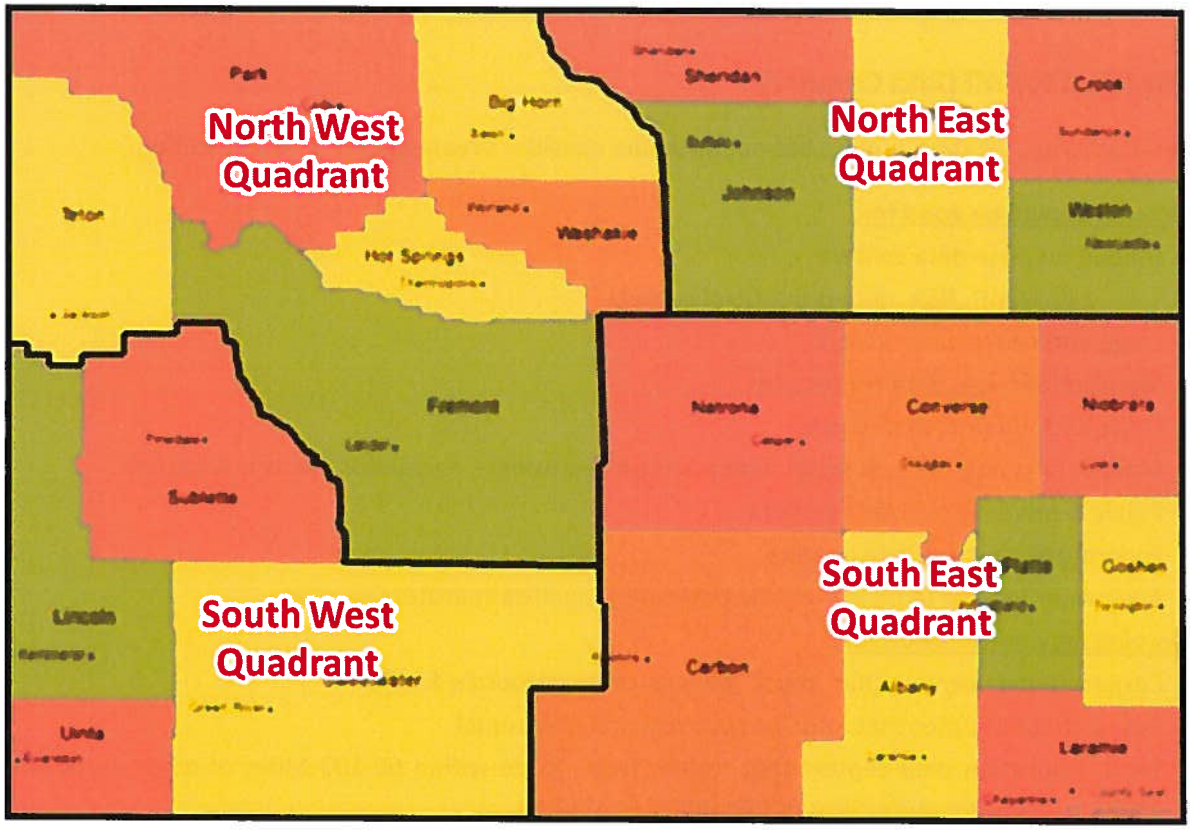
Northeast (NE): Sheridan County, Johnson County, Campbell County, Crook County & Weston County

Southeast (SE): Natrona County, Converse County, Albany County, Niobrara County, Platte County, Goshen County & Laramie County

Northwest (NW): Park County, Teton County, Hot Springs County, Fremont County, Big Horn County & Washakie County

South West (SW): Lincoln County, Uinta County, Sublette County & Sweetwater County

Statewide Infrastructure for Data Centers Assessment – Assessment Quadrants



STATEWIDE GENERAL OBSERVATIONS

In General Wyoming has the following Strengths, Weaknesses, Opportunities and Threats:

Strengths

- Open Space – Large Sites
- Population centers under 50,000
- Land Cost – Large Flat Sites – Berms & Buffer Zones
- Relatively Cheap Power
- Abundant Power From Multiple Sources
- WY Generated Power is 86% Exported – Lots of Growth
- Significant Renewable Energy Sources with huge planned growth
- Climate – Cool/Cold & Dry
- Available State Educated Resources
- Long Haul Fiber Routes – Virtually Every Major Carrier Passes Through Wyoming
- Corporate & Personal Income Tax – Lack of!
- Low Sales Tax on Building Materials & Computing Related hardware & Software
- Data Center Infrastructure Funds are significant and very competitive

Weaknesses

- Water – access to commercially available high volume water is generally restricted to city limits
- Sewer – like water is generally restricted to city limits
- Lack of substations along high voltage power transmission lines
- Power study lead times and study costs
- Construction timing and costs to tap into high voltage transmission lines
- Altitude – which is a positive for cooler climate can have a negative effect on performance for generators and some air handling and cooling system capacities
- Lack of designated Shovel Ready or Commercial ready sites for building on short notice

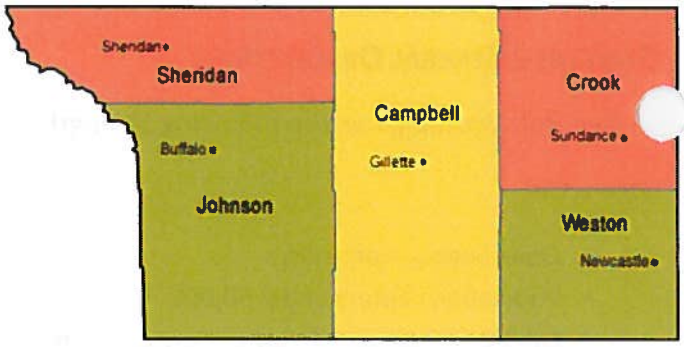
Opportunities

- Federal Government – between GSA, DOD, Homeland Security and Intelligence agencies will be building over 20 sites in the next 3 years
- Google, Microsoft, Facebook, AT&T, IBM, Dell, HP, Lenovo, Twitter, Amazon, Cisco, Apple, etc. all have plans to build 3 to 8 data centers over the next one and a half (1 ½) to three (3) years
- Corporate Data Centers greater then 8MW are expected to exceed 100 sites selected in the next 18 months

Threats

- Incentive packages in other states
- Cheaper power or subsidized power in other states
- Private site developers in other states that are packaged for data centers

NORTHEAST (NE) QUADRANT



Sheridan County, Johnson County, Campbell County, Crook County & Weston County

Strengths

- Open Space – Large Sites
- Population centers under 50,000
- Multiple power plants coupled with dual 230kVA looped distribution lines in some areas of the quadrant
- Power cost in some areas
- Fiber along I-25 and I-90 as well as RT Communication routes in the quadrant
- Climate
- Lower Altitude than some other areas of the State
- Natural Gas sources in the region

Weaknesses

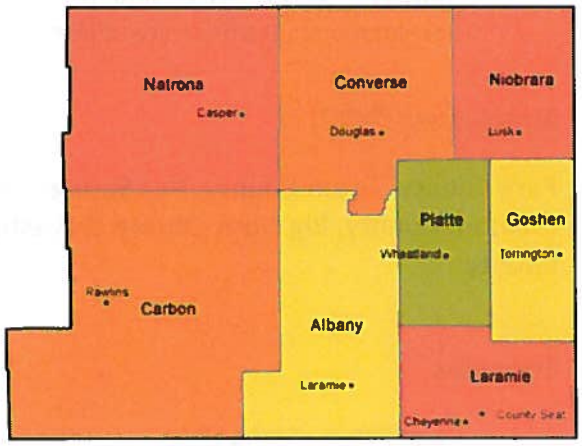
- Water – except in municipal areas
- Sewer / Waste Water Treatment – except in municipal areas
- Altitude – which is a positive for cooler climate can have a negative effect on performance for generators and some air handling and cooling system capacities
- Lack of significant shovel ready sites or large commercial designated sites
- No significant "hub" airport location within 1&1/2 hours of most of the region
- Lack of fiber rings in most of the quadrant
- Power rates and power company capacity in some areas

Areas with Data Center Potential

- Sheridan
    - one small data center site (Double Eagle Tech Park) with very good fiber, power and utilities could accommodate a 40,000 sq ft data center or with land acquisition a 200,000 or 80,000 sq ft data center
    - one combined public & private site (Wrench Ranch Business Park & Sheridan High Tech Park) with good fiber and approximately 2+MW of distribution level power available. Transmission level power could be accommodated with relatively quick upgrade when needed.
    - The area has good population and the commercial power grid could support 25 to 30MW of data centers in the area. Power rate from MDU is very good at $0.03956/KW
- Buffalo – good power grid and dual fiber routes
- Kaycee – good power grid but single fiber route on long haul network
- Gillette – very good power, good coverage on the RT fiber network with access to national long haul routes
- Osage – Switchyard location on a 230kVA power grid with local RT fiber ring & access to national long haul routes
- Newcastle – access to the 230 kVA looped grid and good fiber access on the RT fiber network
- Torrington – would be a good locale with 2 designated commercial sites but poor fiber

SOUTHEAST (SE) QUADRANT

Natrona County, Converse County, Albany County, Niobrara County, Platte County, Goshen County & Laramie County



Strengths

- Open Space – Large Sites
- This quadrant has the three largest population cities in the State – able to support multiple large data centers
- Multiple power plants coupled with several 230kVA and 345kVA looped transmission lines – mostly paralleling I-25 and I-80
- Power costs in much of the quadrant are good or very good
- Virtually all major communication companies have routes along I-80, I-25 and on SR211 to Horse Creek and then west to Laramie
- Proximity to Denver Airport

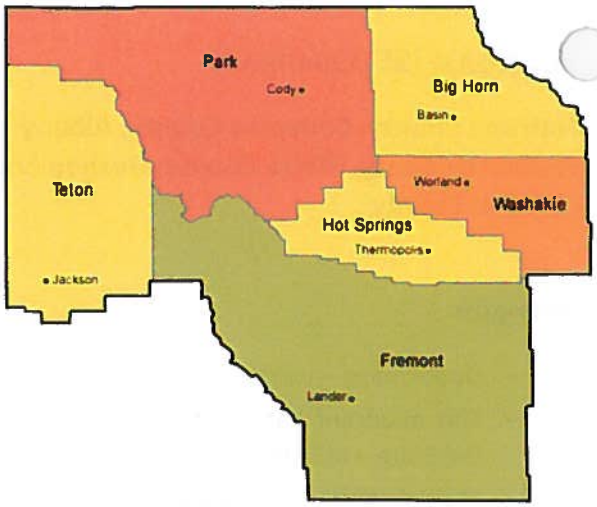
Weaknesses

- Other than the I-80 and I-25 corridors and 211 via Horse Creek to Laramie the rest of the quadrant has either power and/or fiber access shortcomings.
- Water – except in municipal areas
- Sewer/Waste water treatment – except in municipal areas
- Only one shovel ready site currently with power, fiber, water and sewer (the NCAR site)
- Power conditions and/or rates in some areas

Areas with Data Center Potential

- Casper area including Glenrock – power plants, great power distribution networks, two national fiber long haul routes and local fiber routes, good potential sites close to the city which could easily tie into water and sewer systems. Regional airport with several flights a day.
- Wheatland – exceptional power, dual fiber routes and a large commercial designated area adjacent to the 1,650mW power plant. This site would be ideal as a commercial or data center park
- Cheyenne – great power and expansion plans with Cheyenne Fuel, Power and Light. Eight long haul national and two regional fiber routes as well as several carrier points of presence (POPs), good power rates and an excellent commercial development site (NCAR site).
- Rt 211 to Horse Creek – good powergrid and three national fiber routes
- Laramie – very good power including a brand new WAPA switchyard, ten long haul national and two regional fiber routes and at least three designated commercial development locations including the "Verizon" site.
- Rock River, Medicine Bow, and Hanna – very good power and transmission lines as well as four long haul national fiber routes.

- Rawlins – great power and transmission lines, ten long haul national fiber routes and several potential development sites near city utilities



NORTHWEST (NW)

Park County, Teton County, Hot Springs County, Fremont County, Big Horn County & Washakie County

Strengths

- Open Space – Large Sites
- All population centers are well under 50,000
- Good power and distribution in Cody, Big Horn, Washakie and Hot Springs Counties along primary roads as well as in the Riverton and Landers areas
- Good albeit single route fiber networks in Cody, Big Horn, Washakie and Hot Springs Counties as well as in the Riverton and Landers areas
- Power costs in some Coop areas are good

Weaknesses

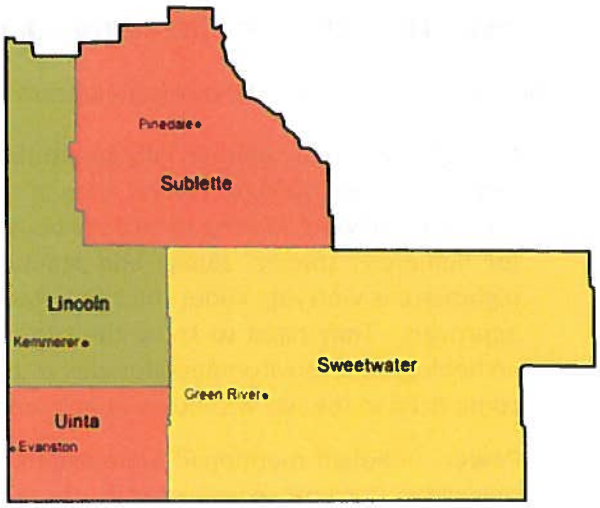
- Generally the rest of the quadrant is very light on power
- Generally the rest of the quadrant is very light on fiber or no fiber at all
- Water – except in municipal areas
- Sewer/Waste water treatment – except in municipal areas
- Only one designated industrial site near Cody with utilities on or near the site
- Power conditions or rates in several areas are not attractive

Areas with Data Center Potential

- Cody – three hydro power plants, good looped 115kVA power distribution network, local ringed fiber with access back to Casper and to Billings MT with a second route currently in construction. A good potential site by the airport with potential easy tie into existing city water and sewer
- Powell, Byron, Lovell areas – good power grid, local fiber with access to Casper and Billings MT.
- Greybull, Basin, Worland and Thermopolis – good looped 115kVA power distribution network, local ringed single path fiber with access to Casper and Billings MT with a second route currently in construction
- Riverton, Hudson and Lander - good looped 115kVA power distribution network, local ringed single path fiber with access to Casper and Billings MT. A second fiber route via Dubois over the Togwotee pass will provide a substantial improvement in communications capacity when completed in 2012

SOUTH WEST (SW)

Lincoln County, Uinta County, Sublette County & Sweetwater County



Strengths

- Open Space – Large Sites
- All population centers are well under 50,000
- Multiple huge power plants in the quadrant
- Several 230kVA and 345kVA looped Transmission networks throughout Sweetwater, Uinta and Lower Lincoln Counties
- Power rate in Rocky Mountain Services area are very good
- Great power in Star Valley
- Power rate in Star Valley is lowest in the State
- Ten long haul national fiber routes along I-80
- Two north/south routes from Evanston through Star Valley with ties into Pacific Northwest

Weaknesses

- Generally other than the I-80 corridor most of the rest of the quadrant is definitely lacking fiber
- Water – except in municipal areas
- Sewer/Waste water treatment – except in municipal areas
- Only one almost shovel ready industrial site with utilities on or near the site

Areas with Data Center Potential

- Evanston – great power and transmission lines just north of I-80 with ties into several wind farms – ten long haul national fiber routes and Points of Presence, two north/south fiber routes through Star Valley – 1,000+ acre county property with multiple fiber routes, water and sewer on site. Proximity to Salt Lake City Airport and population base in Salt Lake City and Park City
- Green River, Rock Springs – very good power and ten long haul national fiber routes – Water and Sewer near city boundaries
- Alpine, Thayne, Afton – All of Star Valley – very good looped power grid, lowest power rates in the State, two regional fiber routes one of which ties into Syringa Networks to SLC, Idaho, OR and WA – access to high tech work force in Jackson
- Carter – right off of I-80 but totally "remote" has dual 230kVA looped power lines, ten long haul fiber routes and points of presence within two miles and a 240,000 water tank
- Kemmerer – only one lateral fiber path today. But great power as well as water and sewer access. It needs to be on a fiber ring to be a data center location.

Statewide Limitations for Recruiting Data Centers or Other High Technology Companies

As noted above in each of the quadrant assessments there is a recurring and universally consistent list of weaknesses.

- **Lack of designated commercially zoned shovel ready sites.** Many of the companies listed as opportunities for data center sites are building several sites in the next 18 to 24 months. These firms are all on fast track schedules therefore they are looking to select sites that they are confident will be able to meet their needs without waiting for numerous studies, zoning and regulatory approvals before proceeding with construction. A site selector's nightmare is worrying about the site potentially failing to qualify one or more of the technical needs or regulatory approvals. They need to know the site is zoned appropriately for the intended purpose, that there will be no archeological or environmental issues to block use and that power, meeting their requirements, is guaranteed or committed to the site without waiting months for a study.
- **Power.** Although mentioned immediately above – needs to be committed to the site with known capacity and reliability. Currently power studies can take four (4) to (9) months, cost $40,000 to $75,000 and produce a result that requires another four (4) to twelve (12) months to build to the site with costs that could be hundreds of thousands of dollars. Worse case would be having to wait months for the initial study to be completed and then find out the needed capacity is or will not be available.
- **Lack of fiber on the site.** You can't operate a data center without significant bandwidth. Significant bandwidth, for large data centers, means fiber based services. This bandwidth needs to have extremely high reliability. High reliability requires ring technology, diversity and most likely redundancy of vendors and/or networks. For data centers under ten (10) MW a single fiber ring should be able to provide the bandwidth and reliability desired for operations. However larger data centers especially if Cloud based services are being offered will require diverse if not redundant routes and vendors. Other than the NCAR site in Cheyenne no other location in the state has ring fiber on the site let alone multiple fiber routes and vendors.
- **Water outside of municipality boundaries.** Generally data center sites will be looking at 20 to over 100 acres space if they exceed approximately 10MW of power load. This generally means the considered sites are not within current city utility boundaries. Wyoming is now a prime area being considered because the climate means little or no mechanical air conditioning may be required. On the days when mechanical cooling is required there may be a need for 10s of thousands of gallon a day for adiabatic /evaporative cooling. However the most likely primary need for water at high pressure and high volume will be for fire suppression systems in these large facilities. Hopefully and most likely never actually needed but a requirement to comply with local fire and more likely insurance carrier demands.
- **Sewer or waste water Treatment outside of municipality boundaries.** The demands are not significant since most data centers may only have 25 or less people working a single shift. But no matter where the building is located it must have access to waste water treatment. Like with water access most considered data center sites will be outside a municipal water or waste water utility area. Some data center builders will consider on-site facilities but many will not want to be responsible for operating or maintaining treatment facilities and will therefore look to connect to some municipal facility.

SUGGESTIONS FOR DIMINISHING STATEWIDE LIMITATIONS

Many companies, especially those looking to select sites and build multiple data center in a short period of time, are not willing to select a site and wait through what could be months of zoning, power studies and regulatory proceeding before determining a site is fully approved for the intended use. Some companies however may be willing to wait and work through all the processes for what they consider to be the ideal site. In 2010 Verizon was willing to gamble on the site in Laramie since they had space and capacity in other data centers that they owned. However Project Summit recently indicated they planned to be building on a selected site within two (2) months of selecting a site. Project Summit is, however, more representative of the normal site selector. In a nutshell most site selectors do not want to deal with significant unknowns.

In order to mitigate or diminish the above noted limitation it will require a significant investment in time, resources and funding to make several or many communities more "immediately" attractive as potential data center sites.

The Wyoming Business Council, various county and city EDCs, public service commission personnel, city and county planners, utility operators and even site or property owners will all need to get involved in the process. For some sites it may even mean soliciting support or input from the Western Area Power Authority (WAPA)

The plan may mean initially focusing on a few high profile, high potential locales and then expanding to other communities. Historically if one or two household name companies select any community in a State it will open the whole State for consideration for data centers. This has occurred frequently over the past few years for example in Washington, Oregon, Utah and Nebraska to name a few.

The primary drivers for data centers over 8MW of power load will be near major power transmission lines and at least dual path fiber routes. For large to Mega data centers this will initially focus us on the entire I-80 corridor, I-25 between Cheyenne and the Casper area including Glen Rock and Wheatland and the Star Valley.

- **Lack of designated commercially zoned shovel ready sites**
  - The business council along with local economic development agencies along these routes should identify two (2) or three (3) sites that would be good potential sites.
  - Work with county or city planners to determine proximity of utilities to targeted sites. Identify sites mostly like to be serviced by local utilities.
  - Identify property owners and open conversations relative to willingness to sell property for data center or commercial use. Secure or identify costs per acre or property if appropriate.
  - Engage other utilities for time and cost estimates to extend utilities to a site. – May need to determine power availability first before know potential needs for other utilities like natural gas, water & sewer.

- **Power**
  - Open conversation with power company representatives to understand potential power available in the community as well as at or near the "selected" site(s). Select sites very close to major power lines!
  - Determine cost and timing for a study.
  - Request power study Engineering Services Agreement (ESA) for the site(s) or for the general community – this may need to be done on and individual case bases (ICB) by community. For example a community availability for Rock Springs would be entirely different than for Cheyenne.
  - Fund the ESA (source of funding could vary like a Business Readiness Grant).
  - Concurrent with ESA process work with power company to estimate routing of power lines to site and estimate time to build (cost to build should be part of a full study).
  - Once potential routes are identified – solicit property owners for willingness to approve right of way.

- If BLM is involved – open conversations early on to determine feasibility.
- Obtain study results and update Local EDC and Business Council recruitment databases.

- **Lack of fiber on the site**
  - After determining best possible sites and owner willingness to sell property meet with local utility (like CenturyLInk or Range Telephone to get cost and timing estimates to build from existing franchised utility assets to selected site(s) for a dual path route.
  - Meet with long haul fiber operator to identify willingness to sell fiber/IRU or bandwidth to a data center customer. Get cost and timing estimate to build from existing long haul route to site(s) in a dual path.
  - Where cable TV company operates – meet with vendor to identify willingness and costs and timing to build conduit and fiber from any of the long haul routes to the site.
  - If long haul fiber owner(s) will not or cannot meet and if there is not a local cable TV company or one that will build – solicit bids from contractors or planning consultant(s) to find long haul routes and estimate building costs and time to build.
  - Fund the bids or consultants (source of funding could vary such as a Business Readiness Grant).
  - Gather data and update Local and Business Council recruitment databases.

- **Water outside of municipality boundaries**
  - Depending upon the location of the site(s) water may or may not have an "easy" solution. Obviously if a site is within a municipal or private water district there may be little effort needed other than a cost and time estimate to build facilities to the site(s).
  - If a site is not within the existing water utility service area but on the fringe there may need to be discussion about either extending the franchise area to the site or more likely if the water is a municipality service then extending the municipality boundary to include the site or annexing the site. This may take a lot of time and effort to accomplish.
  - If site can be served by local water utility - a cost and time estimate will need to be developed.
  - If site cannot be served by local water utility service - a plan to access water by well will need to be developed. Assuming water access is available - Technical specifications for maximum capacity, pipe size and such will need to be developed based on three of four potential data center water needs.
  - Gather data and update Local and Business Council recruitment databases.

- **Sewer or waste water Treatment outside of municipality boundaries**
  - Depending upon the location of the site(s) sewer or waste water treatment may or may not have an "easy" solution. Obviously if a site is within a municipal or private water district there may be little effort needed other than a cost and time estimate to build facilities to the site(s).
  - If a site is not within the existing sewer or waste water treatment utility service area but on the fringe there may need to be discussion about either extending the franchise area to the site or more likely if the utility is a municipal service then extending the municipality boundary to include the site or annexing the site. This may take a lot of time and effort to accomplish.
  - If site can be served by the local waste treatment utility - a cost and time estimate will need to be developed.
  - If site cannot be served by the local waste treatment utility - a plan to develop and operate a waste water treatment facility on the site will need to be developed. Technical specifications for maximum capacity, pipe size and such will need to be developed based on three of four potential data center waste needs.
  - Gather data and update Local and Business Council recruitment databases.

General Finding - Statewide and by Quadrant

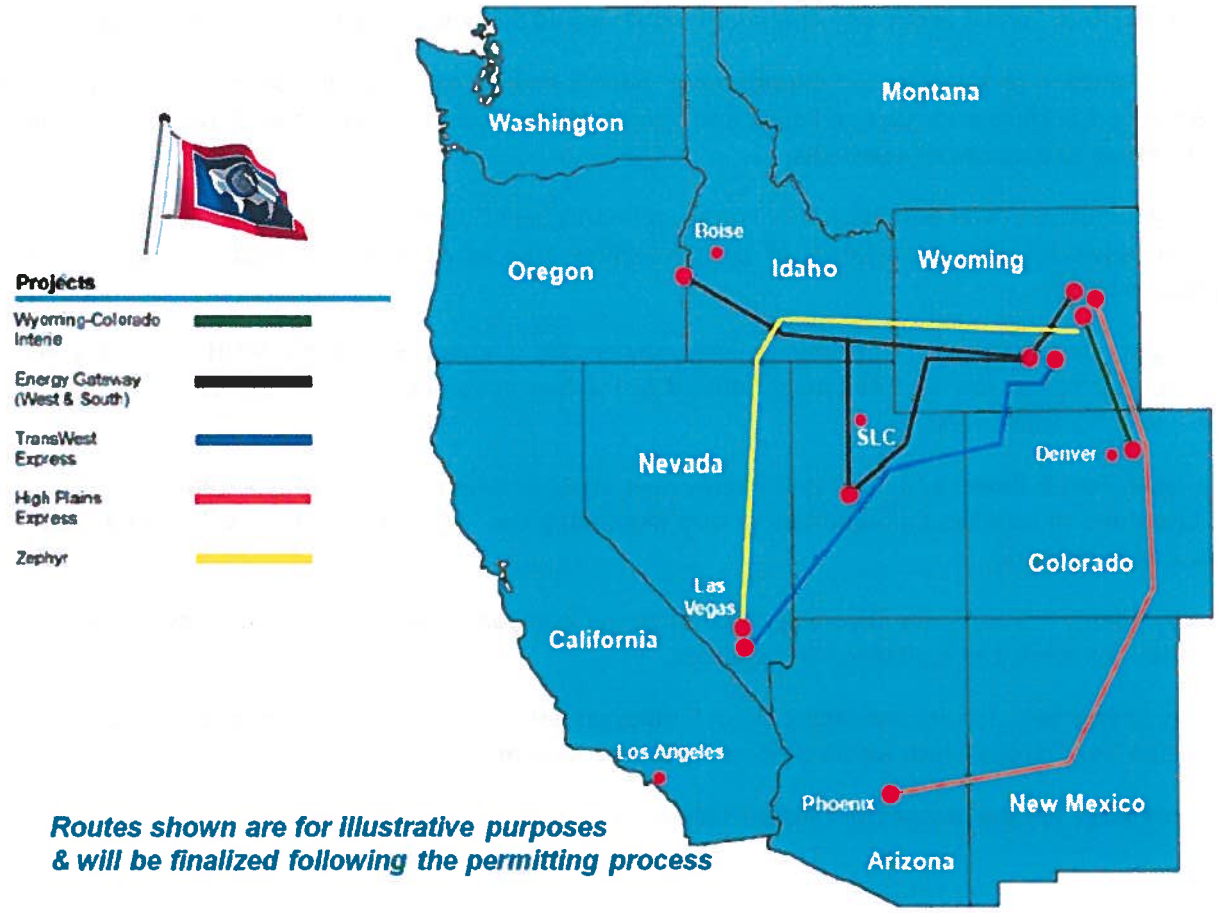
Power

Power production in Wyoming currently is about seven (7) Giga-Watts (7,000 MW). Statistics from the State of Wyoming Public Service Commission indicate that only about 14% of this power is consumed within the state. Therefore about 86% of the power produced is sold or committed outside of the state to the "Grid". This dynamic is expected to change substantially (to greater than 95% sold or committed outside of the state) over the next few years as new generation and transmission projects are completed.

Wyoming is second to none in the U.S. when it comes to energy resources being number one in coal production, high-quality wind potential and uranium reserves; and in the top three for natural gas. Economic development programs and policies are power generation friendly. From Denver to Salt Lake City, Phoenix to Las Vegas and on to Southern California, the West is replete with markets needing new sources of energy to keep up with growing population and customer demand. And whether it's a desire for renewables or additions to baseload capacity, Wyoming is involved in providing and developing the breadth of energy resources and transmission systems required to meet these needs.

Transmission is the critical link between generation facilities and customer markets. Over 15,000 megawatts of transmission capacity originating in Wyoming and connecting with major population centers in the West is under development, representing potentially more than $15 billion in investments in transmission and an equivalent amount in generation facilities.

Transmission Projects Under Development in Wyoming



Power generation plants have a wide range of owners and partnerships that actually produce the power. The ideal site for locating a data center might be right on or adjacent to a power plant where the output meets the grid at a switchyard. Other than building a data center adjacent to the property of a generation plant the next best location for a data center to access power would be near the wires or lines. Power lines are generally designated as either distribution lines (usually "local" at or below 34.5KVA/34,500 volt-amps) or transmission lines (usually 69KVA/69,000 volt-amps to 345KVA/345,000 volt-amps) with some 500KVA lines expected to be constructed or finished in the next 2 to 5 years.

Rocky Mountain Power along with Cheyenne Light, Fuel & Power with its parent Black Hills Energy own or operate about 80+% of the power transmission lines in the state. However the Federal Government under Western Area Power Authority (WAPA) also has "control" over a significant amount of the available energy and how and where it gets dispersed. Coordinating with WAPA can substantially complicate or exasperate the ability of a potential data center or the local economic development agency to determine availability, capacity and time to deliver power to a given site.

Rocky Mountain Power in general has multiple generation sources, generation interconnection agreements and transmission networks within Wyoming with the majority of their service areas having loop or ring transmission networks.

Rocky Mountain Power Rates at the Transmission level (generally what would be required for a 8 MW or larger data center are about $0.041 per KWH which is a good rate but not as low as rates being offered in Fort Collins Colorado, Central Washington and Central Oregon. Rocky Mountain Power rates in Wyoming are the same as their rates in Utah putting a significant area of Wyoming on a competitive basis with Northern Utah.

Rocky Mountain Power can "easily" deliver at least 25 to 30 MW of power to most of their service areas – within a few miles of their transmission lines. In some or many areas 50+ MW can be delivered with as high as 90 MW recently "committed" just north of downtown Laramie. However from Evanston to Walcott Junction, except in the immediate Green River and Rock Springs areas, any sites south of I-80 would be hard pressed to find transmission level power.

From Walcott Junction to Saratoga and Encampment there is enough capacity available for a 20 MW load to be added but this is a coop franchise area (Carbon Power and Light) and the power rate is over $0.10 per KWH or about 2.5X to 3X the rates common to data center operators.

Cheyenne Light, Fuel & Power and Black Hills Energy, primarily servicing the greater Cheyenne city area, has substantial transmission networks with the majority of their franchise area serviced with looped or ring networks feed from multiple power sources.

Cheyenne Light, Fuel & Power's Transmission level power rate is about $0.046 per KWH which is a good rate on a national level but not as low as rates being offered just a few miles south in Fort Collins Colorado or in the Rocky Mountain Power franchise areas.

Cheyenne Light, Fuel & Power and Black Hills Energy have an aggressive plan in place to extent transmission level power south of Cheyenne toward the Colorado border and west along the I-80 corridor which will expand their foot print for large industrial customers.

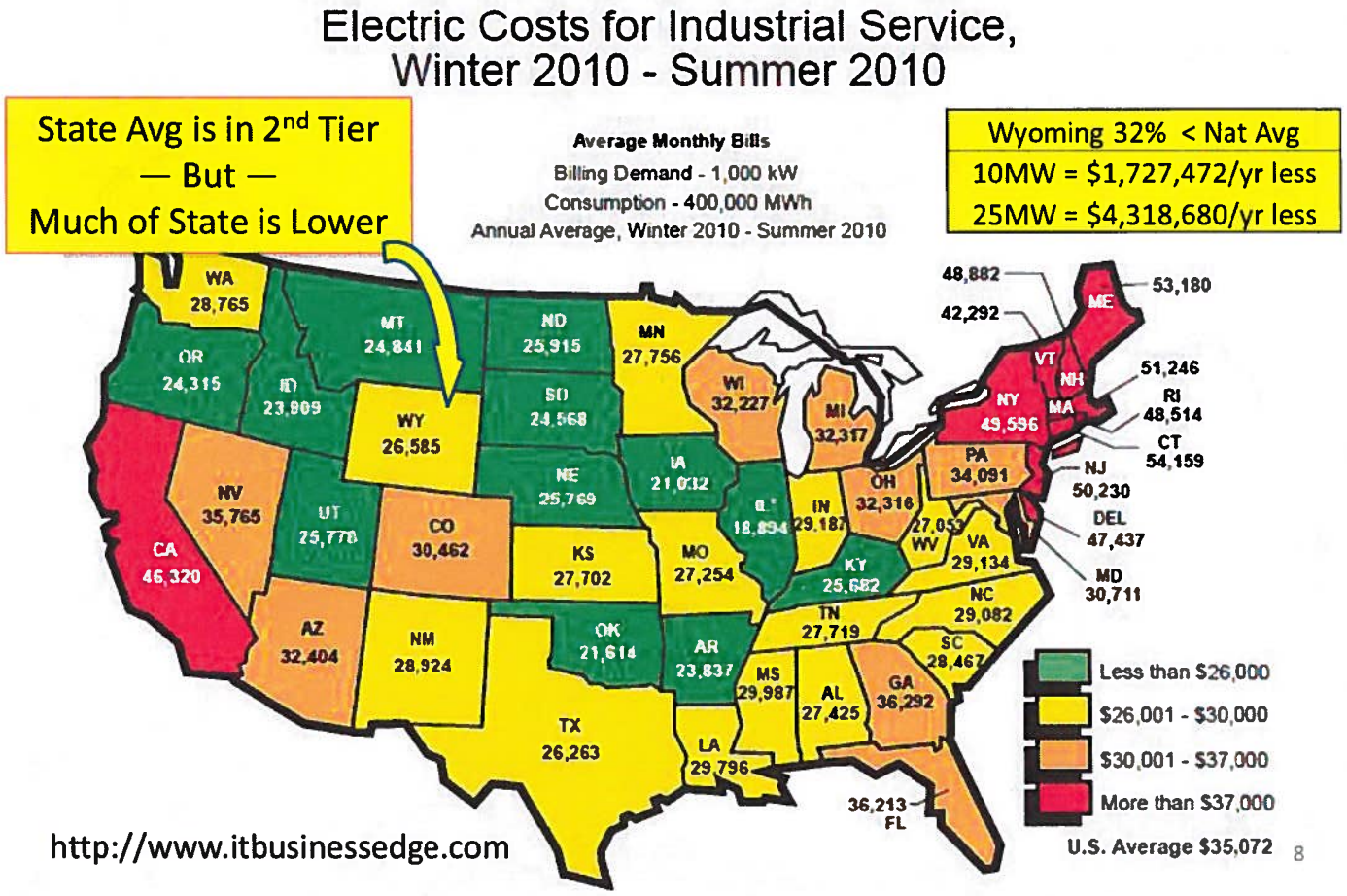
Lower Valley Energy – Star Valley Wyoming, a Coop power company, has a "stand out" power system with multiple looped distribution feeds and multiple power sources.

Lower Valley Energy has capacity, extending about 5 miles on either side of the state road 89 corridor, for about 20 MW of transmission level load(s) which would be ideal for one or two data centers

Lower Valley Energy has the lowest transmission level power rates in the state – approximately $0.034 per KWH.

The remaining Coops and smaller power companies are generally not attuned to looking at or servicing large load customers and work will need to be done to develop actual power potential in these areas.

Wyoming Power Cost Comparison



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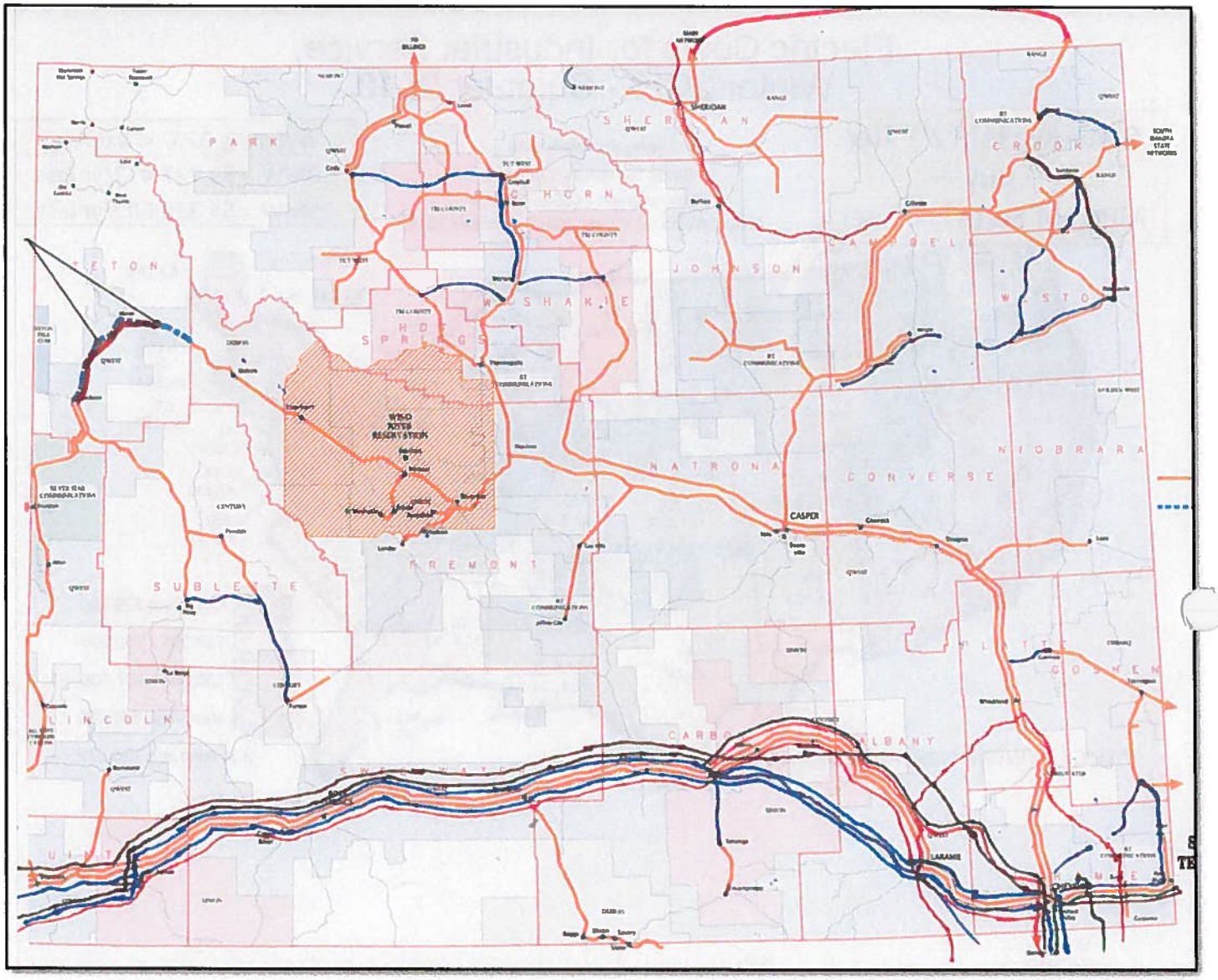
Fiber

Wyoming Existing Fiber Routes, Updated to Reflect Changes since July 2009



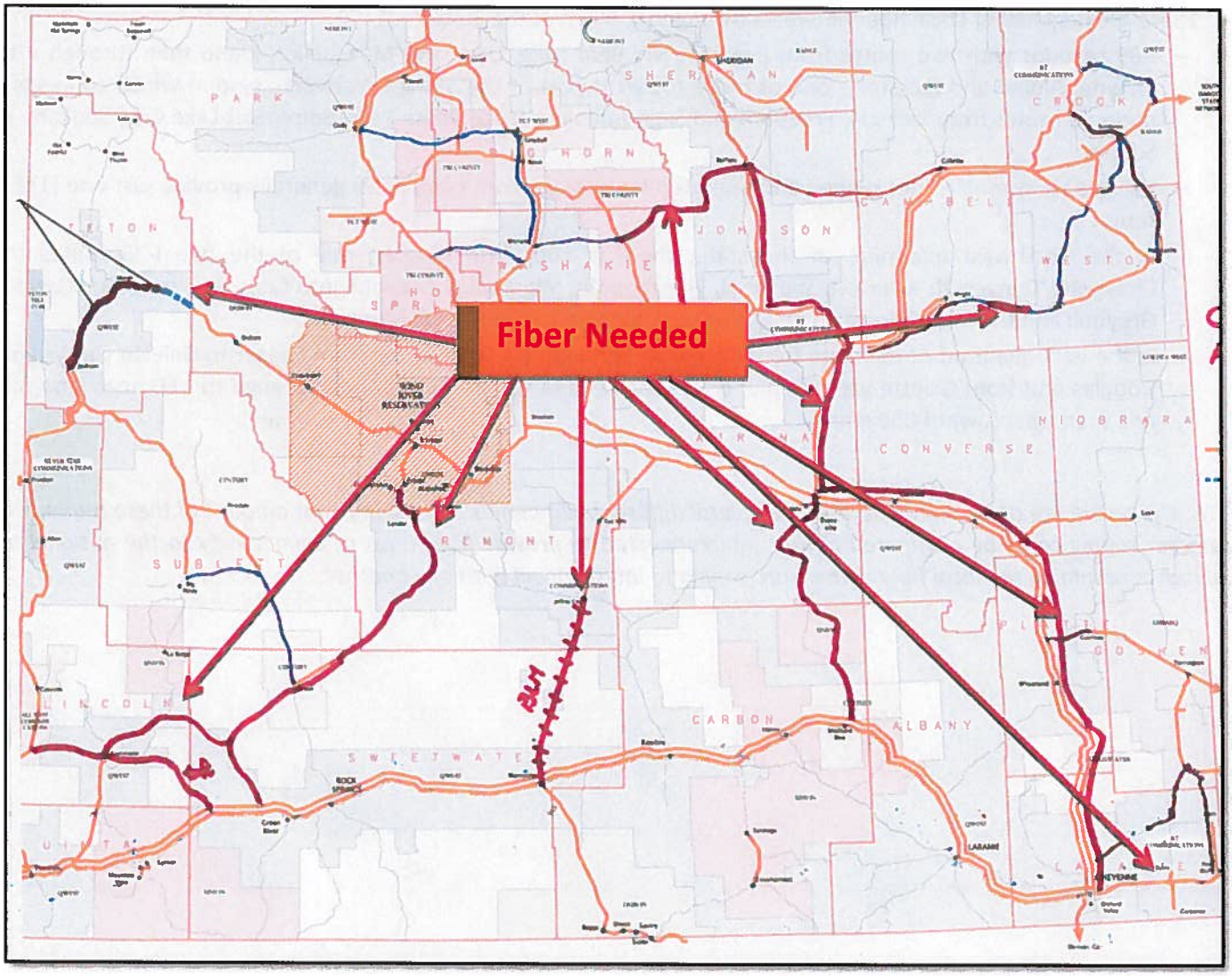
- Virtually every major National Communications company has one or more optical fiber route passing through Wyoming. Additionally numerous national and international communication companies are tenants within these routes and capable of providing services in Wyoming.
- Due to the concentration of long haul optical fiber there is high potential for a large (20+MW) or mega data centers (up to about 90MW) to select site(s) along the below listed routes.
  - I-80 corridor starting at or near either Cheyenne or Laramie and heading west including several routes that follow state road 30 from Laramie via Rock River, Medicine Bow and Hanna back to I-80 at Walcott Junction. Several of these routes divert south of I-80 near the Fort Bridger/Lyman area and cross into Utah about ten miles south of Evanston.

  - I-25 corridor starting near Denver, Colorado with at least 2 distinct routes from Cheyenne via Wheatland and Glenrock to Casper. One of these routes then diverts west from Casper and the other route heads north from Casper toward Buffalo where it "meets" I-90 near Buffalo where it continues north through Sheridan and into Montana.
  - I-90 corridor having two (2) east/west routes running through South Dakota via Spearfish then to Gillette.
- There are Regional or Local fiber networks throughout much of the State:
  - I-89 corridor with two routes from Evanston via Bear Lake, Utah and Montpelier, Idaho then through Afton, Thayne, Alpine and Jackson – one of these routes is part of the Syringa Networks system which connects via multiple routes from Jackson, Freedom and Sage Junction, UT to Idaho Falls, Boise, Salt Lake City, Spokane and Seattle.
  - Various state road routes owned and operated by local telecom companies generally provide just one (1) fiber route.
  - In the Northwest quadrant, of the state, there is fiber from Casper, one of the two I-25 routes from Cheyenne/Denver, to Riverton, Shoshoni, Thermopolis, Worland & Greybull into Cody via Powell and Lovell to Greybull and then north from Powell going to a telecom hub in Billings Montana.
  - In the east quadrant of the state from Casper to Sheridan via Buffalo and from Casper to Gillette via Wright to Douglas and from Gillette via Upton and Newcastle, Lusk to Torrington and LaGrange to I-80 near Pine Bluffs and then west toward Cheyenne.

NOTE: The above are owned and operated by several different companies but a significant amount of these regional and local fiber routes could be configured and/or interconnected to provide fiber rings or connectivity to the national long haul routes assuming the local fiber owners are willing to interconnect with one another.

Weaknesses in the Fiber Foot Print:

Wyoming Fiber Footprint Shortcomings – Gaps or Weakness in Assets



- I-25 Corridor between the Colorado line and Casper then onto Buffalo Wyoming has two fiber routes but real weaknesses exist:
  - These routes are not diverse. Along a significant (about 80+ miles) sections of the route they the two cables run side by side at times appearing to be in the same trench. Based on network survivability standards a minimum of 50 feet of separation is required.
  - Neither of the two fiber owners is inclined to sell (IRU) dark/unlit fiber along their routes.
    - › *The Cowboy network has been trying for years to find the funding to build an alternative route that would open access and provide true route diversity of fiber and broadband services parallel to this route.*
- I-80 Corridor is mostly built by long haul carriers whom are generally not inclined to sell (IRU) dark/unlit fiber or create interconnections unless the cost of creating a Point Of Presence (POP) can be offset and long term revenues of about $40,000 per month can be secured.

- Wind River Indian Reservation has been a long standing challenge for service providers and fiber builders primarily due to very expensive and restrictive right of way access. This may hamper the ability to extend or complete new fiber construction from Riverton, Shoshoni and/or Lander towards Dubois and Moran Junction along 287/26.
  - Today the only routes through the Reservation are CenturyLink that has traditionally not allowed the sale or IRU of dark fiber and a new Dubois Telephone (DTE) segment, which has not been completed. Contractually this new route requires any party interested in acquiring fiber from Dubois/DTE must be a qualified telecom services provider, obtain joint approval from both tribes and pay additional right of way fees in a cable that already exists. This is by no means normal with buried cable routes in the US.
- In the Northwest quadrant there currently exists a "Gap" between Dubois and Moran Junction. This creates what is called an unprotected "lateral" path which would not be desirable for any data center. Until such time as the link from Moran Junction over Togwotee Pass is built central Wyoming from Jackson to Thermopolis via Moran Junction, Dubois, Riverton and Shoshoni will most likely not be considered for a data center. *This "Gap" is being built by a group of telecom companies, The Cowboy Network, and is expected to be finished third quarter of 2012 weather permitting.*
- Riverton & Landers area is not fiber connected south causing an "end of line" or unprotected lateral that is not considered desirable by data centers.
- Riverton/Landers could be connected to Rawlins via Jeffery City & Lamont or to Rock Springs Via Farson & Eden or Via Farson to Green River and/or Kemmerer.
- Kemmerer only has an unprotected lateral fiber route to Evanston area either via state road 189 to I-80 near mile marker 18. This needs to be looped via Sage Creek Junction and then along 89 via Randolph, UT and Woodruff, UT back into Wyoming north of Evanston. Kemmerer should also be considered for a route to Landers which would allow for ring(s) from the NW as well as all the way back through Casper to Cheyenne.
- Casper has no way to complete a loop or diverse route from I-80 back to I-80. This basically leaves a significant section of Wyoming stranded from the ten (10) routes running along the I-80 corridor. This gap could be eliminated by completing construction of fiber to:
  - Laramie via state roads 220 and 487 to 30 or
  - Rawlins via Alcova and Lamont or both
- Jeffery City is the end of a long but basically fallow lateral from near Moneta. Extending this route across wide open spaces to about Wamsutter would create a path allowing a fiber loop from the long haul fiber routes in Cheyenne through Casper through Jeffery City and then back to the long haul routes along I-80.
- Pine Bluffs to Cheyenne is lacking a fiber route that is open for sale or IRU of dark/unlit fiber – Range Tel has a route that covers about 60% of this distance.

If the above short comings in the fiber foot print could be addressed then the majority of the state would be in a position to provide relatively good fiber access for a potential data center of 20MW or larger.

Water

Data Center design includes systems for:

- Potable – drinking, cleaning and typical office type use including in some designs kitchens or break rooms and showers for extended stay or lock down requirements.
  - Depending upon the size and staffing of a facility potable water requirements can vary from under 1,000 gallons per day to several thousand gallons a day.
- Cooling water supply for water chillers, DX cooling systems and/or evaporative coolers – often requiring 10s of thousands of gallons a day during warm weather days.
  - Unless a facility design is engineered for Free Air Cooling with possible only adiabatic cooling (evaporative) assist a data center may require tens of thousands or gallons of cool water and/or water to be cooled by refrigeration systems each day during cooling periods.
  - If water chillers and refrigeration systems are part of a data center design significant water consumption may be required.
  - Chilled water cooling systems can sometime also require substantial sewage access to accommodate the exhausted or waste water.
- Fire Suppression Systems with water volumes and pressures to allow for activated sprinklers in large areas of the facility.
  - There are many variables that determine the design of and water requirements of a fire suppression system. Often valuation of the equipment to be housed in the building and the amount and level of insurance coverage will dictate the fire suppression system(s) design. The higher the value of the insured assets the more likely the insurance underwriter will want full building suppression coverage.
  - A 100,000 square foot open rack building could require thousands of gallons or cubic feet of water per minute at 55 to 65 pounds pressure.
  - Often, unless the data center is a cookie cutter/repeated design from a similar climate the actual water requirements will not be known until after site selection is done. Therefore site selectors often over estimate water requirements in order to be safe about available utilities.

Water availability, let alone capacity, is and will consistently be one of the major problematic issues associated with most potential sites. Even within city limits the nearby pipe sizing is generally insufficient for a substantial sized data center without significant infrastructure upgrades such as much larger pipes, pumps and even water rights.

It should be noted that moderate volumes of water will only be needed for most data centers during summer when temperatures exceed the operator/owners targets.

The most universal concern for "high volume" water will be for fire suppression and therefore insurance coverage costs. An option to a high volume source could be water storage (hundreds of thousands of gallons) and pumps with independent power back up for fire suppression requirements. Most often this will not be used but needs to be included in building design if sufficient supple is not available from a municipal system.

Natural Gas

Office Space/Personnel Heating

- Depending upon the building design and the owners intended use and operation of the data center natural gas requirements can range from none to moderate needs.
- Newer LEEDS certified data centers will try to use output heat from the compute areas to heat personnel areas during cooler times of the year. Some designs though will not accommodate utilization of byproduct heat in personnel areas and heaters may be required.
- Typically a 3" or 4"commercial gas lines will accommodate the typical heating requirements.

Fuel for Back –Up Power/Generators

Anyone familiar with the proliferation of natural gas pipelines in Wyoming would think that it should be a no brainer to run Back-Up Generators from one of the many gas transmission pipelines running all over the state.

But there are several issues related to accessing and using natural gas in most of Wyoming for generators:

- **Efficiency lose due to altitude**
  - Altitude which is great for moderate temperatures across most of the state has a negative effect on using natural gas to fuel back-up generators. Natural gas powered generators at Wyoming altitudes would run anywhere from 20% to almost 40% less efficient than at 1,000 feet or lower elevation. In Laramie for example a 2.5MW natural gas generator would only produce about 1.6 to 1.7MW. At a 25 MW load 3 to 4 additional $3MM units would be needed to support the load as compared to a site at 1,000 feet elevation.
  - Diesel powered generators, although less efficient at altitude than at sea level would still outperform natural gas powered units by a significant amount. Efficiency lose would only be 5% to 15% - requiring maybe only 1 more unit to meet the load at the same site.
  - It should be noted that the offset to needing more generators at higher altitude with natural gas is that diesel powered system require storing large quantities of fuel - on sight - with all the associate environmental and FEMA requirements not to mention technical issues related to storing and maintaining large volumes of fuel in extreme weather conditions like a typical Wyoming winter. A 25MW data center could need to store 100,000 gallons of diesel fuel which would need to be heated, circulated and filtered during cold conditions.
- **Transmission Pipelines**
  - Access to the natural gas in a pipeline is generally restricted.
    - The majority of the pipelines that crisscross the state are high volume high pressure pipelines that are not designed to facilitate connections and metering to commercial sites.
    - Often the majority of the pipeline capacity is committed outside the state.
- **Cool Ambient Air:**
  - This is an "asset" or advantage that cannot be managed or controlled such as power, fiber or mined like coal or extracted and piped like gas or oil. However it is an "asset" that is gaining significant importance in the data center community as part of an overall ground up building designed to utilize the naturally cool ambient air to maintain the computing system environment.
  - Some Wyoming communities are cooler than others. Cooler communities that have significant power and fiber assets as well as water available should start creating promotional or recruiting packages that address the overall advantages of the available infrastructure and natural environment.

› Laramie for example has developed marketing materials and a website the uses "Climatecooled" and Climatecooled.com as the catch phrase. That phrase alone makes a significant statement.

- **Shovel Ready / Commercial Use Ready Site(s):**
  - Some companies building a new data center site, like Verizon Business, will look for independent sites and will be willing to work with the local community and the local economic development organization to find, select and manage a site through all of the legal, zoning, regulatory, environmental, archaeological and community related issues associated with the "perfect" site for their space, security and operational needs.
  - Many companies though like Microsoft, Google, Amazon, Facebook, Twitter and IBM are fast tracking new data center builds (Microsoft is building 5 centers in the next 2 years). Due to the quantity of sties to be selected they, generally, are looking for designated, pre-approved "shovel" or construction ready sites that have already dealt with all of the issues that often can cause a site to fail to start or even worse – encounter a work stoppage due to unforeseen legal, environmental, regulatory, archeological or litigation issues.
  - Many states, like Iowa, Nebraska and recently Colorado have independent developers that have created power parks or commercial/industrial parks to specifically address or eliminate the potential of post purchase problems. But more importantly these sites make it easy for a site selector to know exactly what is available on the site from the point of view of all infrastructure/utilities as well as having confidence in being able to guarantee a construction start schedule.

Other than the NCAR site in Cheyenne and a couple small "development sites" in Sheridan and Torrington there are no other designated industrial or technology sites in Wyoming.

Shortcomings in General

Power – Significant power capacity is available in or near to most primary and secondary communities, highways and roads throughout the state. This is good obviously. However the below listed power related conditions that are not favorable to site selection currently exist:

- Multiple power plant and transmission line operators have the majority of the "available" power committed outside the State of Wyoming.
- Due to multiple transmission line owners and federal management through multiple agencies there is no one company or agency that has a map or maps that accurately delineate all the existing power networks.
- Lack of connection points or sub-stations to accommodate interconnection along existing and planned routes. In fact many of the existing large transmission lines were built for a single purpose – deliver the power out of Wyoming to some other location. Some of these commitments can be 20 to 50 year duration.
- Homeland Security and Federal Regulatory issues restrict the dissemination of transmission line and system capacity information that is needed to determine if a site will have the required power.
- Lack of cooperation from the power providers and WAPA to identify and commit to capacity and availability of power. Normally a 4 to 9 month study costing up to $75,000 is required to determine if capacity is available – even when associated with a brand new sub-station like the Snowy Range Switchyard in Laramie.
- High cost and extended time frames for power line construction and interconnection to transmission lines.
- Several of the Coop power companies are equipped to manage their current operations but are noncommittal relative to estimating capacity for a data center within their franchise or even defer to WAPA, Rocky Mountain Power or Black Hills.

Fiber – There are a few "corridors" with substantial fiber assets and multiple service providers however.

- There are many parts of the state that need improved or additional fiber routes constructed to complete rings and tie into the national networks (as discussed previously in this report). Until these improvements can be addressed we should anticipate that data center site selection will therefore be focused on the I-80 and I-25 corridors resulting in "clustering" in just a few communities. This is evidenced by what has happened in central Washington and central Oregon.

Water and Waste Water Treatment/Sewer – *Universally a problem throughout the state except if the site being considered is well within established city limits (which will not usually the case).*

Natural Gas – Like water – Distribution level gas is universally not available other than within established city limits. Natural gas pipelines are generally high pressure transmission lines and not generally available of interconnection.

Shovel Ready Sites – Other than the NCAR site in Cheyenne, which is not technically a "shovel ready' site, there are no sites in the State that are developed with appropriate power, communications and utility facilities that would accommodate a 20 acre, 10MW data center let alone a 50+ acre 20 to 25MW+ data center.

Some solutions or approaches to mitigating or eliminating several or all of these issues was discussed previously in this report.

FINDINGS BY QUADRANT

Northeast (NE) Quadrant

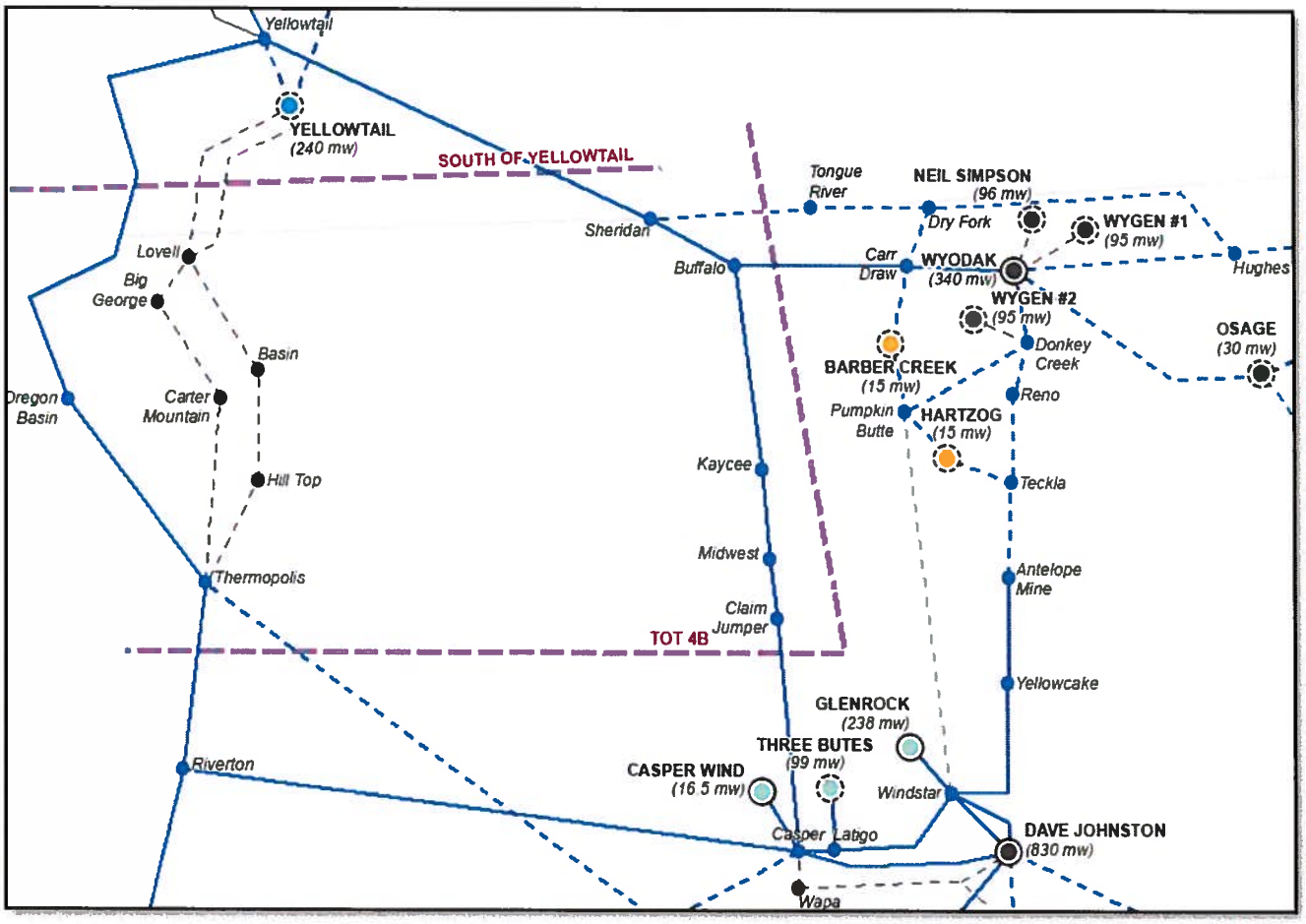
Sheridan County, Johnson County, Campbell County, Crook County & Weston County

Available Technology Skilled Resources

- All cities and towns in the entire quadrant qualify as 50,000 population or smaller.
  - Sheridan, Buffalo, Gillette, Moorcroft and Newcastle could support a 10 to 20 MW data center from a staffing point of view.

Power

- There are multiple power plants and transmission lines owners in the quadrant. There are two 230KVA (230 KilaVolt/Amp) looped or ringed networks that tie about 2,300 MW of local power production, including the Dave Johnson plant near Casper as well as from numerous other plants in a pretty well "protected network which includes Gillette area, Casper, Midwest, Kaycee, Buffalo, Sheridan, with a second "back up ring" including Casper, Riverton, Basin, Yellowtail MT, Sheridan, Buffalo, Kaycee, Midwest then back to Casper. These major transmission lines should have available capacity to support more than one large data center.

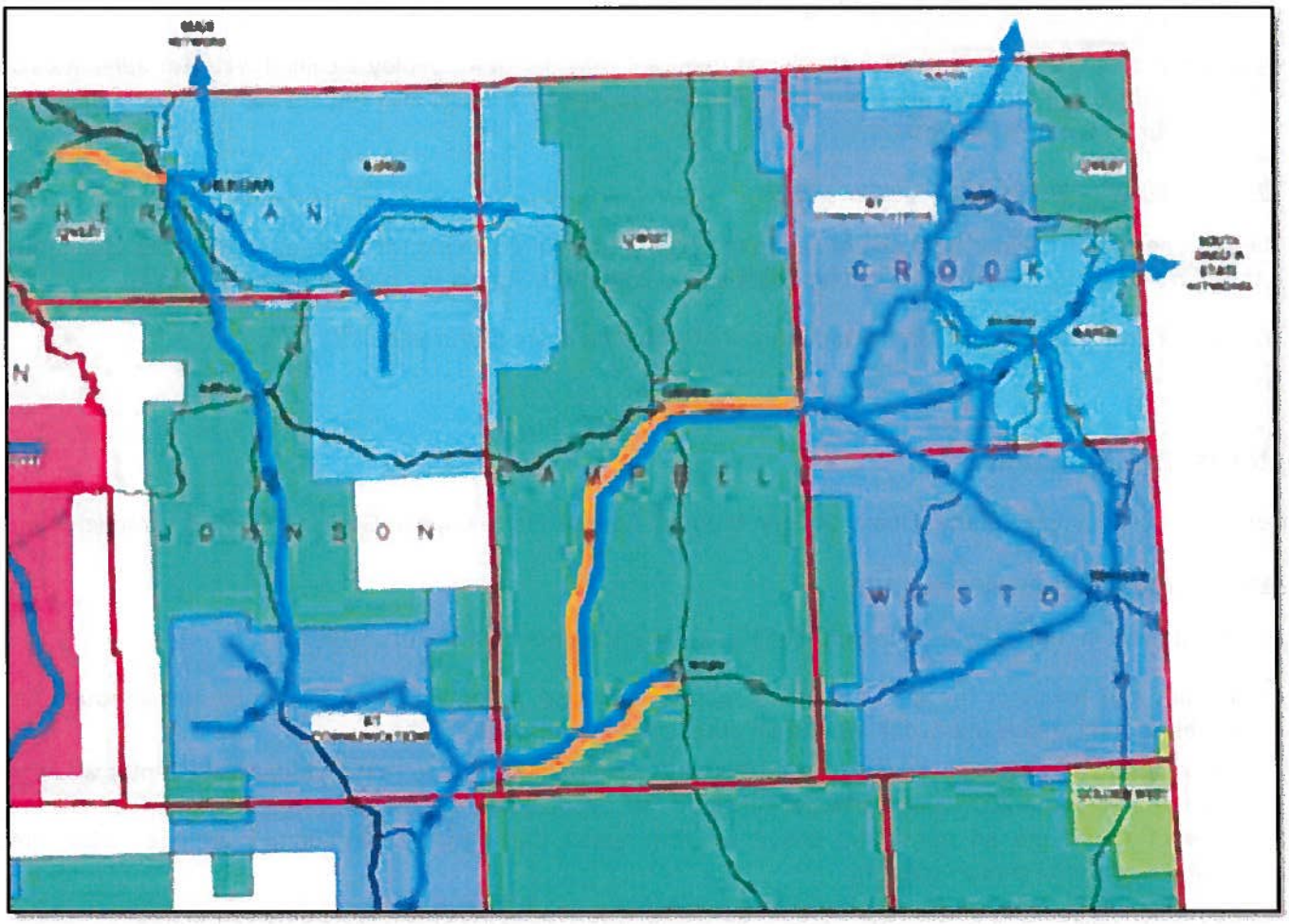


Communications Options

This quadrant has a single physical fiber route following I-25 from Denver and Cheyenne through Casper, Midway, Kaycee, Buffalo, Story and Sheridan then heading north to Billings MT. Although this one route is the primary link between Denver and Billings there are at least 4 sub-owners, such as 360 Networks (now Zayo), that operate fiber within this single route. There is also an east/west AT&T route that enters Wyoming from South Dakota along I-90 and then it parallels the north/south route through Sheridan and onto Billings MT. However AT&T does not sell fiber IRUs or leases which means this route may not be an option for many data centers. This quadrant also has several lateral and local ring routes that feed rural communities. Range Telephone/RT has constructed several rings in Crook and Weston counties with ties into Billings and Lookout SD where they meet long haul routes.

- The I-25 corridor with a single route north and south could support most data centers below the 25MW size.
- The I-90 corridor north of Buffalo where the I-25 north/south route and the I-90 east/west route come, together diverse routes, could support the needs of most data centers over 25MW in size.
- The fiber routes in Crock and Weston counties could possibly support the needs of a data center up to 25MW including ring topology with some network interconnections, planning and splicing.

Northeast Quadrant Fiber Routes



Water

As with most of the rest of the state, other than sites within city limits, water will be an issue throughout th Quadrant. Water rights, wells and water storage will need to be planned and incorporated into a data center strategy.

Natural Gas

Since most of the Quadrant is at an altitude greater than 5,000 feet it is not likely that a large data center will try to use natural gas to power back-up generators due to significant efficiency lose at altitude. However due to the available capacity of natural gas in the quadrant use of natural gas might be a consideration for generators depending upon cost.

- Natural gas may be needed for normal heating. If a data center is built in or near cities like Buffalo, Sheridan and Gillette there may be a convenient supply of natural gas. Otherwise a reasonable alternative may need to be developed or planned.

Cool Ambient Air

The Northeast quadrant, in general, has a slightly higher average temperature during the summer than other parts of the State. Depending upon the cooling strategy of the data center this may or may not have an impact on the selection decision. In most cases a data center locating in Wyoming will not be utilizing refrigeration cooling unless it is a federal government facility demanding no tolerance for temperature variances.

- At worst case a data center in the Northeast quadrant may decide to deploy a chilled water or adiabatic cooling system which will not only drive the operating cost up slightly but will also require significantly higher levels of water during summer months.

Shovel Ready or Commercial Use Ready Site(s)

There is one site on the northern end of Sheridan which is considered an industrial development area albeit not truly a shovel ready site. This site could accommodate a data center requiring a site of greater than 30 acres.

- There are no other sites within this quadrant that would be deemed shovel ready.

Southeast (SE) Quadrant

Natrona County, Converse County, Albany County, Niobrara County, Platte County, Goshen County & Laramie County

Available Technology Skilled Resources

All cities and towns in the entire quadrant qualify as a 50,000 population city or smaller.

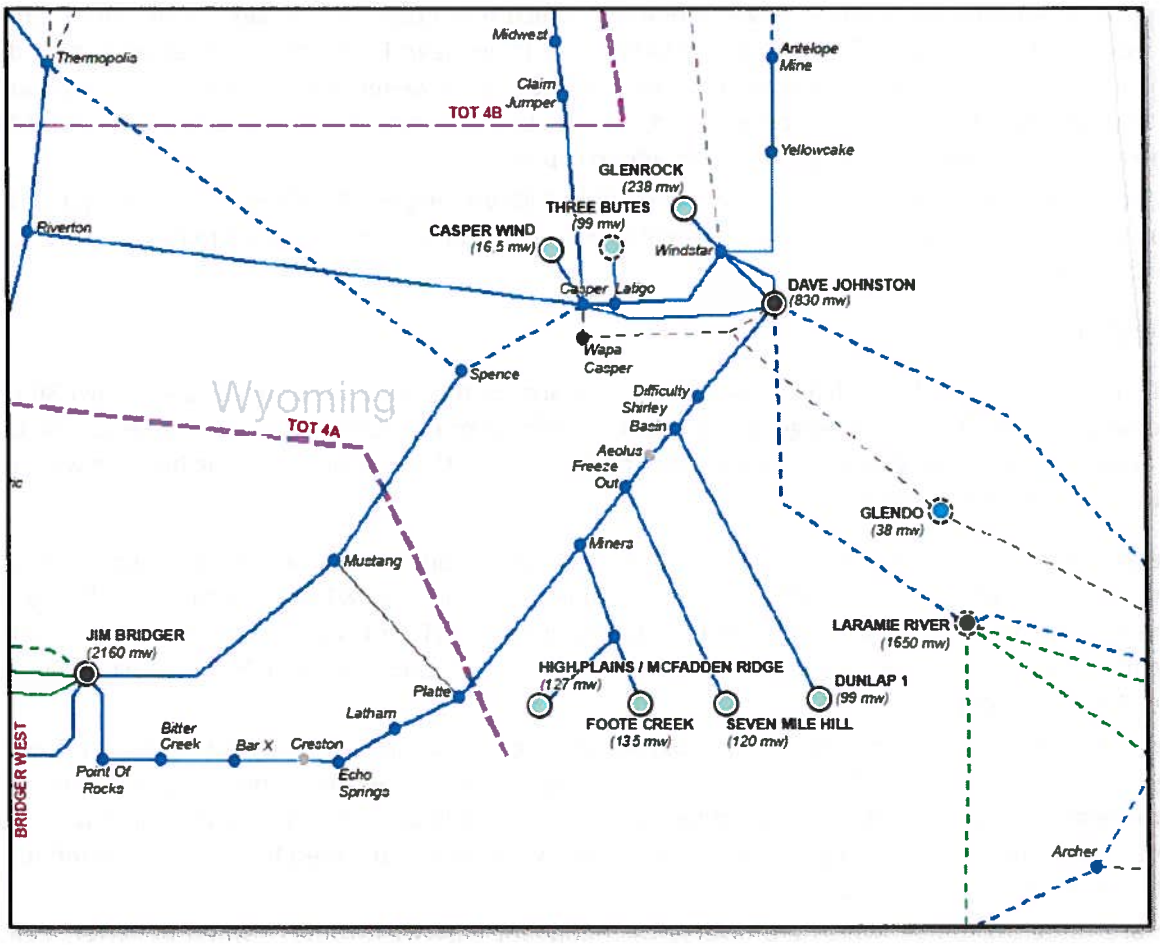
- All cities and towns in the entire quadrant qualify as having a population of 50,000 or less although Casper, Cheyenne and Laramie are by far larger than other communities in the State.
- According to a staffing report developed by CBRE (CB Richard Ellis), for the Verizon Mega Data Center which would have required about 200 support people, indicated that Casper, Laramie and Cheyenne could support the staffing needs of that large an operation. Based on this report these three communities are well positioned to accommodate data centers (plural).
- The remaining portions of this region would be hard pressed to support most large data centers.
- Wheatland could support the staffing needs of a 20 to 30 MW data center.

- Torrington could support the staffing needs of a 10 to 20 MW data center.
- Douglas could support the staffing needs of a 5 to 10 MW data center.
- Other than these few communities – unless a data center needs to be very remote - the southeast quadrant has a limited number of communities that could support a large data center.
- There is an old AT&T site on SR34 about 16 miles from Wheatland that has power, water and sewer that could support a 5 to 10MW data center. However is seems to currently lack fiber.

Power

This quadrant is served primarily by Rocky Mountain Power in franchise areas or from their transmission lines and by Cheyenne Light, Fuel & Power which is served by its parent company's Black Hills Power Company Transmission system. As throughout the rest of the State all the power producers and franchised suppliers share the general transmission lines. Power produced in or immediately adjacent to the Quadrant is over 5,750MW including feeds from Laramie River Plant (Wheatland), Rawhide (CO), Dave Johnson, several plants in Laramie & Carbon counties and Jim Bridger.

Rocky Mountain Power – One Line Map for SE Quadrant



- There are significant looped or protected local power transmission and distribution networks within Casper, Cheyenne, Laramie, Wheatland, Glen Rock, Rock River, Medicine Bow, Hanna and Rawlins.

- Wheatland has the Laramie River Power Plant with a capacity of 1,650MW as well as a substation and switchyard which comprise a major interconnection point for several 345KVA and 230KVA looped transmission systems. Just outside town this site would be ideal for data centers from a power perspective as well as with other utilities.
- Casper is directly fed from at least four (4) of the largest power plants in the state as well as several of the smaller generating plants. Casper is ringed with transmission lines as well as having several 230KVA and 115KVA transmission networks within the city itself. Casper and the outlying areas such as Glen Rock have several areas where conditions would support data center development.
- Cheyenne presently has a substantial power grid both at the major transmission level and at the local transmission level with significant "improvement" projects in progress that will further solidify the availability of significant capacity and reliability. Just east of Laramie the Archer substation has several 345KVA and 230KVA feeds and distribution lines for "local" demand.
  - Cheyenne Light, Fuel & Power has construction going on to extend 230KVA and 115KVA lines in a looped arrange just south of Cheyenne which will provide the power needed to develop an industrial or power park.
- Laramie, which was selected by Verizon for their Mega Data Center has several 138KVA and 230KVA transmission lines feeding the city. Recently, about 3 years ago which is recent in transmission systems terms, a major new switchyard (Snowy Range) was implemented just north of Laramie City limits on 30th street. This site has several 230KVA and 138KVA transmission lines including "back feed" capacity from the Cheyenne area if ever needed. The property directly adjacent to this switchyard was the site selected by Verizon for a 75 MW data center.
- Torrington is serviced by Wyrulec Power Company which is a Coop that serves almost all of Goshen County. Wyrulec indicated they could handle 8 to 10MW load in or near Torrington without having to do any major reconfigurations of their present distribution system. There is, however, a WAPA substation just south of the city with existing 230KVA and 115KVA looped feeds. It would seem that, if needed, capacity over 10MW should be available if Wyrulec were to engage WAPA for added capacity.
- Rock River, Medicine Bow and Hanna all have multiple 230KVA and/or 138KVA looped network transmission lines in proximity. These sites could be ideal for small to medium data centers that want to be remote or out of sight of normal traffic lanes.

Communications Options

The Southeast quadrant is fiber rich in the southern most area of the quadrant – specifically along I-80 where several routes coming up from Denver converge with a couple east/west routes coming in from Nebraska. The Cheyenne and Laramie areas are the convergence points for all of these routes as they transit Wyoming heading west into Utah and Idaho and then onto other points west.

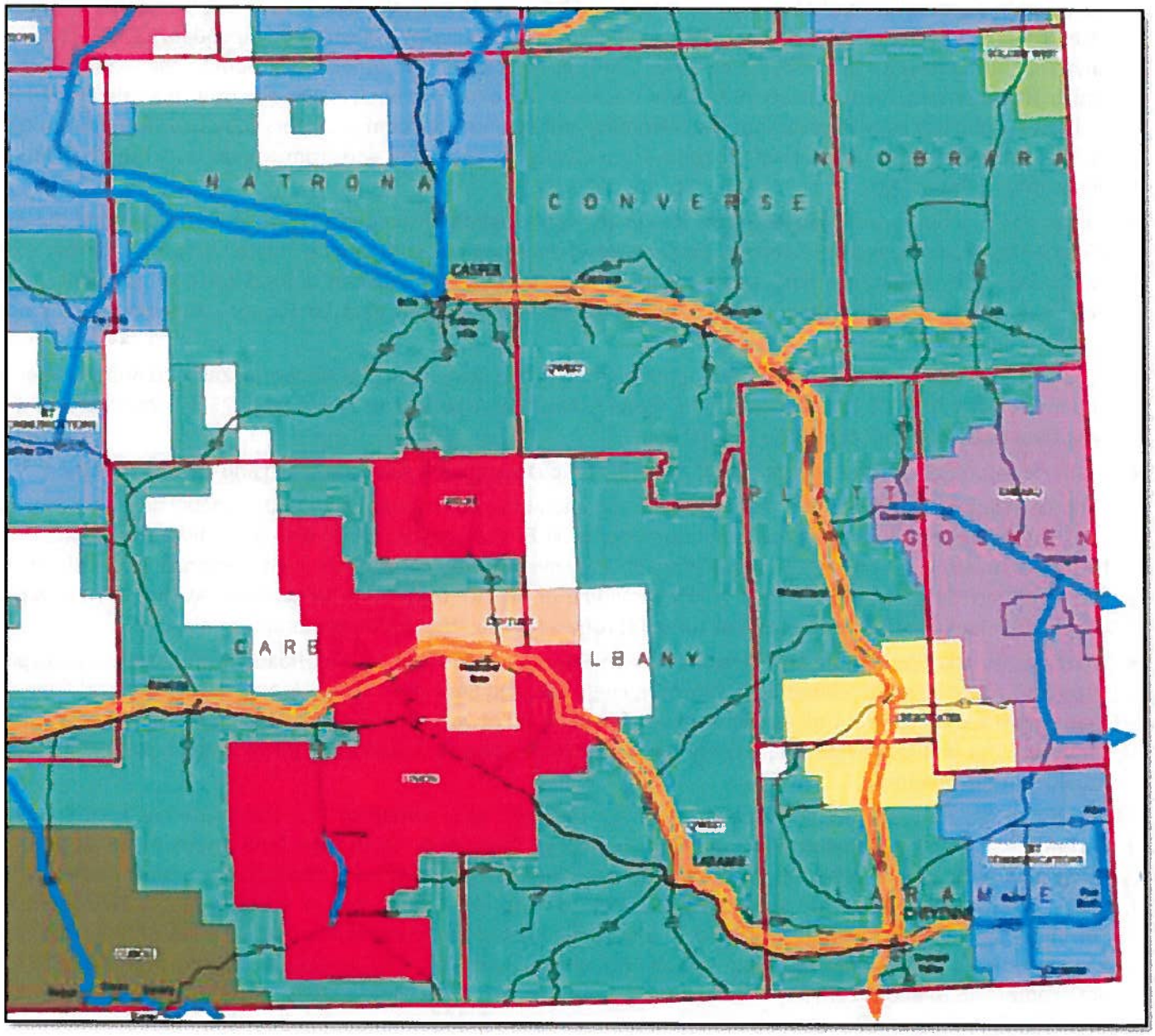
- Cheyenne has several routes and providers that come north out of the Denver area where they then either transition west or bifurcate into both west and north routes. Sprint, AT&T and CenturyLink also have routes that enter the state parallel to I-80 from Nebraska. CenturyLink, AT&T and Level3 have Points of Presence (POPs) in Cheyenne where they manage access over their fiber west to Salt Lake, south to Denver, East to Omaha and North to and through Casper.
- There is a second fiber route north from Denver paralleling I-25 passing through Cheyenne, with a Point of Presence, that continues parallel to I-25 into Casper and then continues north on I-25 passing near Midwest into the Northeast Quadrant to Buffalo, Sheridan and then into Billings MT. This route is primarily subscribed to several service suppliers including 360 Networks whom was recently acquired by Zayo Broadband Inc. Zayo has a history of not selling fiber IRUs or leases.
- There are three (3) routes, which are diverse or redundant east/west routes owned by AT&T, CenturyLink and Level3 that come up from Denver and pass north through Cheyenne to SR 211 at I-25 and then follow 211 to Horse Creek (with regeneration sites near Horse Creek) and then take County Road 228, a dirt road, west where

they meet Roger Canyon Road, then onto Haul Road which then intersects Highway 287/30 from Laramie looping past Rock River, Medicine Bow, Hanna and then meeting I-80 at Walcott Junction.

- Cheyenne therefore has about 7 east/west routes and 2 north/south route passing through.
- Cheyenne additionally has Opticom / Bresnan that has been building local fiber networks and will interconnect with virtually every one of the long haul fiber network operators. This should allow for convenient interconnections by any data center to any fiber or broadband services provider in the area.
- Wheatland has the two north/south fiber routes from Cheyenne to Casper (CenturyLink and 360 Networks/Zayo) passing through the area. Both these route divert east of I-25 a few miles and come within a mile of the Laramie River Power Plant.
- Glen Rock has the two north/south fiber routes from Cheyenne to Casper (CenturyLink and 360 Networks/Zayo) passing through the area.
- Casper has two fiber routes coming north from Cheyenne, as noted in the Cheyenne overview above. One of these is owned by CenturyLink and continues west toward Shoshoni. Historically Qwest has not offered the sale of fiber IRUs or leases in any of their routes. This would limit the ability of a customer like a data center to acquire anything but bandwidth in this route or other CenturyLink routes. The other route from Cheyenne is the one in which 360 Networks/Zayo controls 36 fibers in the route. Zayo has not been inclined to offer the sale of fiber IRUs or leases. This has caused several of the Wyoming independent telecom providers (Cowboy Network) to try to pull together funding to build another route from Casper to Cheyenne and from Casper north to Sheridan and eventually to Billings MT.
- Casper has two fiber routes heading west (one is the continuation of the CenturyLink/Qwest route) and the other is owned by Wyoming based telecom companies which interconnect with several independent owned fiber routes in northwestern Wyoming. With some planning and cooperation between a local telecom providers in the northwestern area a ring route through Billings could be configured back to Casper. However this is not a "normal" situation.
- Casper has one fiber route heading north (continuation of the route with 360 Networks/Zayo) to Buffalo, Sheridan and into Billings MT. RT has acquired some rights to this fiber near where 259 meets I-25. RT from this point has built fiber to Gillette and other points north east.
- Casper has some local fiber networks that currently touch existing developed areas in and around the city.
- Laramie including points about 6 miles south of I-80 and about 10 miles north of I-80 probably has more long haul fiber routes passing through it than any other city west of the Mississippi. There are 9 distinct east/west long haul fiber routes. Two of these 9 routes (Verizon and Level3 #1) do not pass through Cheyenne as the divert from I-25 near Fort Collins and somewhat follow a rail line or SR 287 from there to Laramie. At this point AT&T and CenturyLink have two (2) and Level3 has three (3) routes passing through the general Laramie area.
- AT&T has an additional route that heads north on Roger Canyon Road to Haul Road where it meets and splices into AT&T route #2 which comes across from Horse Creek and Cheyenne. There is also a series of local fiber rings that are owned by CenturyLink as well as several new local networks that have been built by Opticom/Bresnan in Laramie. This would provide a data center with interconnection to virtually any major long haul fiber/broadband provider in the quadrant.
- Torrington has a single fiber route passing through the city this is owned by RT. This route has a meet point in Torrington that allows connectivity between Guemsey, Torrington, La Grange (and south to 85 & 216) and Bridgeport Nebraska. RT also has fiber from Albin to Pine Bluffs and then west back to about mile marker 370 on I-80. However – there is no connectivity directly back to the I-25 routes or to Cheyenne. This leaves the Torrington area short of a looped fiber path. It should be noted that there is less than 30 miles of fiber that would have to be built to complete this loop – albeit with only one vendor. This would probably be acceptable to most data centers up to about 20MW.

- Rock River, Medicine Bow and Hanna have the three (3) long haul routes that come across from Cheyenne via Horse Creek as well as the Wiltel (another Level3) route that follows the gas pipe lines that are just south of Medicine Bow and Hanna which cross 287 just before it meets I-80 near Walcott Junction.
- There is no fiber connectivity south and west from Casper toward Laramie and/or Rawlins/Sinclair via Bairoil which would put Casper and Wheatland "on the map" for looped access to the numerous east/west long haul routes along I-80. RT does have a fiber route starting near Moneta terminating or dead ending in Jeffery City. If this route could be extended to I-80 between Rawlins and Wamsutta it would upgrade much of the northern part of the state with the ability to provide looped fiber routes with any of the east/west long haul national routes in the I-80 corridor.

Southeast Quadrant Fiber Routes



Water

As with most of the rest of the state, other than sites within city limits, water will be an issue throughout the Quadrant. Water rights, wells and water storage will need to be planned and incorporated into a data center's strategy.

Natural Gas

Since most of the Quadrant is at an altitude well above 5,000 feet with Laramie and some areas above 7,000 feet it is not likely that a large data center will try to use natural gas to power back-up generators due to significant efficiency lose at altitude. However there are abundant high pressure gas pipelines throughout the quadrant area which, under the right contractual arrangements, might be a consideration for generators depending upon cost.

- Natural gas may be needed for normal heating. If a data center is to be built in or near cities like Casper, Cheyenne, Laramie, Wheatland, Torrington, Rock River, Medicine Bow and Hanna there may need to be a convenient supply of natural gas.

Cool Ambient Air

The Southeast quadrant, in general, has some of the coolest summer temperatures in the State. Depending upon the cooling strategy of the data center this may or may not have an impact on the selection decision. In most cases a data center locating in Wyoming will not be utilizing refrigeration cooling unless it is a federal government facility demanding no tolerance for temperature variances.

- At worst case a data center in the Southeast quadrant may decide to deploy chilled water or adiabatic cooling systems which in this quadrant should only slightly increase operating cost but will require moderate levels of water during summer months.

Shovel Ready or Commercial Use Ready Site(s)

There are no actual Shovel Ready sites in the Southeast Quadrant. Cheyenne, Laramie and Torrington have sites that are pretty close to being shovel ready with the exception of committed power capacity.

- Casper – has several open spaces which are near power lines and fiber facilities that could be proposed for data center or other industrial uses. Preparation would need to be done to develop plans for creating pre-designated data center or industrial sites.
- Cheyenne has the nearest thing to a shovel ready site in the quadrant and the State – the same site NCAR is on. This has roads, water, sewage and at least two (2) fiber routes on or adjacent to the property. What appears to be missing is a firm commitment of dedicated power capacity to the site. An ESA study (an engineering study by both Cheyenne Light, Fuel and Power and WAPA) costing between $50,000 and $75,000 would need to be completed and assuming availability a commitment to purchase or reserve power would need to be signed (and paid) in order to guarantee the availability of the committed level of power.
- Laramie has selected sites that should be of interest to most data centers including appropriate zoning and commitments from the land owners to make the site available for sale to a data center. Like in Cheyenne though these sites would still need to have and ESA done to assure the needed power would be available.
- Torrington has two small sites on the south side of the city that would be ideal for a small to medium data center. One site already has a few industrial buildings on the campus and has 20+ acres that could be developed for a data center. The second site is only about ½ mile south of the city and is idle farm land. Zoning and most of the normal studies and an ESA power study would need to be done.

- Rock River, Medicine Bow and Hanna – there are no designated sites that I am aware of in these communities but like all of Wyoming, other than power commitment, sites should be able to be selected, optioned/acquired and all regulatory processes completed in favorable time frames.

Northwest (NW) Quadrant

Park County, Teton County, Hot Springs County, Fremont County, Big Horn County & Washakie County

Available Technology Skilled Resources

All cities and towns in the entire quadrant qualify as a 50,000 population city or smaller.

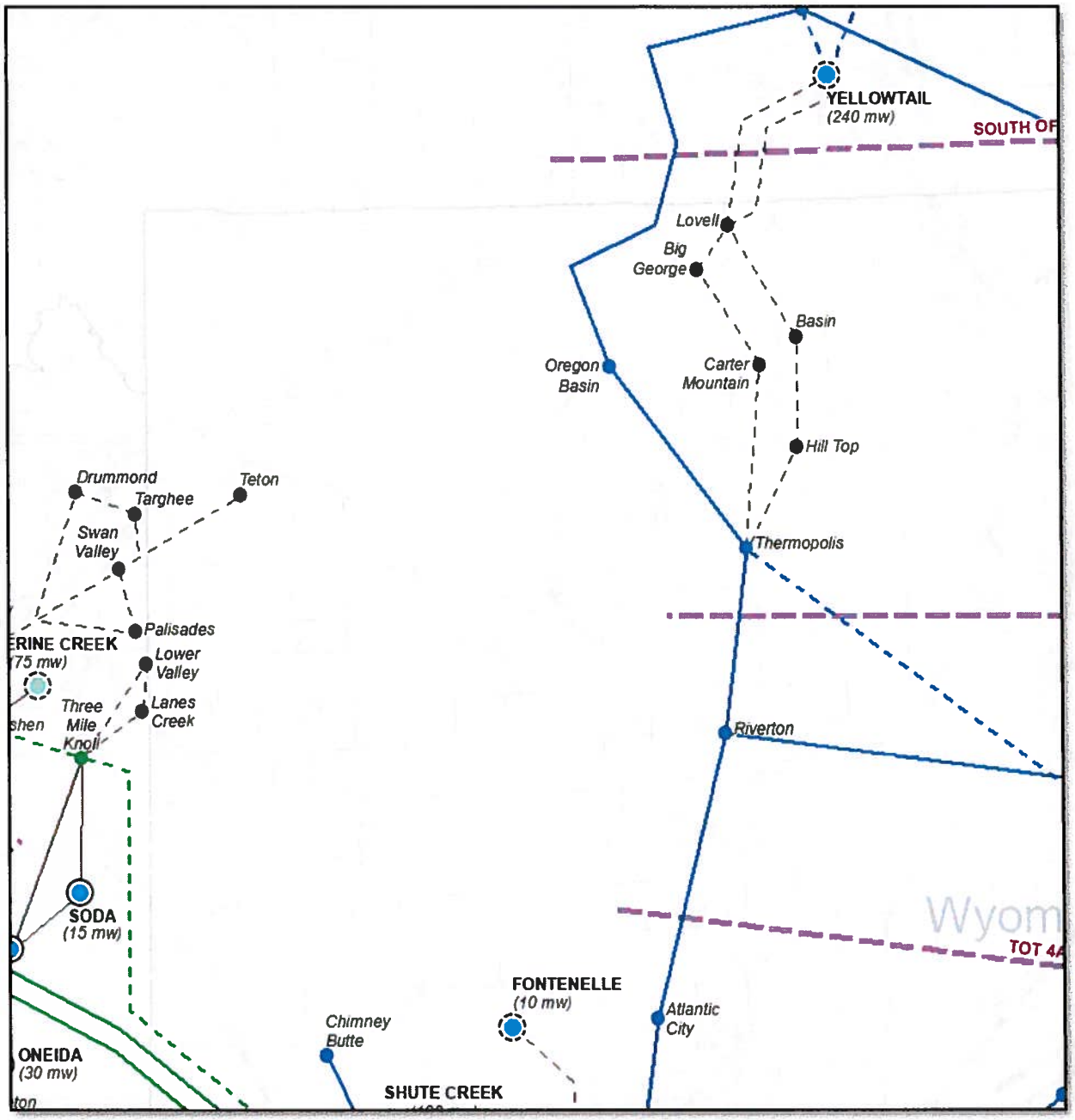
- Jackson, Dubois, Lander, Riverton, Thermopolis, Worland, Basin and Cody could support a 10 to 20 MW data center from a staffing point of view.
- Shoshoni, Greybull and Lovell could support a 5 to 10 MW data center from a staffing point of view with area normal drive times.

Power

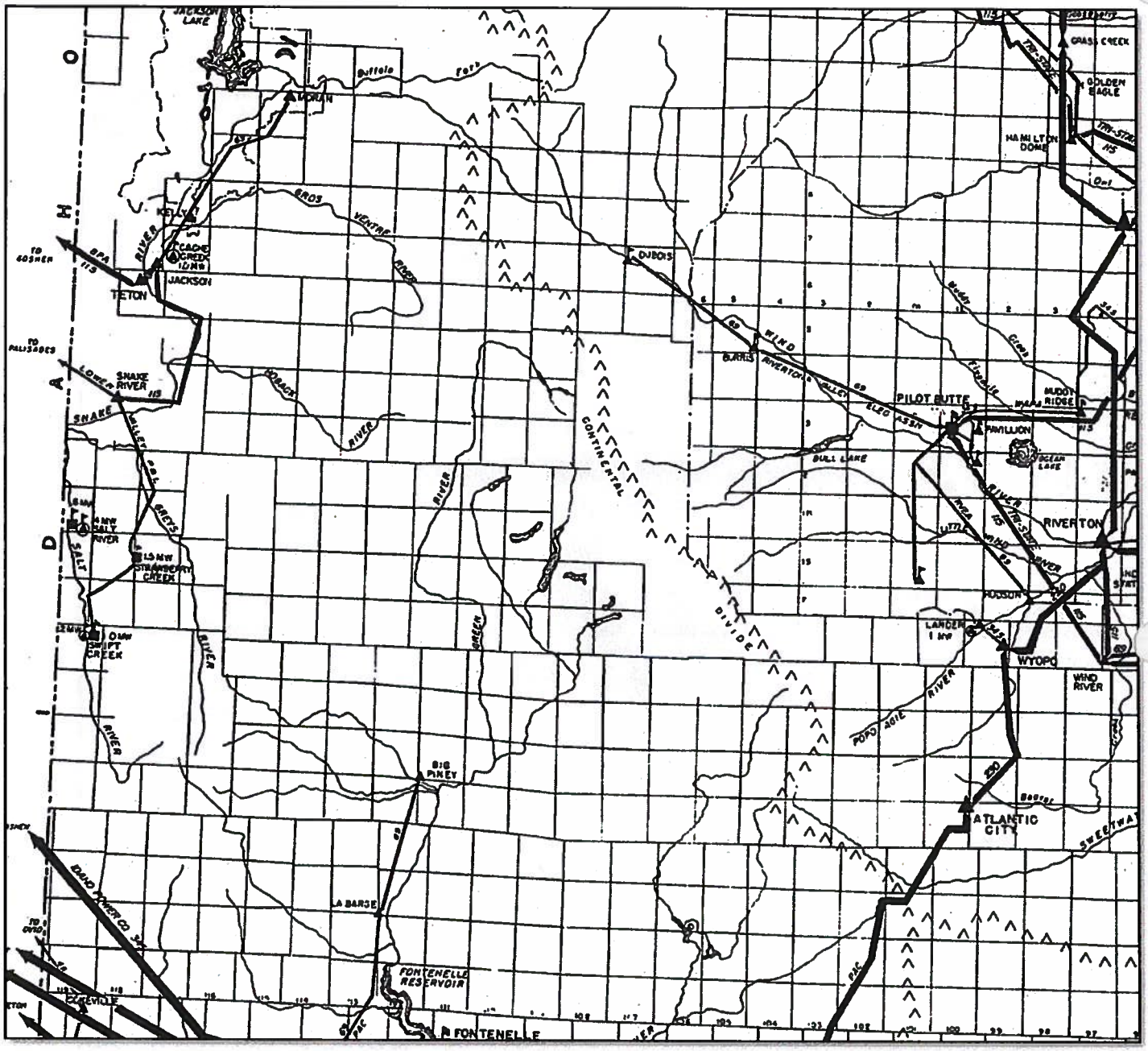
There are multiple power plants, power companies and transmission line owners in the NW quadrant. There are two 230KVA (230,000 Volt/Amp) looped or ringed networks that connect with approximately 3,200 MW of Regional power production, including the Jim Bridger plant near Rock Springs and Naughton near Kemmerer as well as several other power plants in a collection of "protected and unprotected networks which service Lander, Riverton, Thermopolis, Worland, Powell, Basin, Lovell and Cody. There is also a protected feed to Jackson from Idaho which ties back to the "Grid" including Jim Bridger. These major transmission lines should have available capacity to support up to a 30MW data center in one or more of these communities. However several areas like Dubois are on sma unprotected legs of 69 or 34.5 KVA which will only support about 10MW of load but with no significant reliability.

Since the Rocky Mountain Power Company transmission line map for this area shows limited distribution a snapshot from the WAPA map for this quadrant is also included in this section.

Rocky Mountain Power – One Line Map for NW Quadrant



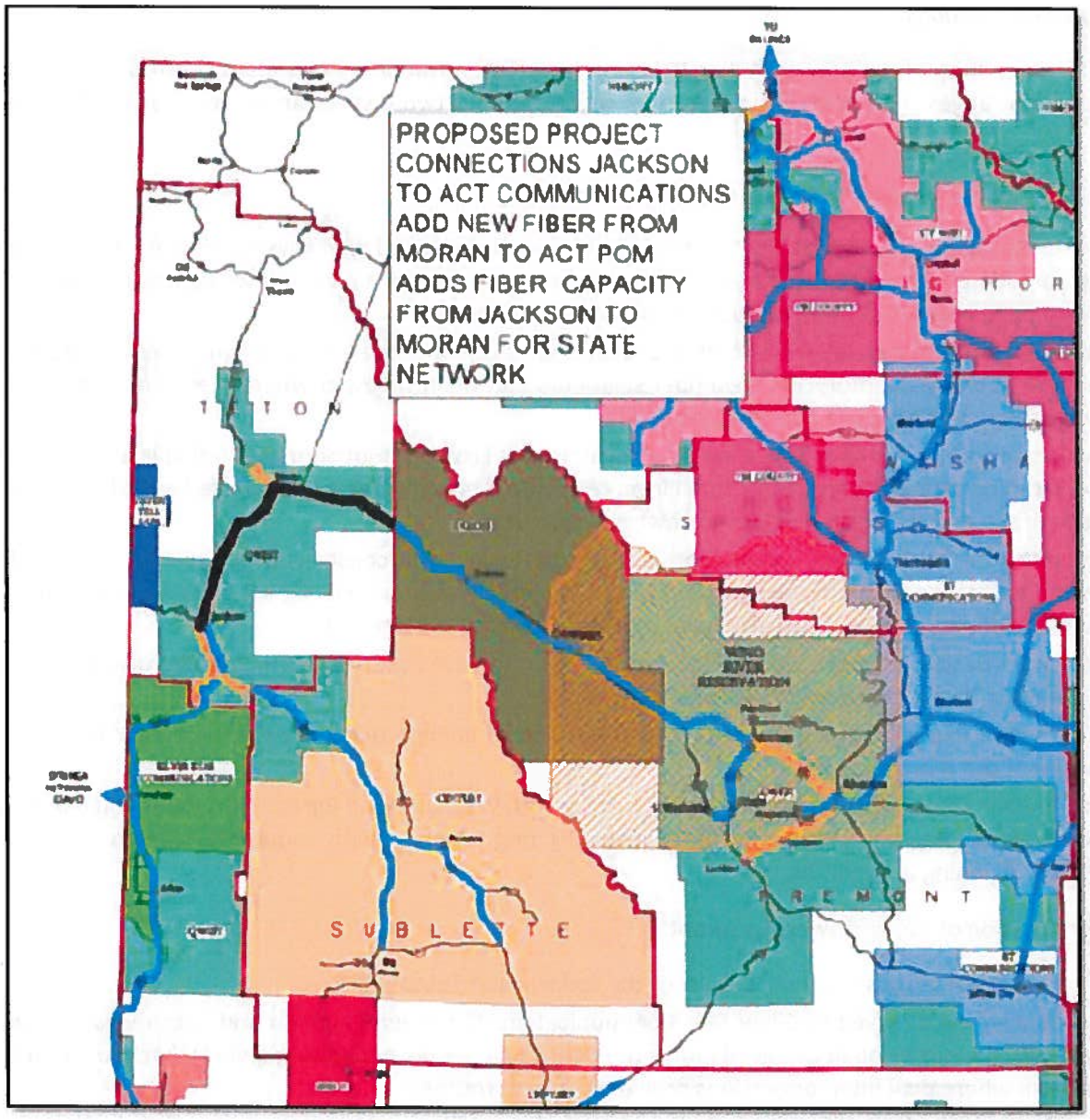
WAPA One Line Power Distribution Map – NW Quadrant



Communications Options

Due to the geography of the area including Yellowstone & Teton National Parks along with the Absaroka and Wind River mountain ranges the northwest quadrant is separated into two distinct areas - east or west of the mountain ranges.

- Eastern portion of the northwest quadrant:
  - Generally has single physical fiber routes following local roads and highways which were and are being built to accommodate better connectivity within the region and as part of a plan, by two companies, to extend fiber to the home in order to provide multiple "triple play" services.
  - The quadrant also has several lateral and local ring routes that feed rural communities. Range Telephone/RT and DTE as well as CenturyLink have fiber segments that tie into Casper where they can meet the north/south routes between Cheyenne and Sheridan.
  - The Range companies have built a series of local rings in Fremont, Hot Springs, Washakie and Big Horn Counties that interconnect with the Casper to Billings, MT route. This provides a reasonable level of protected routes in much of the eastern portion of the northwest quadrant.
  - Optimum/Bresnan formerly Cablevision is currently engaged in construction of several new local and inter-town fiber routes in the eastern portion of this quadrant often paralleling other routes – potentially creating diverse facilities. Optimum will also build to suit to any carrier if needed.
  - The routes described above would allow a data center to have access to protected fiber along many of the local highways in the eastern portion of the NW quadrant.
  - The town of Basin Wyoming is in the unique position of being a telecom or at least fiber hub for the eastern portion of the NW quadrant.
  - From a fiber access point of view Fremont, Hot Springs, Washakie and Big Horn Counties could possibly support the needs of data centers up to 20MW including ring topology with some inter-company cooperation and network planning and splicing.
- Western portion of the northwest quadrant:
  - For all practical purposes consists solely of the Jackson and Teton Village.
  - This area which is served by Silver Star Communications has several Jackson and Teton Village local fiber rings that interconnect through Driggs Idaho to the Syringa Networks network and via Hoback Junction to Alpine to Freedom where dual interconnections providing diverse routes:
    - One to Idaho Falls where it meets the Jackson/Teton Village route to create a regional ring and
    - One to Thayne and south to Evanston.



Water

As with most of the rest of the state, other than within city limits, water will be an issue throughout the area. Water rights, wells and water storage will need to be planned and incorporated into a data center's strategy should they be interested in this quadrant.

Natural Gas

Since most of the Quadrant is at an altitude greater than 5,000 feet it is not likely that a large data center will try to use natural gas to power back-up generators due to significant efficiency lose at altitude.

- Natural gas may be needed for normal heating which may be more of an issue in the western area of the quadrant than in the eastern areas of the quadrant.

Cool Ambient Air

The western portion of the northwest quadrant, in general, has cool summer temperatures. The eastern, flatter, area of the northwest quadrant has slightly higher temperatures than the higher elevation areas of the State. Depending upon the cooling strategy of the data center this may or may not have an impact on the site selection decision. In most cases a data center locating in Wyoming will not be utilizing refrigeration type cooling systems unless it is like a federal government facility demanding no tolerance for temperature variances in the computing areas of the building.

- At worst case a data center in the northwest quadrant may decide to deploy chilled water or evaporative cooling system as opposed to a mist or adiabatic cooling strategy which will drive the operating cost up slightly as well as require fairly significant increases in consumption and volume of water during summer months.

Shovel Ready or Commercial Use Ready Site(s)

There is one site in Cody, near the airport, which is considered an industrial development area albeit not a shovel ready site. This site might be able to accommodate a data center up to 30 acres or requiring up to 20MW of power.

- There are no other designated sites within this quadrant that would be deemed shovel ready.

Southwest (SW) Quadrant

Lincoln County, Uinta County, Sublette County & Sweetwater County

Available technology Skilled Resources

All cities and towns in the entire quadrant qualify as a 50,000 population city or smaller.

- According to a staffing report developed by CBRE (CB Richard Ellis), for the Verizon Mega Data Center which would have required about 200 support people, indicated that Casper, Laramie and Cheyenne could support the staffing needs of that large an operation. This same report indicated that Evanston could easily support the staffing needs of a 30 to 50MW data center from within the county or a one hour drive time radius.
- Rock Springs, Green River, Lyman/Ft Bridger and Kemmerer could support 20 to 30MW data centers from a staffing point of view.
- Star Valley along 89 including Afton, Thayne and Alpine could support one or two 10 to 20 MW data center from a staffing point of view.
- Sublette County, specifically Pinedale might be able to support a 5 to 10 MW data center from a staffing point of view but with concerns about winter drive times.

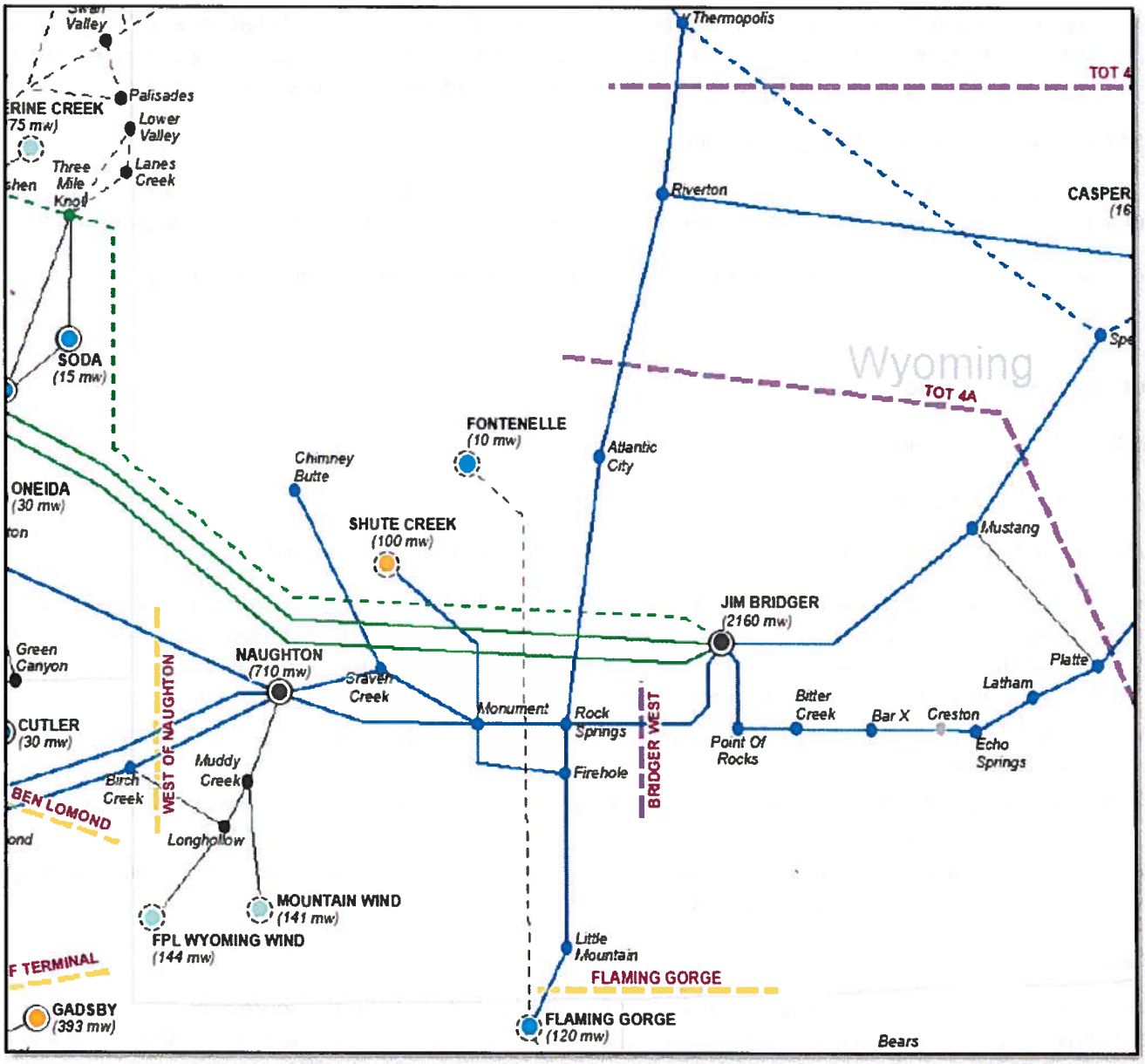
Power

There definitely is substantial power produced and available to the grid in the southwest quadrant. There is over 3,050MW of power produced (including about 500MW of wind power) in the quadrant feeding into a grid that also has over 2,050MW produced in Utah and available as backup to the grid in the SW quadrant.

- There are three (3) 345KVA (345,000 Volt/Amp) looped or ringed routes that pass through this quadrant that interconnect with all of the 5,100MW of Regional power production, including the Jim Bridger plant near Rock Springs and Naughton, near Kemmerer, as well as several other power plants. A significant portion of this regional grid is "protected" and should be attractive to data centers requiring up to 90 or 100MW in some areas of the quadrant.

- Star Valley area power provided by Lower Valley Energy has a substantial local power grid from south of Smoot Wyoming "along" 89 through Afton, Thayne, Freedom, Alpine then Jackson and up to Moran Junction. The area south of Alpine has several looped or protected segments providing what should be highly reliable service. Th area should be able to accommodate a couple 10 to 20MW data centers from a power perspective.

Rocky Mountain Power – One Line Map for SW Quadrant



Western Area Power Authority (WAPA) – Power Map for SW Quadrant

Communications Options

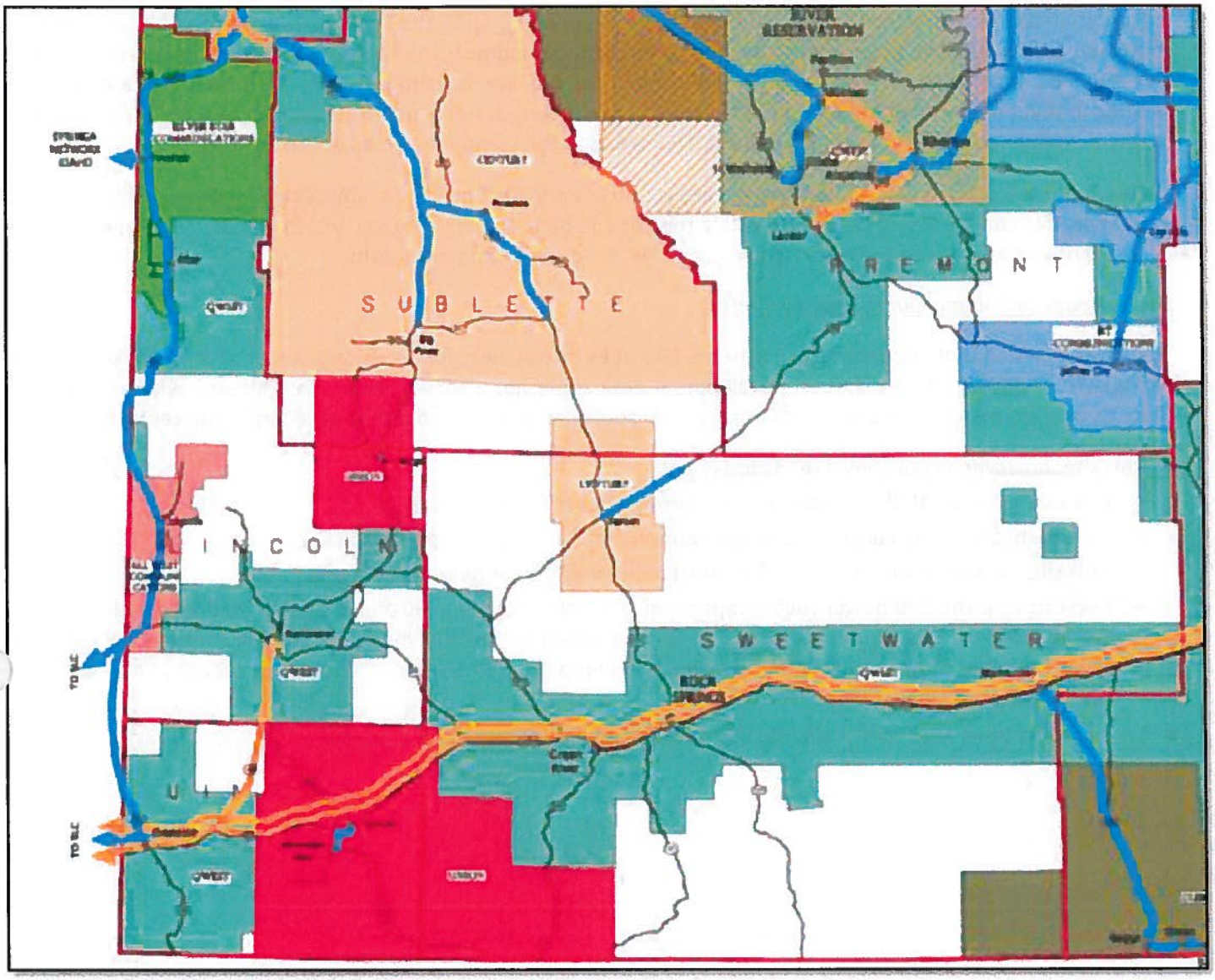
This quadrant includes the I-80 corridor with every major long haul national fiber and communications services providers and it has huge areas with no fiber or broadband assets at all.

- It should be noted that there is probably more fiber installed and more bandwidth available along or intersecting the Wyoming I-80 corridor than anywhere else west of the Mississippi.
- There are seven (7) distinct physical fiber cables with at least ten (10) vendor routes passing through Cheyenne Wyoming then heading west. By Laramie Wyoming two (2) additional routes converge with the seven from Cheyenne creating nine (9) distinct physical fiber cables with at least twelve (12) vendors along the "I-80 corridor" heading west. All of these follow three "paralleling" routes west "converging" near Walcott Junction Wyoming where they all generally follow I-80, the Union Pacific rail line or Williams Pipe line(s) through or near Sinclair,

Rawlins, Wamsutter, Rock Springs, Green River, Little America, Carter/Lyman and Evanston before crossing into Utah.

- In the southern part of the southwest quadrant along most of the distance from the eastern border of Sweetwater County through Uinta County and leaving Wyoming at or near Evanston there are nine (9) long haul fiber routes within 11 miles of the I-80.
- Anything greater than 10 miles south of I-80 through the southwest quadrant is virtually devoid of fiber assets.
- There are two (2) routes from Evanston heading north somewhat "paralleling" 89 entering the Star Valley area. One of these routes connects with Syringa Networks providing ring and diverse routes from Star Valley into Idaho and Utah as well as into both Oregon and Washington States.
- Pinedale, Boulder and Big Piney are the only communities in Sublette County with any fiber and this is on an inverted Y lateral, unprotected feed from the Alpine area. Like any other area with lateral fiber feeds this would not be acceptable for almost any size data center.
- Anything more than 10 miles north of I-80 through all of Sweetwater County and most of Uinta County and almost all of Sublette County is virtually devoid of fiber assets.
- Kemmerer with population, power and significant water and waste water systems has only one single lateral fiber route owned by CenturyLink (which usually does not provide fiber IRUs or leases) which leaves this community out of the running for data centers due to this current lack of looped or ring fiber.
- One interesting location in this quadrant is near Carter Wyoming on SR 412. Between 7 and 10 miles north of I-80, but hidden from view of the highway, all nine (9) fiber routes with six (6) regeneration huts and two (2) 230KVA power lines cross the road. Other than water, what else could a data center ask for??

Southwest Quadrant Fiber Routes



Water

As with most of the rest of the state, other than within city limits, water will be an issue throughout the area. Water rights, wells and water storage will need to be planned and incorporated into a data center's strategy should they be interested in this quadrant.

Natural Gas

Since most of the Quadrant is at an altitude greater than 5,000 feet it is not likely that a large data center will try to use natural gas to power back-up generators due to significant efficiency lose at altitude.

- Natural gas may be needed for normal heating which may be more of an issue in the western area of the quadrant than in the eastern areas of the quadrant.

Cool Ambient Air

The western areas of the Southwest quadrant, in general, has cool summer temperatures as does much of the rest of the state. The eastern, flatter, areas of the southwest quadrant have slightly higher temperatures than the higher elevation areas in the western areas of the quadrant. Depending upon the cooling strategy of the data center this should provide a positive benefit in the western areas of the quadrant. The flatter, warmer summer temperature in Sweetwater County may have an impact, albeit minor, in the site selection process. In most cases a data center locating in Wyoming will not be utilizing refrigeration type cooling systems unless it is similar to a federal government facility demanding no tolerance for temperature variances in the computing areas of the building.

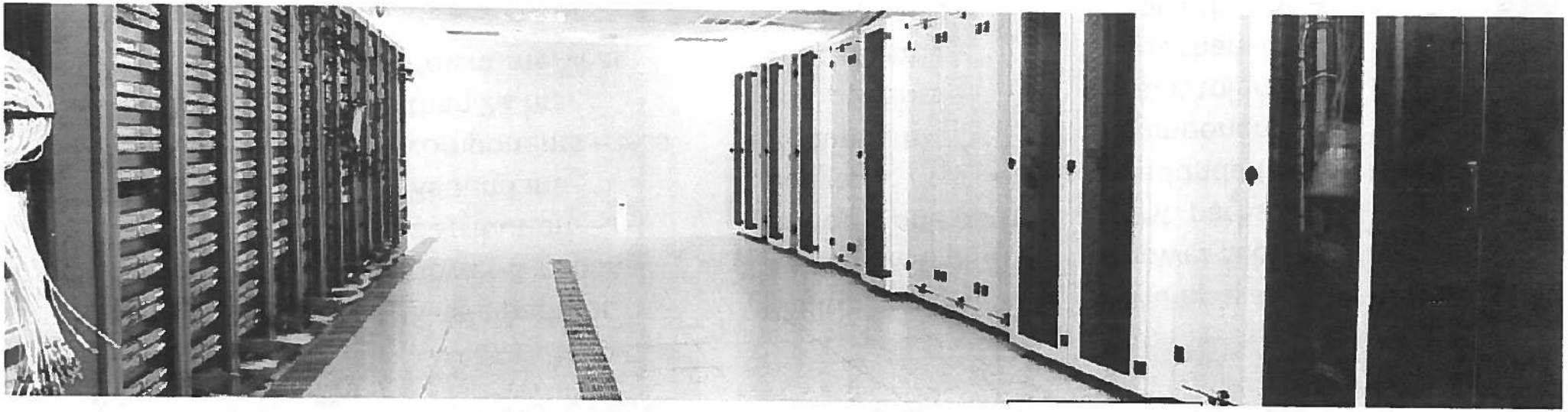
- At worst case a data center in the eastern areas of the southwest quadrant may decide to deploy chilled water or evaporative cooling system as opposed to a mist or adiabatic cooling strategy which will drive the operating cost up slightly as well as require increased volume of water during summer months.

Shovel Ready or Commercial Use Ready Site(s)

There is one site in Uinta County adjacent to the City of Evanston, next to the visitors center at mile marker six (6) on I-80 which is considered an industrial development area albeit not a shovel ready site. This site, which is owned by Uinta County, is over one thousand (1,000) acres and could easily accommodate several large data centers.

- This site, however, is not shovel ready today but:
  - This site has four (4) fiber routes running through or very near the site.
  - This site has both high pressure and distribution natural gas lines crossing the site.
  - This site has water (an 8 inch line & pumps) and sewage on or near the property.
  - Two ring or protected power routes capable of supporting between 50 and 90MW of load are within one and a half (1 & ½) and two (2) miles of the site. Getting power to this site should be comparatively "easy" based on limited number of right of way that would be required in order to extend these high capacity lines across I-8 and directly onto the site.
- There are no other sites within this quadrant that would be deemed shovel ready.

Principles of Data Center Siting And Economic Development Incentives



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Specialists in Location Economics

UEDA Winter Forum
February 23, 2011

THE BASICS OF A MISSION CRITICAL FACILITY

What is it?

Data center, Disaster Recovery Facility, Network Operation Center (NOC), Trading floor

Data center: Usually the highest energy user

Tier1	Tier2	Tier3	Tier4
▪Single path for power & cooling distribution. ▪No redundant components – less than 28.8 hrs downtime/year	▪Single path for power & cooling distribution. ▪Redundant components – less than 22 hrs downtime/year	▪Multiple power & cooling dist. paths, but only one path active. ▪Redundant components – concurrently maintainable – less than 1.6 hrs downtime/year	▪Multiple active power & cooling dist. paths ▪Redundant components ▪Fault tolerant – less than .4 hr downtime/year

Source: Uptime Institute

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DATA CENTER LANDSCAPE: THE MARKET NEED

- Data center construction and expansion is predicted to grow in 2011 with about 80% planning to expand their facilities in the next 12 to 24 months.
- New Construction for large enterprise data centers estimated at nearly $6 billion in 2010 and expect to double by 2015.
- According to International Data Corporate, spending on cloud Computing services will increase from $16.2 Billion in 2008 to $42 Billion by 2012.
- According to U.S. Dept of Energy, data centers can consume up to 100x more energy than a standard office building. Often, less than 15% of original source energy is used for the information technology equipment within a data center.
- According to the Environmental Protection Agency (EPA), data center energy consumption doubled from 2000 to 2006, reaching more than 60 billion kilowatt hours per year. That number could double again by 2011.
- Digital Realty Trust (DRT) provides data center solutions and consultation. They reported that they leased 1.2 million square feet of space in 2010, exceeding the levels seen prior to the financial crisis in the fall of 2008.

DATA CENTER LANDSCAPE: THE TREND

- Data Centers have become **more efficient, more standardized**.
- Data Centers facilities **accommodate broader range** of temperatures and humidity in server rooms, allowing data centers to reduce the use of energy-intensive chillers.
- Greater adoption of **Modular Designs**: Factory-built data centers grew significantly, with flexible modular concepts focused on energy efficiency and rapid deployment.
- **Mega** Data Centers: Due to the growing demand for cloud computing and financial scalability, companies are consider building mega, or multiple instead of single facilities.
- Innovations in **Portable** Data Centers: Google patented portable data center in a shipping container in 2008. Included in Google's patent filing was the floating data center that generates its own electricity using wave energy. Experts think this could be the missing link in the effort to bring high-speed Internet access to underserved communities, if the container is hooked to a major dark fiber route.
- Strong demand for **turnkey data center** programs: Essentially a "plug and play" raised-floor data center space, shifting development costs from tenant to landlord, and allowing for quicker deployment than if the customer built a new facility on its own.
- **Conductivity / Synchronizing**: Locating data center within reasonable distance of the main business site (primarily important for financial services).

DATA CENTER LANDSCAPE: THE RESPONSE

- **From the Economic developers:** An increasing number of states are offering economic development incentives specifically earmarked for data center or mission critical facilities. For economic developers, data centers represent the following:
  - A tangible sign than a community is making a transition into the digital economy
  - Credibility and viability of the community's economic conditions
  - Opportunities for a new industry
  - Capital intensive project associated with hundreds of millions of dollars for construction & equipment. And with equipment advances occurring every year, potential for frequent equipment purchases and upgrades.
  - Ancillary businesses and vendors that support Data Centers

- **From the utility companies:** Currently, only a small portion of utilities offer programs to incentivize companies to reduce power consumption. And many programs remain underutilized due to:
  - Complex requirements and difficulty in accessing
  - Non-standardized requirements across different utility companies
  - Unavailability in areas that may be of interest to the prospect company

KEY CRITERIA TO EVALUATE DATA CENTER LOCATIONS

POWER AVAILABILITY AND RELIABILITY

The sites with the best power infrastructure will be those that have substation capacity of at least 7MW immediately available, redundant feeds from separate substations, reliability, using the standard IEEE reliability and adequate access to natural gas. Data centers rely on local utilities, particularly power companies, for essential services, so it's important to check the quality and cost of local electric services before you commit to any particular facility.

TELECOMMUNICATIONS /CONDUCTIVTY

The availability of both lit and dark fiber optic broadband service, ideally from multiple carriers, is of paramount importance. The use of fiber, particularly dark fiber, is growing rapidly as data center operators address security, scalability and cost concerns.

CONDUCTIVITY / SYNCHRONIZATION

Many data centers require conductivity that allows for synchronous replication of data typical up to 60 miles of primary space.

SECURITY/ RISK ANALYSIS

Because almost every site will exhibit vulnerability to one threat or another, the objective is to select a location that mitigates the most risk:

Natural disasters:

- Flooding
- Earthquakes
- Tornadoes
- Hurricanes

Hazardous area:

- Airport approach
- Freight Rail lines
- Natural Gas Pipelines
- Oil & Chemical production facilities

SECONDARY CRITERIA TO EVALUATE DATA CENTER LOCATIONS

BUILDING/SITE CONSIDERATIONS	For a building or site to be capable of accommodating the requirements of an enterprise data center, it must conform to "industry" standards as well as local land use ordinances. The site should be configured for maximum, efficient use of the land; Have sufficient size to accommodate building footprint; Offer opportunities for expansion, among other key building/site considerations.
LABOR MARKET CONSIDERATIONS/ SUPPORT VENDORS	Labor is not always perceived as a critical success factor during the siting of data centers or mission-critical facilities. However, the presence, or absence, of key operator, technician and professional skills can hamper a center's effectiveness or worse, expose the center to unnecessary risks and costs.
COST	Power can account for as much as 80% of the operating cost profile of a data center. With power consumption growing an average of 14% per year among larger facilities, power costs have increasingly become a key location determinant for many mission-critical facilities. The use of ambient air in cooler climates have opened up new markets for some new data centers.
INCENTIVES	Economic development incentives are pricing tools that reduce the costs or financial risks associated with data center investment, increasing ROI and shortening the payback period. The influence of incentives looms larger once the data center location options are distilled to a "short list" of candidate markets.
RENEWABLE ENERGY OPPORTUNITIES	The availability of renewable sources of energy is becoming an increasingly important consideration in the siting of data centers.

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DIFFERING CRITERIA FOR DIFFERENT TYPES OF FACILITIES

MEGA DATA CENTER

- Large volumes of lower cost electricity.
- Green energy (focus on renewable power sources)
- Proximity to dependable & plentiful water. (Water used for cooling purposes)
- Large areas of land - allows for more privacy and security.
- Distance to other company data centers is less critical
- Tax incentives – the cost of these projects and more flexibility in geographic location increases incentive impacts

MARKET DRIVEN 3rd PARTY DATA CENTER

- Significant electric capacity
- Conductivity / latency
- Proximity to dependable & plentiful water. (Water used for cooling purposes)
- Inventory of land or large buildings
- The distance to consumers for fast internet connections between data centers and customer
- Tax incentive
- Green energy (focus on renewable power sources)

FINANCIAL SERVICES/ REDUNDANT DATA CENTER

- Significant electric capacity
- Conductivity / latency / synchronization
- Proximity to dependable & plentiful water. (Water used for cooling purposes)
- Inventory of land or large buildings
- The distance to primary or secondary locations
- Other security / risk issues
- Tax incentive
- Green energy (focus on renewable power sources)

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HOT SPOTS: RECENT AND ONGOING PROJECTS

OREGON

- **Facebook** : $188 Million, 147,000 sq ft.
- **Amazon :** $100 Million, 116,000 sq ft
- **Google:** approx $600 Million, 250,000+ sq ft /about $3,000 per sq ft
- **Mission West Properties/CDH Consulting:** $150 Million, 143,000 sq ft (potentially expanded to 286,000 sq ft)

IOWA

- **Microsoft:** postponed
- **Google:** $600 Million, 55 acre site
- **IBM**: Dubuque, up to 1,300 jobs

WYOMING

- **Verizon Mega Data Center** : 500,000-700,000 sq ft, multi-billion project (check if finalized)
- **GreenHouse Data :** 12,000 sq ft, powered entirely by Wind & Solar
- **EchoStar:**77,000-sq ft, multi-million
- **National Center for Atmospheric Research (NCAR):** $70 million, 171,000 sq ft

VIRGINIA

- **Microsoft:** looking at North Carolina and Virginia
- **Terremark:** up to 500,000 sq ft
- **Quality Technology Services:** one of the world's largest data center campuses.
- **DuPont Fabros:** estimated price $1,000 per sq ft

MISSOURI

- **IBM**: 93,000 sq ft, 800 jobs by 2012
- **Unisys:** 10,000-50,000 sq ft
- **Emerson Electric:** $50Million State of the art global data centers, 35,000 sq ft
- **Digital Realty Trust:** Typical facility cost $500 - $1,000 per sq ft (space on servers)

BLS

HOT SPOTS: RECENT AND ONGOING PROJECTS

NEW YORK

- **Verizon:** $500 Million, 900,000 sq ft. $4.5 billion in investment.
- **Yahoo**: $50 Million, 155,000 sq ft
- **IBM:** 12,000 sq ft, one of the world's greenest data centers

NORTH CAROLINA

- **Apple**: $1 billion, 500,000 sq ft
- **Google**: $600 million, 137,000 sq ft (bldg 1) 337,000 sq ft (bldg 2)
- **American Express:** $600 million
- **IBM:** $360 million
- **Microsoft:** looking at North Carolina and Virginia

WASHINGTON

- **Sabey Corp**: 525,000-square-foot data center (currently postponed)
- **Yahoo:** 180,000 sq ft
- **Microsoft:** 470,000 sq ft, one of the largest data centers in the world

TEXAS

- **Cisco:** $180 million,
- **IBM:** project halted
- **Citigroup:** $450 million
- **Hewlett-Packard:** Consolidating 85 into 6. 400,000+ sq ft,
- **Lowes:** $120 million

NEW JERSEY

- **Equinix:** $260 million building , 340,000 sq ft
- **Direct Edge, Savvis Communications :** Cluster of NJ Financial Data Centers
- **SunGard** Expands
- **NYSE Euronext:** 400,000 sq ft

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A LOOK AT THE ECONOMIC IMPACT OF A DATA CENTER

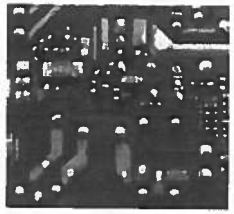
Project Details

- **Sq ft**: 150,000
- **Jobs:**25 permanent jobs and 5550 construction jobs
- **Cap. Investment**: $97 million

Economic Impact Analysis

- **Annual IT Spending:** $50 million
- **Equipment:** $40 million
- **Labor:** $10 million
- **Income Tax:**
  - Construction: $ 2.1 million
  - Permanent Jobs: $2.8 million (total 20 years) - $1.3 million NPV
- **Sales Tax:**
  - Construction: $4.1 million
  - Annual IT expenditure: $65 million ($31 million NPV- 20 years)
  - Utility Tax: $11.8 million ($6.2 million NPV -20 years)

ECONOMIC DEVELOPMENT INCENTIVES



FEDERAL INCENTIVES

UTILITY INCENTIVES

STATE INCENTIVES

FEDERAL INCENTIVES

Federal data center power reduction incentive program proposed in 2009, but not yet implemented.

The power reduction program would be defined in phases:

- Phase 1: Develop the program guidelines and rebate options
- Phase 2: National Communication of the program
- Phase 3: Begin the power reduction effort
- Phase 3a: Initial reduction would last one (1) year with a goal of reducing power utilization by two (2) billion kWh per year.

Initial cost projections for the program:

- Rebate program cost to the federal government 200 million dollars based on an assumed average of .10 cents per kWh (2B kWh * .10/kWh = $200M).
- Cost to implement and manage the plan = 1.5% of rebate total
- Energy provider rebates = 200 million dollars

Source: Data center pulse

INCENTIVE PROGRAMS OFFERED BY UTILITY COMPANIES

Utilities may offer x type of incentives, few offer specific incentives geared for data centers

Source: Synapsense.com (see appendix for direct link)

ECONOMIC DEVELOPMENT AND UTILITY INCENTIVES

OREGON:

- **SALES AND USE TAX EXEMPTION** on sales of server equipment that will be installed in a data center; labor and service charges for installing servers, to sales of power infrastructure equipment; sales of power infrastructure; and labor and services for construction of power infrastructure.
- **PROPERTY TAX ABATEMENT** available in Enterprise zones.
- **UTILITY** (Energy Trust): Provides a wide range of incentives to Oregon businesses for energy efficiency and renewable energy projects (Server Virtualization, Heating and Cooling Units, Lighting/lighting options, and Solar).

WYOMING:

- **SALES TAX AND USE TAX EXEMPTIONS** for equipment purchases of more than $2 million for data centers that have also made a $5 million capital investment in the state.
- **THE MANAGED DATA CENTER COST REDUCTION PROGRAM** provides grant to assist with reduction of the utility cost for electrical and/or broadband for the recruitment/growth of managed data centers of sufficient redundancy. Grant is based on capital investment, payroll and payroll the business will realize over five years. ($2.2 million maximum grant). Business must create a match of at least 125% of the grant amount in payroll and capital expenditure with the caveat that 50% of the match will be in payroll creation. Payroll must be greater than 150% of the county's median wage.

VIRGINIA:

- **RETAIL SALES AND USE TAX EXEMPTION** for computer equipment bought or leased between July 1, 2010 and June 30, 2020 for use in a data center. The facility must generate capital investment of at least $150 million and create at least 50 new jobs that pay one and one half times the prevailing average wage in the locality. (Contract employees eligible, construction jobs not eligible)

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ECONOMIC DEVELOPMENT AND UTILITY INCENTIVES

TEXAS:

- **TAX INCREMENT FINANCING:** Offers up to $5 Million to help defray infrastructure improvements over the life of the project
- **UTILITY REBATES FROM THE DATA CENTER EFFICIENCY PROGRAM** (Austin Energy): The program's incentives are intended to reduce the added incremental costs associated with the specification and installation of high efficiency energy technologies. Rebates up to $200,000 per site per fiscal year.
- **SOLAR INCENTIVES** available through GreenChoice, Austin Energy's renewable energy program.

WASHINGTON:

- **SALES TAX EXEMPTION:** (up to 15 months) on the purchase and installation of computers and energy for new data centers; Sales of server equipment that will be installed in a data center; Labor and service charges for installing servers, and to sales of power infrastructure equipment; Sales of power infrastructure; Labor and services for construction of power infrastructure.
- In addition, some counties offers land and renewable hydroelectric power by way of the Columbia River.

MISSOURI:

- **CHAPTER 100 BOND:** Boone County Commission approved a Chapter 100 bond policy amendment that will allows regional officials to negotiate abatement (up to 100% of personal property taxes and up to 50% of real estate taxes).

ECONOMIC DEVELOPMENT AND UTILITY INCENTIVES

NORTH CAROLINA

- **CORPORATE INCOME TAX FOR CAPITAL-INTENSIVE BUSINESSES :** Certain capital-intensive businesses may qualify for a benefit that could allow them to pay significantly less income tax in North Carolina. The amount of income for income tax computation will be calculated solely based on the company's sales factor. (Expires 1/2019)
- **PRIVILEGE TAX:** Allows data centers to pay a 1% privilege tax, instead of the usual 7% sales tax. Recently broadened, extending the 1% privilege tax to all electricity used by an internet data center normally subject to a sales use tax of 3%.

TENNESSEE

- **SALES TAX EXEMPTION** on purchases, installation and repairs of qualified industrial machinery used in the operation. Computers, computer systems, computer software and repair parts used in qualified data centers also exempt.
- **INDUSTRIAL MACHINERY TAX CREDIT:** A 5% Industrial Machinery Tax Credit on the purchase of computers, computer systems, computer software and repair parts for a qualified data. (Minimum capital investment of $250 million/create 25 new jobs paying at least 150% of the state's average occupational wage)
- Reduced sales taxes on the purchase of electricity (1.5% vs. the previous rate of 7%).
- **ENERGY EFFICIENCY LOAN PROGRAM** from Tennessee Valley Authority: In August 2010, the $50 Million program was launched to help Tennessee businesses finance investments in energy efficient technology, energy retrofits and renewable energy systems to reduce operating cost and spur economic growth.

ECONOMIC DEVELOPMENT AND UTILITY INCENTIVES

NEW JERSEY:

- **TIF:** May qualify for tax incremental financing for infrastructure upgrades
- **PSE&G:** 2010 offer incentives for energy efficient equipment for data centers - $10 million program for electrical / mechanical systems

NEW YORK:

- **PAYMENT IN LIEU OF TAXES (PILOT):** Offering up to $5 million to upgrade existing data centers to be more energy efficient, a 20-year tax break that pay no property taxes for the first 10 years, then pay 20 percent more every two years after that.
- **PERFORMANCE BASED INCENTIVES:** The New York State Energy Research and Development Authority's (NYSERDA) Industrial and Process Efficiency (IPE) program offers performance-based incentives to help data center owners and operators offset the cost of investments in energy efficiency and IT productivity projects in their data centers.
- **SALES TAX EXEMPTION** on all equipment purchases.

PRACTICAL GUIDE FOR UTILITY AND ECONOMIC DEVELOPERS

- **Reduce duplication.** Duplication exists among state/local economic development agencies as well as across chamber of commerce and tourism groups.
  - Aggregate/review the state's key benefits/strengths and opportunities. If materials are created, house it across all of the local/state levels. The more opportunities to be found, the better.
  - Utility Economic developers can act as a intermediary, housing and linking various resources under one marketing channel/environment.

- **Identify/certify sites:** While utility service issues rarely make normal projects happen and can certainly prevent them from happening, they can have significant impact on data center projects.
  - Identify sites and available building in close proximity to available capacity.
  - Work with utility planning department to assemble knowledge of primary and sub transmission upgrades and expansion.
  - Be prepared to arrange meetings with clients and engineering department to get timely answers of supply availability, service options, cost of services and timing.
  - Clear policy and information of rates, service charges, capacity payments and duplicate service charges.

- **Outreach:** Work closely with local and state officials and real estate professionals to brief them on the uniqueness of data center requirements and the impact on the utility and its customers.

BLS ENERGY SERVICES

Mission Critical Facilities Services:

Assists data centers, disaster recovery and other specialized capital-intensive projects* with managing the complex location requirements and the public sector variables that can impact the feasibility, timing and cost.

(Network Operation Centers or Security Command Centers)

Utility Location Services: (Electricity, Gas, Water, Sewer, Telecom)

Assists companies with re-development projects, expansions, or new service layouts; from initial site selection strategies through economic development incentives negotiation and compliance.

Infrastructure Assessment Services:

Review and analyze potential of existing building and sites for mission critical or solar facilities. We review and make recommendation on sites that have the best infrastructure at lowest cost.

Energy Optimization Services:

Review and analyze energy conservation options; coordination of installation and post-installation monitoring.

Solar and Renewable Energy Services:

Provides a comprehensive solar and other renewable energy installation service, from feasibility, to issuing and reviewing bids, through regulatory and utility review, to installation completion and monitoring.

Energy Procurement Services:

Assists companies with the acquisition of energy from third party suppliers, from initial RFP through contract negotiation and agreements.

Our services can be integrated into any stage of the corporate relocation or expansion process.

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MANAGING ENERGY SERVICES

Our Energy Advisory group has a deep understanding of utility issues, methods, technologies, infrastructure and costs, with experience in both utility economic development and customer service.

- **Technical Expertise:** We understand the intricate and technical aspects of alternative energy supply. Our utility technical expertise merged with our economic development experience allows us to view projects strategically and tactically in a seamless process.

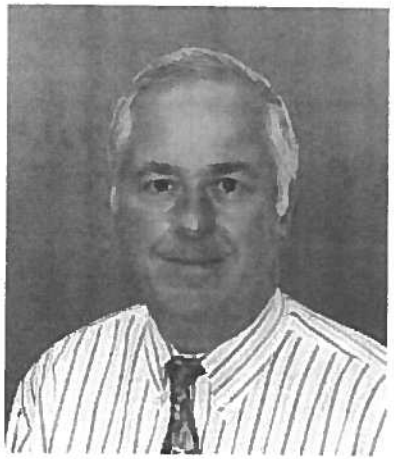
- **Analytic Preparation:** Our site evaluations are wide-angled, taking into account local zoning, potential development yield, utility infrastructure, utility relocation requirements, site constraints and potential community impact concerns.

- **Risk Management:** We work with clients and their Real Estate advisors to evaluate and qualify risk while ranking each potential site in an apple to apple comparative manner.

- **Project Positioning:** We present community benefits, and competitive positioning among candidate jurisdictions. We obtain development approvals and utility commitments for finalist site(s).

- **Post Closing follow through:** We carefully monitor post installation to ensure that the project fulfills the clients energy objectives.

TIM COMERFORD: ENERGY SPECIALIST



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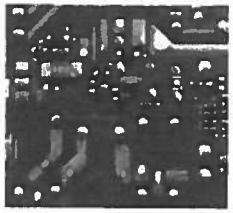
Tim heads the firm's Energy Advisory Practice. In this role, Tim leads a specially-designed interdisciplinary division focused on assisting companies, developers, municipalities and real estate advisors with issues that pertain to energy procurement, renewable installation, infrastructure assessments utility relocation, with a special focus on mission critical facilities.

In his former role, Tim was Manager of the PSE&G's Area Development Department and President of the PSEG Area Development LLC and its two subsidiaries: PSEG SiteFinders LLC and PSEG Economic Development Services LLC. Tim was responsible for all aspects of PSE&G's economic development program, which included business attraction, expansion and retention. As President of PSEG Area Development LLC, he led strategic alliances with qualified economic development services providers. Under his leadership, PSE&G's economic development activities have been instrumental in bringing thousands of jobs and millions of dollars in investment into the State of New Jersey.

APPENDIX & RESOURCES



POWER REQUIREMENTS
ADDITIONAL LINKS/RESOURCES

Use Rack Unit — The Primary Planning Factor

Power per Rack Watts

- Server blade enclosure 50
- Patch panel power 25
- Wattage per server 43 x 10 servers per enclosure 430
- Total wattage per enclosure 505 x five enclosures per rack 2,525
- Add energy factor for HVAC power (60 percent) 1,515

Total Wattage per Rack 4,040

- **Total Space and Power Over Raised Floor (Base Case) — 200 Racks**
- **Space** 6,000 square feet (200 x 30 square feet)
- **Expansion space** 6,000 square feet (double the rack footprint for growth capacity during a 10-year period)
- **Total space** 12,000 square feet
- **Power** 808 Kw
- **Watts per SF** 67 watts (Use a design envelope of between 50 watts and 100 watts per square foot.)

Example Goal:

Maintain an *average* of 4 kilowatts per rack over the raised floor

Source: Gartner Research (April 2005)

By aggregating the total rack population, total kilowatts and space can both be calculated. In the example above, a simple rack configuration of 200 racks, each housing 10 servers, results in a total space requirement of 12,000 square feet and a total power requirement of 808 kilowatts or 67 watts per square foot, which is well within the 50 to 100 watts per square foot planning envelope. If the average power demand exceeds 4 kilowatts per rack, this suggests that rack configuration should be replanned, or that additional space should be factored into the layout to optimize overall cost efficiency.

Action Item: Use the rack unit as the principle planning factor for calculating overall space and power demands for the data center.

APPENDIX: ADDITIONAL LINKS & RESOURCES

- Data Center Knowledge
- Synapsense: Incentives offered by utility companies
- Viridity: Data center rebates
- Department of Energy
- Environmental Protection Agency
- Green Biz
- Gartner's Design Best Practices PDF
- Data Center Pulse Report
- http://searchdatacenter.techtarget.com/
- http://www.7x24exchange.org/
- http://www.afcom.com/
- http://www.thegreengrid.org/
- http://www.uptimeinstitute.org/
- http://datacenterjournal.com/
- http://www1.eere.energy.gov/femp/program/dc_resources.html

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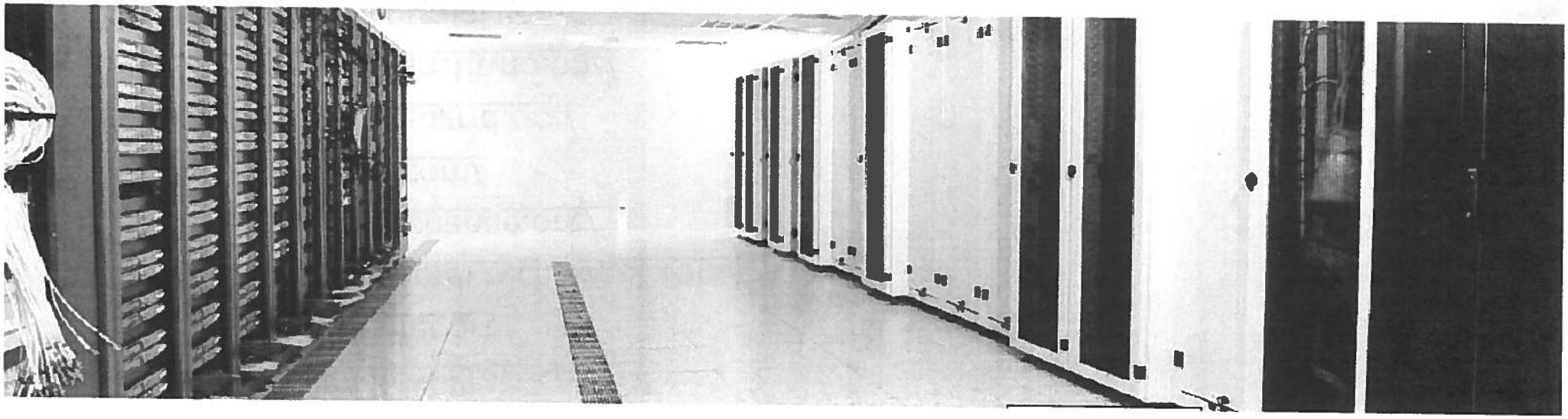

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UEDA WINTER FORUM
FEBRUARY 23, 2011

DatacenterDynamics

2011

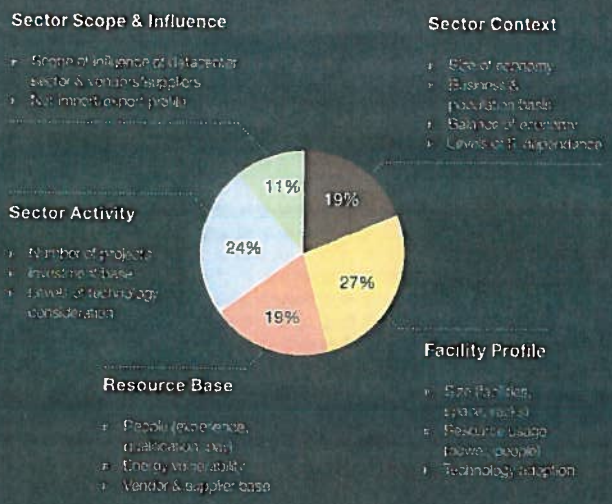
MARKET PROFILES

The census obtained information from individuals regarding the profile of their organization's data center infrastructure, including the number of data centers they operated of over 20 racks and the the total area of floorspace dedicated to ICT activities. This data enables us to profile each market, or to give it a 'shape' - you will see from the graphs that market shape tracks closely to the economic profile or activity of each market.

For each market we have written a short analysis, but deeper analysis can provide a treasure trove of market behaviors. To better interpret this data we have created the DCD Development Index (see below).

The Data Center Development Index [DCDi]

This index has been designed as an aid to interpreting the sample data – it is used in various parts of the reporting on the Census. The basis for the calculation is shown above. It should be noted that the weightings have been calculated based on factorial analysis of Census and relevant external data and the output is purely a relative measure between markets. There is no absolute value which a market needs to reach since, on the evidence of computing this scale since 2007, the sector worldwide will move and evolve, not just individual markets.



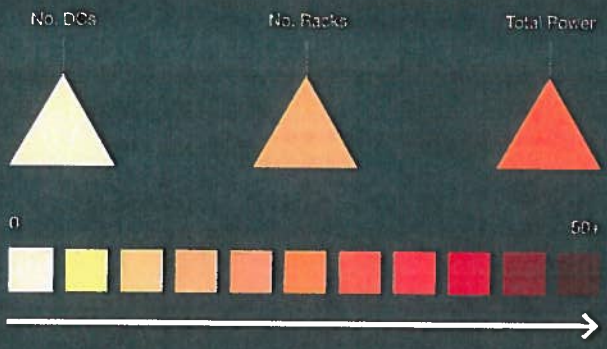
DI Segment	Score	Description/Focus
A1	50+	Global
A2	30-50	Developed Regional
A3	20-30	Developed Local
B1	20-30	Developing Major
B2	10-20	Developing Intermediate
B3	Under 10	Developing Minor

To help interpret the profiles

Sectors

- ICT
- Telecommunications
- Public Sector
- Education/Research
- Healthcare
- Professional Services
- Media & Broadcasting
- Construction
- Transport and logistics
- Industrial/manufacturing
- Energy & utilities
- Banking & finance
- Retail & personal services
- Internet
- Travel & Hospitality
- Other

Rate growth



Where is their primary data center housed?

Australia

Sample size: 163 end-user/operators

Estimated rack population of sample: 250,000

China

Sample size: 190 end-user/operators

Estimated rack population of sample: 400,000

South East Asia

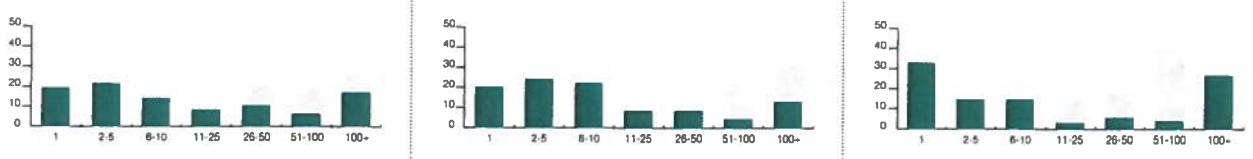
Sample size: 115 end-user/operators

Estimated rack population of sample: 200,000

Industry Sectors represented by sample

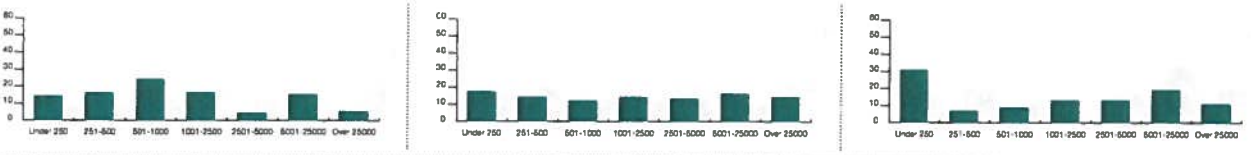
No. of data centers per organization

Grouped % total - (20 racks +)



Dedicated space per organization

Grouped % total - (white/raised floor m²)



Where is their primary data center housed?

Growth indicated by sample: next 12 months

DCDi 29.5

DCDi 21.5

DCDi 14.3

Reading between the lines

As more organisations look at Australia as a location for their regional IT operations so Australia's facility profile continues to grow. Strong levels of investment expenditure indicate a particular emphasis on ensuring existing facilities are fit for purpose. Australia's location and the importance of engineering to its wider economy means the highest average pay of any sample in the Census. Yet there are strong concerns in the market over the roll-out of the carbon tax and the impact on energy costs.

A fast moving and dynamic market on course to become one of the world's largest, a growth path only limited by concerns about the availability of energy and skilled staff. In terms of investment, the market has some of the highest growth rates in the world. More than simply adding facilities China's emphasis is on getting the technology right first time so its adoption of relatively sophisticated FM, IT and outsourcing options is in line with the more established Western markets.

What distinguishes this market is the very high level of increase in investment expenditure - the highest proportionate increase of any market. This is due to the ICT growth within Singapore as a regional hub and the broader economic growth of the ASEAN economies. While the focus in Singapore will be bringing existing facilities to a state of meeting capacity needs, other ASEAN markets will focus on new build. The urgency is reflected in the market's strong concern about the availability of suitable real estate for data centers.

United Kingdom

Sample size: 397 end-user/operators

Estimated rack population of sample: 1m

France

Sample size: 228 end-user/operators

Estimated rack population of sample: 810,000

Spain

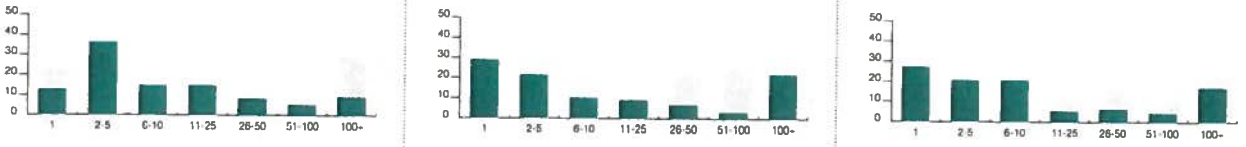
Sample size: 231 end-user/operators

Estimated rack population of sample: 690,000

Industry Sectors represented by sample

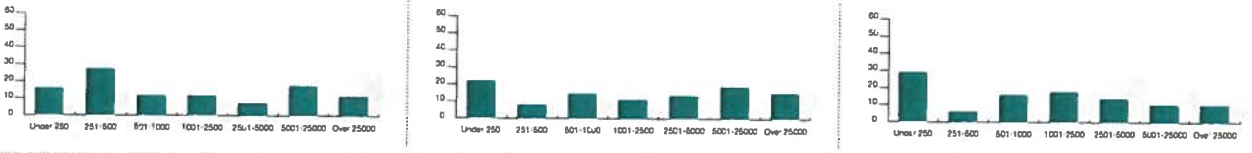
No. of data centers per organization

Grouped % total - (20 racks +)



Dedicated space per organization

Grouped % total - (white/raised floor m²)



Where is their primary data center housed?

Growth indicated by sample: next 12 months

DCDi	53.5	DCDi	42.0	DCDi	37.4

Reading between the lines

Is one of the five largest data center markets globally with a substantial facility base. Like other European markets growth of facilities and investment will be restrained but the large facility base means this represents considerable investment activity. The UK has been marked historically by a resistance to outsourcing and this carries through into the findings of the Census. Concerns for energy costs are high and hopes that vendors will continue to develop energy efficient technologies equally so. The shadow of the impending tax of energy use adds to this uncertainty.

One of the largest European markets with a sizeable facility base to match. Perhaps surprisingly for a country that is less energy-vulnerable than its neighbours, there are high levels of concern about current and future costs of energy. As France has a lower power density per rack than many other developed markets this represents the challenge of balancing increasing IT needs against energy costs. There is a strong interest in IT-based solutions such as the cloud (in its various manifestations) and virtualisation as a way ahead.

Spain's jagged route towards data center growth continues. A facility profile appropriate to a European Tier 1 market will grow only slowly in the near future. The market has high expectations of the development of public and private cloud and of energy efficient and cooling technologies. While sluggish immediate growth may be all that is needed to cater for the IT needs of the broader economy, limited availability of capital and reduced operating budgets will cause concern that this can be achieved.

Nordics

Sample size: 87 end-user/operators

Estimated rack population of sample: 95,000

Russia

Sample size: 232 end-user/operators

Estimated rack population of sample: 140,000

Turkey

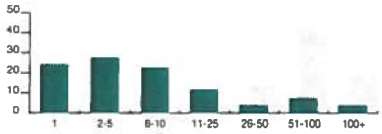
Sample size: 120 end-user/operators

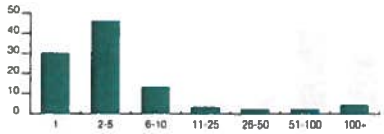
Estimated rack population of sample: 36,000

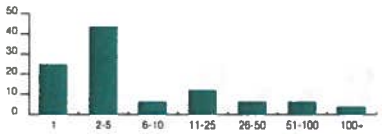
Industry Sectors represented by sample

No. of data centers per organization

Grouped % total - (20 racks +)

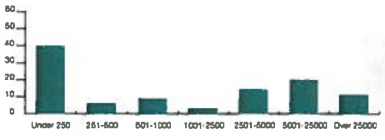


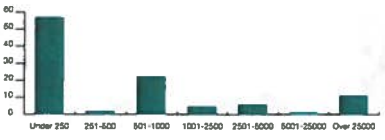


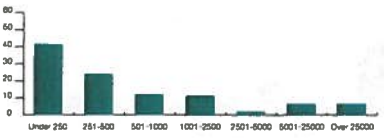


Dedicated space per organization

Grouped % total - (white/raised floor m²)







Where is their primary data center housed?

Growth indicated by sample: next 12 months

DCDi 22.4

DCDi 11.1

DCDi 6.4

Reading between the lines

The smallest of the developed European markets, the facility profile includes few large facilities and a mix of local and global/international operators both with small portfolios in the region. The region shows very strong growth from an already sophisticated level of data center operation and will focus on upgraded monitoring of facilities to meet concerns about energy costs. While the region is developing a reputation for renewable energy sources on the evidence of the Census this is some way away for most of its operators.

One of the most highly educated data center markets in the world. High levels of post-grad qualification are not however rewarded in wage terms. The large number of organisations with small portfolios and doubts about options available locally mean the lowest level of outsourcing of any Census market. Despite being an energy rich country, operators are concerned about the availability of energy to their data centers as most have experienced problems with the electricity grid. The market is experiencing high growth and this will put pressure on the availability of skilled staff.

The smallest market included in the Census and very much a developing market based on local operators with small and low density portfolios. Turkey indicates some of the strongest growth rates in the world in terms of both proposed facilities and investment dollars. To be achieved this will require the meeting of a multitude of challenges – costs, energy shortage, the lack of suitable Real Estate and of skilled staff. The strong interest in any outsourcing options that are going suggests that this will be a key to Turkey's short term development.

Italy

Sample size: 238 end-user/operators

Estimated rack population of sample: 380,000

Argentina

Sample size: 148 end-user/operators

Estimated rack population of sample: 70,000

Brazil

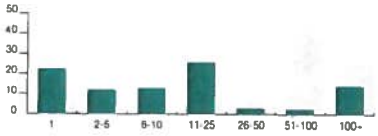
Sample size: 106 end-user/operators

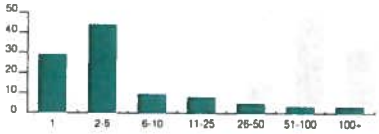
Estimated rack population of sample: 105,000

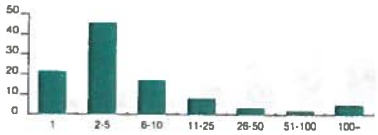
Industry Sectors represented by sample

No. of data centers per organization

Grouped % total - (20 racks +)

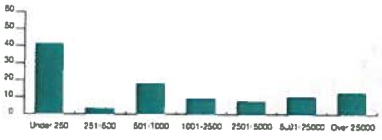


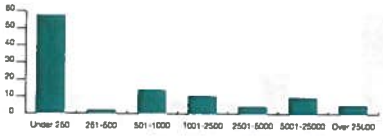


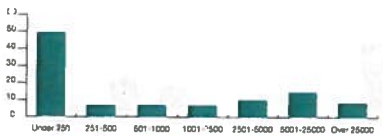


Dedicated space per organization

Grouped % total - (white/raised floor m²)







Where is their primary data center housed?

Growth indicated by sample: next 12 months

DCDi 23.8

DCDi 7.5

DCDi 20.7

Reading between the lines

As the largest of Europe's secondary markets, Italy has a substantial facility profile. It is however of low power density and, for a European market, very strongly dependent upon ICT and telecommunications. Strong growth in investment expenditure is projected, mainly on upgrading existing facility stock. There is concern about reducing operating budgets therefore it is unclear where the money for upgrade is coming from.

In common with Colombia and Mexico, a secondary Latin American market comprised mostly of local or national operations and sharing a very strong projected growth in terms of investment and facility development. The DC market is recently established and appears keen to implement good facility management through monitoring and cooling. The small size of most portfolios explains only a limited interest in outsourcing. The market is based substantially on ICT, telecoms and finance. Strong growth will put pressure on key resources - staff, energy and the money required to meet market IT needs.

Brazil is one of the two mega-developing markets. Like China, Brazil already has a facility base to rival all but a few European markets but the majority of these facilities are of low power density and located in office buildings. The extent of growth in Brazil – as high as 50% in terms of facilities and investment – places emphasis on new build as well as the upgrading of existing facilities. Like China, Brazil indicates strong interest in advanced technologies such as cloud and virtualisation of balancing growth as a means of overcoming resources ceilings (energy, skills and money).

Colombia

Sample size: 94 end-user/operators

Estimated rack population of sample: 50,000

Mexico

Sample size: 148 end-user/operators

Estimated rack population of sample: 160,000

Middle East & North Africa

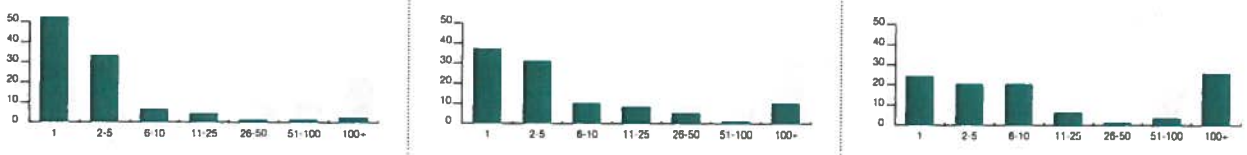
Sample size: 135 end-user/operators

Estimated rack population of sample: 132,500

Industry Sectors represented by sample

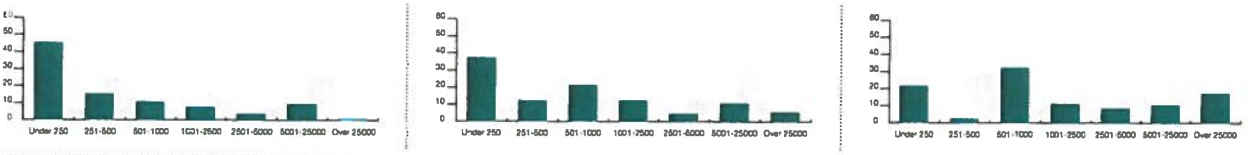
No. of data centers per organization

Grouped % total - (20 racks +)



Dedicated space per organization

Grouped % total - (white/raised floor m²)



Where is their primary data center housed?

Growth indicated by sample: next 12 months

DCDi 5.7

DCDi 11.3

DCDi 12.1

Reading between the lines

The smallest of the Latin American market covered and a classic emerging market with a small facility base almost always located in existing commercial premises, low power densities and strong growth prospects. The key concern of operators of meeting future IT requirements will be met by significant upgrades particularly to rack densities. Thus there will be significant investment in IT support systems. The focus on end-user facilities is emphasised by low levels of interest in outsourcing options outside the small number of global organisations.

Mexico occupies a strange place in the data center landscape with pronounced characteristics of both a developed and a developing market. The workforce profile is both experienced and educated. The facility profile is the largest in Latin America outside Brazil but growth is moderate in comparison to other regional markets and limited by concerns to energy availability and cost and the capability of many existing facilities to meet increased IT needs. The reason for Mexico's unusual position can perhaps be seen by the limited profile of local market vendors suggesting a strong influence from the US market to the north.

The emerging profile of this market means locally-focussed organisations with a low rack densities and small portfolios. Its workforce is highly qualified but inexperienced. Given patchwork economic growth in these markets there is variable growth. As a developing market, operators are particularly keen to implement best DC practice, particularly in DCIM and to correct low levels of monitoring. Market growth leads to a concern among operators that they will not be able to find suitably skilled staff.

US: Eastern Seaboard

Sample size: 124 end-user/operators

Estimated rack population of sample: 340,000

US: West Coast

Sample size: 247 end-user/operators

Estimated rack population of sample: 770,000

US: Central

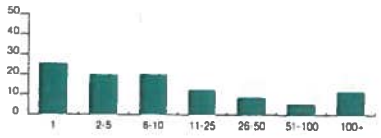
Sample size: 148 end-user/operators

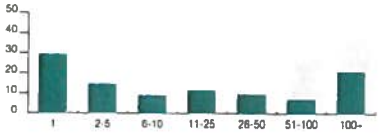
Estimated rack population of sample: 700,000

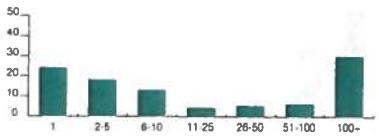
Industry Sectors represented by sample

No. of data centers per organization

Grouped % total - (20 racks +)

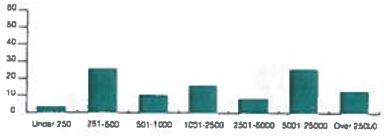


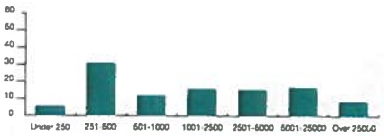


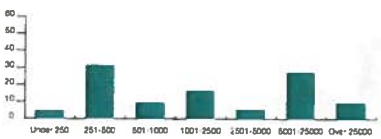


Dedicated space per organization

Grouped % total - (white/raised floor m²)







Where is their primary data center housed?

Growth indicated by sample: next 12 months

DCDi 56.4

DCDi 64.6

DCDi 41.4

Reading between the lines

A major and global market whose data center profile is spread evenly across all industry sectors and based around the financial center of the New York area, the Government sector in Washington DC and the growth regions of New Jersey, North Carolina, Atlanta and Philadelphia. Growth here slowed during 2007 to 2009 and now the region indicates a sense of making up for lost time. Significant concerns related to costs remain and because of this there is a high level of anticipation for vendors to produce more energy efficient technologies.

California is the dominant market although the strongest growth is indicated in the Pacific North West. The market has a considerable facility profile, global reach and a high level of sophistication in facility operation. Operators are now beginning to invest post-recession in order to get existing facilities up to the best current standards. Significant concerns about budgets and capital costs remain and the cost of energy is of high concern in California. The cloud and virtualisation are the key areas of interest for these operators going forward.

The regions of the United States between the Appalachians and the Rockies include major metropolitan markets, some of the US's fastest growing regions and States which have actively cultivated inward data center investment. These account for the very high growth profile of the region and the high levels of technology adoption as the region looks to upgrade existing facilities.

DatacenterDynamics

The Objective

The 2011 Data Center Industry Census was designed to be the largest ever comparative study of data center operators and end-users, in order to:

1. Provide statistically valid snapshots of scope and direction of the global data center industry as of July 2011.
2. Collect information from all sides of the industry (owners, operators, suppliers, vendors) and make that information available back to the industry.
3. Enable comparison between markets to track individual market development.
4. Create opportunity for the industry to come together and help raise money for a worthy global cause — the UNICEF Children's Emergency fund.

The Set-up

The questions asked were developed after extensive consultation, and referencing 15,000+ questionnaires obtained from DatacenterDynamics events over the last five years.

The online survey was made available in English, French, German, Italian, Russian, Chinese and Spanish.

Separate questions were asked of data center owners and operators and of vendors/suppliers into data center markets.

The survey was conducted over June and July 2011.

The Response

We achieved 5,400 interviews in total, 3,800 from data center owners and operators and 1,600 from suppliers/vendors.

Interviews came from more than 70 countries with sufficient numbers for statistical analysis from 22 key markets and groups of markets.

The sample includes a high level of representation of all major types and sizes of private and public organisation, of different facility profiles and of different respondent typologies (IT, FM, experienced/less experienced etc...).

The Result

The Census enables us to:

1. Profile individual markets and sectors and to compare them against each other.
2. Describe key trends in the evolution of data center markets and the reasons behind those trends.
3. Find out how individuals from different backgrounds and jobs perceive new technologies.
4. Provide answers to a myriad of questions on the nature of this rapidly growing industry sector.

Big Data Blitz

Openness to the climate and to new ways of thinking are among key data center location drivers.

by ADAM BRUNS
adam.bruns@siteselection.com

The unique climates and business climates of western North Carolina, central Oregon and Washington, Northern Virginia and Iceland are providing the most bang for the buck for major data center projects, which are being announced at an unprecedented pace. Where companies and their data services providers go next hinges on such factors as disaster risk; latency; broadband infrastructure; cost and availability of power; and the increasingly relevant size of carbon footprints.

At the Advania Thor Data Center outside Reykjavik, Iceland, power from both hydroelectric dams and geothermal plants has kept the facility's carbon footprint at zero, while also staying affordable — Iceland's average cost of electricity is approximately 20 percent less than the average across the 27-country European Union.

Speaking of zero, "natural free cooling, amply provided by Kári (an Icelandic nickname for the wind), is used to control temperatures inside the data center, and helps to keep costs down," says the company's website. "The average temperature at the data center location is 1.8°C in January and 10°C in July."

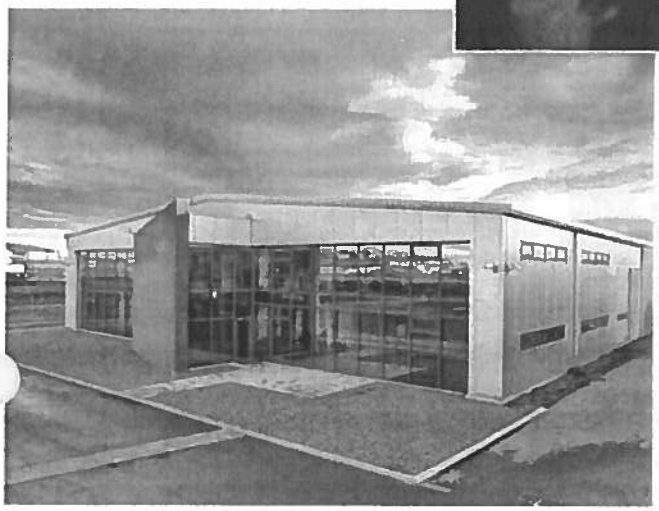
Moreover, the location midway between Europe and the United States means minimized bandwidth usage and network latency: Iceland is connected to the world by three sub-sea cables that function together as a single system linking the nation to Scotland, Norway and Nova Scotia, Canada. "The utilization on these cables is low and the bandwith is plentiful," says the company.

Those conditions are why Cushman & Wakefield and consultancy hurleypalmerflatt's Data Centre Risk Index 2012 report, released in April, added the Nordic nations of Norway, Finland and Iceland (along with seven others) to the previous index's total of 20 nations. They also added to the index the factors of energy security and education. (See the rankings, as well as scores by variable, on p. 36).

The rise of the Nordics comes as Google has located in Finland and Facebook in Sweden. Iceland ranks highest among the Nordics. Switzerland ranks 10th primarily due to low risk factors, low inflation and low corporate taxation. Such factors explain why ABB and ICT service provider Green on May 30 announced the opening of Green's new Zurich-West data center expansion based on direct current (DC) technology. Green's facility, which employs HVDC-capable HP servers, is the most powerful application of DC in a data center to date.

"Performance tests showed that Green's new power distribution system is 10 percent more efficient than for comparable alternating current (AC) technology," said a news release. "In addition, investment costs for the system were 15 percent lower than for an AC system," and DC systems, it says, require as much as 25 percent less space, and reduce equipment, installation, real estate and maintenance costs.

Those percentages can come in handy when nearly 6 million servers are coming online annually and data center energy demand is increasing by more than 10 percent a year.



Photos courtesy

The Advania Thor Data Center in Hafnarfjordur, Iceland, is a 28,000-sq.-ft. facility located 10 minutes from Reykjavik, Iceland. The LEED-Gold facility is one of the most energy-efficient data centers in the world, in part because of its entirely renewable energy draw from nearby hydropower dams and the Svartsengi geothermal plant, which produces the steam in the photo above.

Cool Only Goes So Far

Speaking by phone from his London office, Keith Inglis, partner in the EMEA Data Centre Advisory Group at Cushman & Wakefield, says the Nordics have become increasingly attractive by the simple virtue of their cooler air and improved energy efficiency, which supports sustainability objectives while also boosting their brand images as lovers of the planet. "In a

Data Centre Risk Index 2012

			TIER 1			TIER 2								TIER 3		
RANK	INDEX SCORE 1st = 100	COUNTRY	ENERGY COST	INT'L BAND-WIOTH	EASE OF DOING BUSINESS	CORPOR-ATION TAX	COST OF LABOR	POLITICAL STABILITY	SUSTAIN-ABILITY	NATURAL DISASTER	EDU-CATION	ENERGY SECURITY	GDP PER CAPITA	INFLATION	WATER AVAIL-ABILITY
1	100	USA	8	1	3	29	19	20	20	29	1	17	11	15	11
2	91	UK	18	2	5	17	18	15	26	12	13	23	15	22	21
3	83	GERMANY	16	3	15	24	24	8	15	9	16	20	13	5	24
4	81	ICELAND	7	27	7	8	14	20	1	18	7	8	16	24	1
5	80	CANADA	6	11	10	19	23	2	10	23	2	1	9	11	2
6	80	QATAR	1	29	21	2	14	12	30	2	19	7	1	6	30
7	80	HONG KONG	23	4	2	4	8	10	28	16	23	29	17	26	22
8	79	SWEDEN	15	7	11	18	27	3	4	3	9	15	5	4	9
9	78	FINLAND	10	19	9	11	25	3	7	1	15	30	10	12	8
10	75	SWITZERLAND	11	13	17	1	29	5	9	13	18	11	3	1	13
11	75	FRANCE	12	5	18	27	21	20	17	10	20	18	14	13	18
12	75	NORWAY	19	19	4	19	30	1	3	15	12	6	2	3	3
13	74	SOUTH KOREA	5	22	6	11	13	19	12	20	8	26	19	21	19
14	73	NETHERLANDS	14	6	19	13	26	10	23	5	10	16	8	9	15
15	70	THAILAND	4	26	13	10	2	29	8	22	22	14	28	17	14
16	65	IRELAND	26	24	8	3	22	15	24	14	6	21	6	10	10
17	64	SINGAPORE	28	17	1	5	11	17	29	4	17	22	7	25	29
18	63	SOUTH AFRICA	3	30	20	26	14	29	13	8	30	10	26	28	28
19	62	MALAYSIA	13	25	14	13	7	26	22	19	26	3	25	14	7
20	60	JAPAN	27	10	16	30	20	8	25	30	3	27	12	2	17

The rankings above from Cushman & Wakefield and hurleypalmerflatt rate countries' risk profile according to three prioritized tiers of criteria.

sense, cooling and the climate is the driver for certain players," he says. In fact, three of the 10 new countries introduced this year make the report's top 10.

But Inglis is quick to point out that no matter how much sustainability rises in weighted importance, "the bottom line is occupiers are going to be driven by commercial need first and foremost. Some countries say, 'Why are we so low?' I turn around and say commercial drivers are going to dictate where the client is going to go. If customers are in Qatar, they need to be accepting of the fact that Qatar does not score well on, for example, bandwidth, and clearly is going to score low on sustainability, since nearly all power is generated by the oil industry."

Inglis buttresses his argument with an observation he gleaned from a recent data center conference, where he learned that while some 85 percent of companies have a sustainability program, less than half those companies are applying its principles to data center deployment.

"It's a potential PR disaster," he says. "Data centers need to draw from sustainable sources ... they account for between 1.5 percent and 2 percent of emissions." People are increasingly concerned about it, but again, he says, "it doesn't stop them from going to where the infrastructure exists to support the data centers in the first place. It's a difficult balance to capture."

In the Asia Pacific, Inglis points to South Korea as one to keep an eye on, because "it has a government that's investing in a knowledge economy." Asked about Australia's relatively low ranking, given its high-profile digital economy strategy and national broadband rollout, he says the rollout is encouraging, and more data centers are indeed popping up, especially in Sydney. By comparison, he says there's also a broadband rollout afoot in China: "500 million people connect in five years is their plan," he says.

The new Tulip Telecom data center in India is designed to international green building standards and engineered with power, chillers, cooling, rack layout and uninterrupted power supply systems. "A data center that can last decades when information technology is changing every two to three years is critical for Tulip to support its growing business," said Steven Sams, vice president, Global Site and Facilities Services, IBM. Image courtesy of IBM

Commercial Needs Prevail

Asked if he sees evidence of data centers as economic development harbingers for other projects such as shared service centers and IT and software R&D centers, Inglis says, "If anything, it's the other way around. Data centers tend to grow around where the skill sets are already."

Ultimately, says Inglis, a data center goes into a country for commercial purposes first and foremost. "A lot of people get bound up because of too many risks in India, for example, but India can still be nirvana."

That may be the case for Tulip Telecom and IBM, which in February committed to building India's largest data center in Bangalore to serve the country's growing mobile consumer market. Covering more than 900,000 sq. ft. (83,610 sq. m.), and 20 Enterprise Modular Data Centers in

a four tower building, the facility is engineered to support up to 100 megawatts of power, making it the third largest data center in the world. IBM has designed and delivered more than 1,000 modular data centers for customers around the globe, and says it's helped customers save up to 30 percent in energy costs per year compared to traditional data centers.

Asked about the importance of latency, Inglis says it's most relevant to financial markets, but that 75 percent of the overall data center market is serving the opposite of lightning-fast speed: data storage, for content as trivial as all those digital photos from the holidays or as crucial as the data insurers require to be kept for a number of years.

"Those can go anywhere," he says of the data storage facilities. "That's why Facebook is going to Sweden. The latency argument goes out the window." That said, one interesting development is the bracketing of synchronous replication operations with asynchronous in one big data center. "As soon as they do that, it needs to sit very close to the big Internet exchange points such as London or Amsterdam," he says. "Our data center in London is 20 miles away. I want my emails coming up in milliseconds."

Top States for Data Centers

Jan. 2010 – March 2012

Texas	20
Virginia	17
North Carolina	11
Ohio	10
Georgia	8
Illinois	6
Pennsylvania	6
Arizona	6
California	5
Minnesota	5

Top U.S. Metros for Data Centers

Jan. 2010 – March 2012

Washington, D.C.	10
Atlanta	7
Chicago	6
Dallas-Ft. Worth	6
Phoenix	6
Austin-Round Rock	5
Columbus, Ohio	5
Houston	4
San Antonio	4
Allentown, Pa.	3
Philadelphia, Pa.	3
Prineville, Ore. (micropolitan)	3
Richmond, Va.	3
Shelby-Kings Mountain, N.C. (micropolitan)	3

Source: Conway Data New Plant Database

Unprecedented Activity

Six years ago, global data center firm Equinix operated 17 data centers. Today that number is 21 in the U.S. alone and 18 more abroad, with several projects announced around the world since the beginning of this year alone. No wonder the company showed 105 job openings on its jobs Web page on May 15.

They're just one of many trying to get their hands around the cloud, as big data, like an encroaching flood, threatens to outpace all efforts to contain it.

Gary Nagamori, a managing principal at HDR Architecture, says big data is pressing on existing infrastructure, as organizations struggle all at once with collecting it and putting it to use in research.

"Before they can even get to the cloud, most levels of IT I think are really strug-

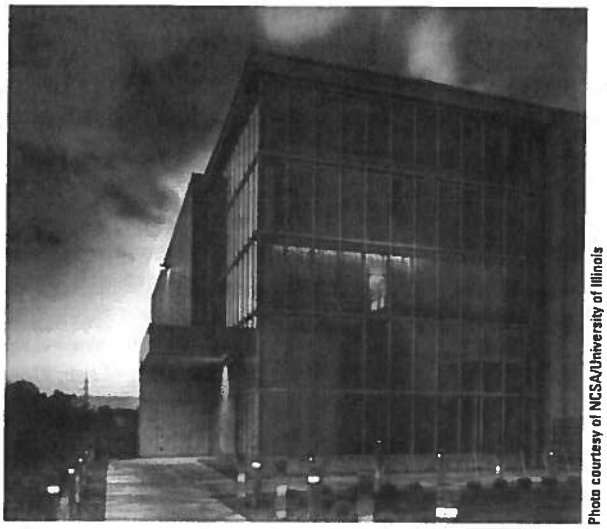


Photo courtesy of NCSA/University of Illinois

The National Center for Supercomputing Applications (NCSA), located at the University of Illinois at Urbana-Champaign, announced in May it is adding 380 petabytes of automated, near-line storage capacity for data produced by scientists and engineers using the sustained petascale Blue Waters supercomputer and to support other projects. By the end of year one of operation for the Blue Waters supercomputer, NCSA projects that the system will hold 50 petabytes of science and engineering data — more than any other U.S. research institution.

gling to provide for this explosion in data," he says. "IT's stressing out most IT networks, taking them to a point of unreliability. Ask the average CIO, and they're quietly grappling with that now. There's a need to really think about what a data center has to do, and therefore where it should be located. It's no longer an issue of backup, it's about using that data."

Chasing all that data means a lot of territories are chasing data centers as a crucial cog in regional economic development. A check of legislative calendars around the U.S. will turn up a number of new measures such as the Alabama Data Processing Center Economic Incentive Act of 2012 and several statutory updates in Nebraska passed earlier this year.

A run through the major global real estate and AEC service providers ranging from CBRE and Jones Lang LaSalle to Structure Tone, IDI, Integrated Design Group and Russo Development will turn up a server's worth of data about new data center and mission-critical real estate practices within their folds.

And utilities are doing all they can to appease the demand for their power while marketing at the same time: Witness Exelon's June rollout of a new energy efficiency program for data centers in its Chicago territory, and the joint work by TVA and Deloitte to identify 12 sites in TVA territory (Bristol, Tenn., most recently) that are best suited for data center location.

Some go so far as to attribute the need for new power generation plants to the demand for power from the data economy. According to a recent press release from the Nuclear Energy Institute's annual conference in North Carolina celebrating the thousands of jobs being created by new nuclear plants in Georgia and in South Carolina, Mark Mills, founder of Digital Power Group, said approximately $1.2 trillion of U.S. gross domestic product is associated with creating and transporting information, while only $500 billion is associated with transporting people or things.

Meanwhile, concurrent with the news that its innovative fuel cells would power Apple's mega-data center in Maiden, N.C., California-based Bloom Energy in March announced the formation of its own Mission Critical Practice.

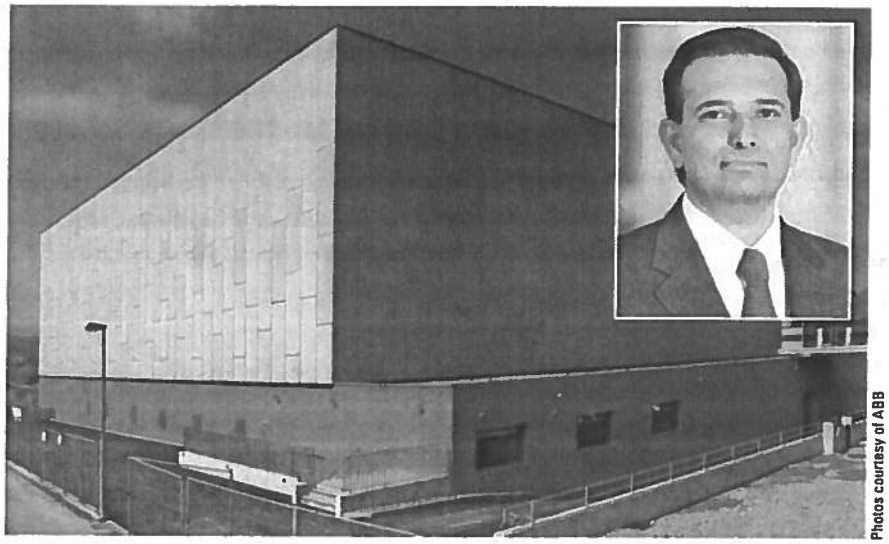
Hosted data center companies and REITs, as well as stand-alone projects, can't move forward fast enough, whether

it's the incipient Steel Orca project coming together on former U.S. Steel property in Pennsylvania or the June announcement from CenturyLink firm Savvis that it would be opening or expanding centers at seven locations this year in Singapore, London (2), Santa Clara, Calif.; Washington, D.C.; Dallas; and Weehawken, N.J., bringing its total data center footprint to more than 2 million sq. ft. (185,800 sq. m.) in 50 facilities. The company also recently located a new German headquarters in Frankfurt.

The growing Equinix portfolio includes new projects, acquisitions or expansions in Zurich and Geneva, Switzerland; Sydney, Australia; Hong Kong; Shanghai; Singapore; Tokyo; Paris; Seattle; Washington, D.C.; and Dulles, Va.; and Boca Raton, Fla., which it plans to use as a jumping-off point to serve Latin America and Brazil's World Cup and 2016 Olympics needs in particular.

Capital Crunch

A recent study of North America by data center REIT Digital Realty Trust (DRT) found that 92 percent of senior decision-makers on data center strategies at large corporations will definitely or most likely expand in 2012. The figure is 76 percent among decision-makers in the Asia Pacific.



Photos courtesy of ABB

Tarak Mehta (inset), head of ABB's Low Voltage Products division, says Green's new data center in Zurich, Switzerland, will serve as a global showcase to demonstrate that direct current (instead of alternating current) "enhances reliability while minimizing footprint, installation and maintenance costs."

It's no surprise to REIT watchers that DRT in May announced its fourth facility at its Northern Virginia campus in Ashburn, in Loudoun County, in the middle of what is probably the most data-dense corridor in North America and one of the densest in the world. Recent projects have also come to Ashburn from Equinix, RagingWire, Sabey and DuPont Fabros.

As the project tallies presented here illustrate, Northern Virginia and Greater D.C. are truly the leaders in data center attraction and expansion. A 2007 presentation from Dominion Chairman, President and CEO Thomas Farrell noted that PJM had predicted overall demand in Dominion's service area would go up by 1,800 MW in the next five years. Five years later, his May 8, 2012 presentation noted that data center demand alone is projected to grow by 1,200 MW, and overall demand by 4,000 MW in the next decade.

Kent Hill, senior manager of economic development for Dominion Virginia Power, says the 24-hour load characteristics for data centers are similar to those of a large manufacturer, but such centers happen to be in locations where you wouldn't find manufacturing, such as Ashburn in Loudoun County, Va.

But while the dense fiber and dense facility footprint is there, data centers also are going elsewhere in Virginia, such as Microsoft's location in the south-central part of the state, and QTS's purchase of the former Qimonda and Infineon semiconductor manufacturing facility in Richmond.

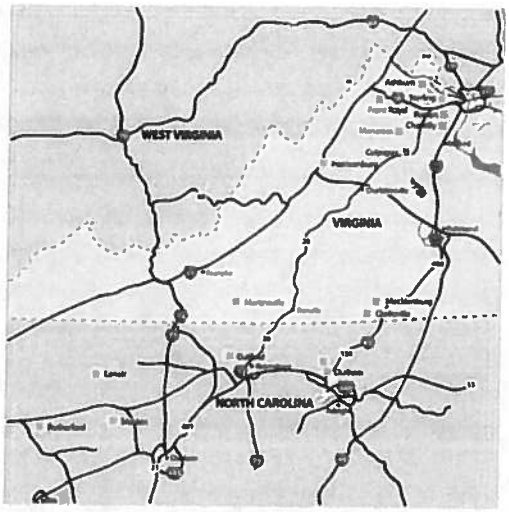
Asked about the importance of broadband infrastructure for cultivating a data center cluster, Hill calls it "absolutely critical," noting the funding of such infrastructure by tobacco commission money in southside Virginia. "The Microsoft location would probably not have oc-

curred without that infrastructure being in place," he says, and other prospects are looking there for the same reason. A similar dynamic is at work in Ulster, N.Y., where Time Warner Cable Business Class and TechCity Properties recently announced the completion of an advanced communications fiber network to the 258-acre (104-hectare), 2.2-million-sq.-ft. (204,380-sq.-m.) TechCity complex near Kingston, N.Y.

Asked about Northern Virginia's unique mix of government and private sector data centers, he admits there are likely some government centers that operate behind a meter served by Dominion, but aren't necessarily sharing what they're doing there. At the same time, "there is a fairly large federal data center consolidation process under way. We're looking at how it will impact our region, and making sure we have sites and buildings that can accommodate that. We are also seeing some government facilities in colocation centers," some of which are factoring government security standards into their designs and site selections. "That's what's nice about the Northern Virginia market — you have several options."

Hill says since cost of power might represent between 20 percent and 50 percent of total operating costs at a data center, that's still a big factor. But sustainability is getting bigger as the data gets bigger.

"All things being equal, if the price is the same, and reliability is similar, site selectors are going to pick the site with the lowest carbon footprint. That's the message we're getting," he says. "Our generation mix puts us into the lowest third of utilities in terms of carbon intensity. But our approach is balanced between traditional sources and an increasing mix of renewables as they make sense from a cost-effectiveness standpoint." He anticipates Dominion being ahead of the state's renewable energy goal of 15 percent by 2025.



This map produced late last year by Grubb & Ellis offers a taste of the feverish data center activity in Northern Virginia and Greater Washington, D.C., as well as North Carolina.

The more pressing timeline, he says, often is the one a data center project requires, with a large block of power attached.

"It's caused us to change our whole planning model," he says, with what would normally be a five-year timeline compressing to coming online in 12 to 18 months. "It's changed how we plan and locate our substations," he says. "Particularly now that the concept of modular data centers is out there, basically a mini data center can be brought in on a flat bed, connected to a power spine and you're up and running. How quickly you can deliver a site and deliver the power are bigger issues particularly for some of the colocation companies, who may land a big contract in the course of a month or two."

Count Virginia among those jurisdic-

tions with freshly minted data center incentives too, says Hill, which primarily expands job number thresholds to garner tax exemptions. He says it was an issue for some colocation companies who were not getting credit for their tenants creating jobs.

"So that was amended to include tenants for that property so they get credit," he says. "It's a big issue for these customers. It's very capital intensive and, depending on the company, they're replacing servers and equipment every two to four years, so a sales tax exemption is pretty significant."

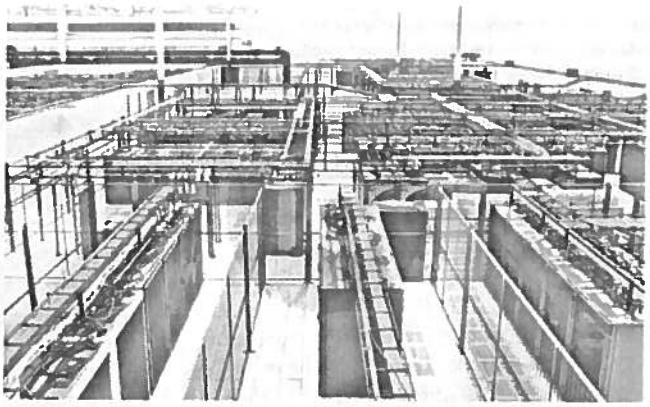
Hill says the communities his department works with are all interested in attracting data center business precisely because of the improvements such facilities bring to the tax base. "We're finding that even though the job count is not typically as high as you'd see in manufacturing, the tax benefits are substantial," he says.

Similar dynamics are at work not far to the south in Kings Mountain, N.C., which has attracted data centers in the past two years from AT&T, Wipro InfoCrossing and Walt Disney Worldwide Services. As in Virginia, the cost of power is a big lever. So was the 2009 decision by Atlanta-based T5 Partners to develop the 260 acres (105 hectares) of Potts Creek Industrial Park, and bring the park into the city's jurisdiction, where municipal incentives apply.

Wipro was the first to take advantage, choosing to locate in a former CrisCraft building. Disney's project (with another phase planned) should be complete this year. And AT&T's 500,000-sq.-ft. (46,450-sq. m.) first phase should be complete by 2014, bringing with it a $200-million investment and approximately 100 full-time jobs.

The facilities all will be served by Duke Power. But in Kings Mountain's case, in addition to the tax base, the city happens to operate the area's other utilities. The city should see a 12-percent increase in its utility revenue from the three data center projects alone.

"We're just glad they're here," says Kings Mountain Mayor Rick Murphrey of the data center projects, noting his area's fixed assets: significant water, sewer, gas and electric infrastructure left over from the textile era. He says the projects' name recognition has led to better name recognition for his city, which will still collect a franchise tax while foregoing the city tax and some permit fees. Meanwhile, fiberoptic infrastructure is being installed around all municipal buildings, and the already substantial water infrastructure is being expanded still further.



The cabling and layout of an ID modular data center offer a glimpse of a modular future for data and the companies that produce, store and use it.

Image courtesy of ID

> **"The end user doing site selection now has flexibility. If I'd like to put 1,000 square feet in Phoenix and haven't had the option, now I have it."**
>
> *— Chuck Smith, managing director, data center advisory services, CASE Commercial Real Estate Partners, on the advent of modular data centers*

Texas at the Top

It's no surprise that four Texas metros are among the Top 10 areas since Jan. 2010 in our tally of data centers, nor that that activity drove Texas to the No. 1 spot among states.

CASE Commercial Real Estate Partners (the exclusive developer for the Mark Cuban Companies) and Synergy Renewables (an affiliated company of T. Boone Pickens) are developing the first data centers in the U.S. to use 100-percent green power based upon clean waste-to-energy technology and Texas wind generation. The data centers will be at Wonderview, Cuban's development located not far from downtown Dallas.

The project was announced in October 2011. In April 2012, CASE announced it was launching data center advisory services in partnership with Amicus Partners. Leading the new service line are Jeff Crawford and Chuck Smith, managing directors, and Jim Mangus, senior director, who have combined over 50 years of operational data center experience. Smith's 15 years in the industry have allowed him to observe the flocking of facilities to high-tech test beds such as Silicon Valley, Austin and Seattle during the tech boom, followed by outsourcing by end users, usually following Internet bandwidth to DFW, Chicago and New Jersey.

"Picture it as an evolution," he says. "Chase the tech innovation, then chase the traditional Tier 1s. Then evolve into any major city that has big Internet backbones — Atlanta, Denver. Then you see the colocation companies pop up in those cities."

Thus, about five years ago, he says, companies started asking themselves the question, "If we don't consume 3 megawatts of power, why are we in the data center business?" Companies then began outsourcing to a proliferation of wholesale data center providers. Though the backbone of site selection hot spots remains, he says now we'll see companies, whether colocation firms or end users, moving into Tier 2 cities. The June announcement of a $15-million, 40,000-sq.-ft. (3,716-sq.-m.) colocation project from Involta in Tucson, Ariz., may serve as an example. Involta CEO Bruce Lehrman said the 600-cabinet facility would offer advantages to businesses in such areas as Phoenix and Southern California.

Smith says we'll also see the rise of modular data centers, a hot topic at a recent conference convened by Uptime Institute.

"Company X wants to spread a data center across three or four different geographic locations, different climates and time zones, but you still have to buy by the kilowatt or sq. ft., and you'll probably end up buying more than you need," explains Smith. "The thought process with modular is to accomplish exactly this — 3,212 square feet in this city, 18,000 square feet in that city. You can start doing that if you're modular. The Uptime guys said there are 36 avowed modular/container providers and manufacturers now. The end user doing site selection now has

In 1954, GE installed the UNIVAC computer in its first commercial installation at Appliance Park in Louisville. GE's new LEED-Platinum data center in Louisville houses cabinets of servers; just one cabinet is millions of times more powerful than the original UNIVAC. See the Oct. 2011 edition of the Site Selection Energy Report for a profile of the new Louisville facility.

Photo courtesy of GE

flexibility. If I'd like to put 1,000 square feet in Phoenix and haven't had the option, now I have it."

Smith says modular is showing up in places that already have robust power: Phoenix-based modular data center firm IO is putting in about 800,000 sq. ft. (74,320 sq. m.) in Phoenix and about the same in New Jersey, "huge shells where they park modules," he says, with the ability to have modules of different densities.

The benefit of the approach also accrues to the facility's PUE, or power usage efficiency, as each modular container has its own.

Smith says a client recently stated a desire for 500 kilowatts of Tier-3 data center, a typical demand. Conversation revealed the client, in a perfect world, wanted 30 percent Tier 3 and 70 percent Tier 2 but "that doesn't exist." But with modular, it can be done.

"It's on demand like virtualization is to servers," says Smith. 'I only want the data center I need' — you'll start to be able to do that, so theoretically it will drive down what the end user pays."

It will also introduce new drivers to the site selection process. For instance, Smith says, a Fortune 500 company wants to put the data center in Ohio because its headquarters is there.

"Well, there's no Digital Realty Trust or DuPont Fabros there, but a modular company can go there on behalf of that Fortune 500. Site selection used to be so clean, right? Now, if a Fortune 500 tells you, 'I'd prefer two megawatts of data center in Abilene, Texas, it can be done. And it may take utilities a bit out of the driver's seat.

"Take a state that's deregulated like Texas," he says. "You can move around a little more freely if you're deploying modular solutions versus a big campus data center."

In more general terms, says Smith, his team is seeing a future where there's less competing for data centers between states, and more competing among cities of various sizes. In Texas, Farmer's Branch is competing with Dallas. In California, Santa Clara has successfully gone toe to toe with San Jose.

Asked if such areas are seeing IT services, back-office and other spinoff from their data center activity, he diverges from Inglis of Cushman & Wakefield and says, "Without a doubt. It's probably one of those intangibles that doesn't get reported on enough," citing Santa Clara and Richardson, Texas, as examples. His team currently is consulting to a project linking high-performance computing projects between Canadian universities and the U.S. "They're even talking about allowing commercial data centers to be built on a university's land," he says.

In another case, Smith says, "We met with a city last week, and they said, 'Here's land and incentives.' I asked 'What do you think you're gaining?' They're aware it's not jobs. And if they're giving away tax revenue, they understand. They believe it's a big lure to attract traditional brick-and-mortar companies." SITE

Rare Distinction

Of the 4,770 buildings in the United States to earn Energy Star certification from the U.S. EPA in 2011, only eight were data centers. Three were in California: BAIS and CoreSite in Santa Clara, and RagingWire Enterprise Solutions in Sacramento. One data center each earned the designation in Minnesota (3M in Maplewood), Arizona (American Express in Phoenix), Illinois (HSBC in the Chicago-area city of Volo), Georgia (Travelers in Norcross) and Virginia (Manassas Technology Center).

EPA's Energy Star Portfolio Manager tool *(www.energystar.gov/portfoliomanager)* enables data centers to assess their energy performance relative to their peers using a 1 to 100 scoring system, as well as track changes in energy consumption over time.

IDC

IDC TECHNOLOGY SPOTLIGHT

The Next Phase of Datacenter Development

December 2009

Adapted from *Datacenter Network Customer Requirements* by Lucinda Borovick, IDC #217999

Sponsored by Cisco Systems

As organizations move their datacenters to meet increasing business challenges, they need to evolve their infrastructure in a way that positions IT to create a dynamic datacenter. Recent IDC research shows that the datacenter has been a key area for investments in new technologies (including virtualization for servers, storage, and networks), infrastructure-related investments needed to support consolidation efforts, and foundational investments to support automation. The key requirement for IT today is to gain greater utilization from the IT assets it has already deployed as well as position the datacenter for the future.

Innovation in the datacenter network is required to achieve these goals. In effect, organizations that strive to create a dynamic and agile datacenter can take steps to simplify their network architecture in order to transition to an energy-efficient, operationally efficient, secure, virtualized datacenter that can support the changing requirements of the business with agile services and applications.

This Technology Spotlight discusses the steps customers can follow as they evolve their datacenter network architecture, with virtualization at the core of this evolution. This paper also highlights the role that Cisco Systems' products can play in the virtualized and dynamic datacenter.

The New Datacenter

The datacenter is in the midst of unprecedented change and transformation. Changes in the compute infrastructure such as new dense computing platforms and expanding use cases of server virtualization are causing the network infrastructure to support higher-density configurations and virtual machine mobility.

In addition, the expanding use of content such as video and files that are typically accessed and stored on Ethernet networks is creating an unprecedented opportunity for Ethernet to support datacenter storage. The demand to reduce ongoing operational costs is highlighting both energy efficiency and product designs that reduce the burden of managing and operating devices for the IT staff.

Virtualization is at the core of datacenter transformation for the following reasons:

- The consolidation it enables delivers immediate returns on reducing ongoing operational costs and increasing the efficiency of the server architecture.
- It enhances business continuity by maintaining or improving the availability of workloads (applications and databases) running in the datacenter.
- It establishes the foundation of an automated dynamic IT environment.

IDC believes the push to the next wave of virtualization in support of an on-demand datacenter will require a richer set of network services. Datacenter managers and IT decision makers want visibility into the logical infrastructure across datacenter domains. In this next generation, IT will be able to migrate mission-critical virtual machines across the datacenter and across the globe. Mission-critical workloads will not migrate to a virtual architecture unless they have the same consistent network security, management, and policies available on virtual ports as they do on physical ports.

In the journey to a dynamic datacenter, organizations can simplify their infrastructure while taking a phased approach to building a dynamic datacenter.

The Benefits of the Dynamic Datacenter

Legacy datacenters face challenges around manageability, utilization, reliability, physical footprint, and energy efficiency. Ultimately, such challenges can combine to cause a degradation of service or higher costs, or both. As a result, IT organizations need to consider new technology approaches that change the traditional economics of the datacenter. To date, virtualization has been at the heart of this shift; however, IDC is increasingly seeing a requirement for purpose-built systems that lower the burden of integration for organizations across their server, storage, and networking resources. Such resources are required for the multiple workloads that IT shops typically run.

IDC envisions customers taking an iterative approach to a dynamic datacenter depending on their server infrastructure and their current use cases for server virtualization. Among current use cases are the following:

- Virtualization for disaster recovery and hardware maintenance: disaster recovery; planned downtime
- Virtualization for capacity planning: pooling of resources; balance workloads based on hardware requirements and application requirements
- Virtualization for application availability: alternative to clustering; unplanned downtime; operating system application awareness
- Virtualization for policy-based automation: service-oriented computing; IT in the cloud
- Virtualization for consolidation: reduce the incidence of server sprawl

The dynamic datacenter — which is characterized by flexibility and agility in order to respond to changing business requirements — needs a single low-latency network to realize the following capabilities:

- Manage workloads based on business priorities
- Provide virtual I/O, virtual network services
- Enable IT to leverage the cloud, which brings new workloads to the network

The Step-by-Step Approach to the Dynamic Datacenter

To enable the dynamic datacenter, organizations should ideally implement a phased approach that involves deploying virtualization technology initially to consolidate servers and gradually deploying virtualization throughout the datacenter infrastructure. Each phase of virtualization deployment should have operational goals and defined areas of ROI. The transition from a legacy datacenter to a dynamic datacenter is a challenging process that involves both technology and cultural transformation; having a well-defined road map as well as iterative and progressive milestones can help IT organizations successfully implement an infrastructure that will support the dynamic datacenter.

The four phases of datacenter transformation include the following:

- **Server consolidation.** This phase involves reducing TCO in the datacenter by consolidating multiple physical machines into virtual machines with higher utilization. There are significant cost benefits to consolidating physical machines with low utilization to multiple virtual machines running on fewer servers.
- **Scalable dynamic datacenter fabric.** This phase involves increasing the scalability, flexibility, and efficiency of the datacenter fabric by allowing any datacenter asset to access any other datacenter asset. This datacenter fabric will be based on 10 Gigabit Ethernet. The dynamic datacenter fabric will support sophisticated activities such as dynamic resource scheduling with virtual machines.
- **I/O consolidation.** This phase involves transitioning to a unified datacenter fabric to further reduce TCO by eliminating redundant components, including interfaces, cables, and switches. This I/O consolidation will support FCoE and iSCSI server access.
- **Unified computing.** This phase involves a fully virtualized datacenter with pools of computing, network, and storage resources. Enabling this datacenter are fully automated management and provisioning capabilities, resulting in improved cost efficiency and more responsive IT services.

Virtualization — when applied throughout the datacenter (servers, storage, and networking infrastructure) — offers many of the same benefits as server virtualization: consolidation; cost savings; green IT; and dynamic, agile computing that responds to changing business requirements. In addition, such a unified computing environment offers the following benefits, which have both cost and operational advantages:

- Modular, repeatable design
- Ability to reuse locally, regionally, and worldwide
- Scalable capacity planning
- Ability to reduce overprovisioning
- Ability to facilitate the just-in-time datacenter
- Predictable operations
- Higher levels of availability

Market Trends

Large-scale datacenters have reached an inflection point where the combination of their physical infrastructure and the use of large-scale virtual servers is creating the need for new approaches to IT. This creates an opening for new architectures as well as new suppliers and solutions to enter the datacenter.

The massive scale of the architecture arising in the datacenter is creating an opportunity for the datacenter network to evolve and have an important and unprecedented role to play in datacenter management.

The attention being paid to the datacenter will intensify over the next few years and may in fact drive customers to consider alternative models or investments that they may not have considered recently.

Organizations will increasingly be looking for a compute and network resource that is purpose built for virtualization. Specifically, dynamic datacenters will require a very high memory footprint that can support a highly dense virtual environment as well as accelerate the adoption for applications with high I/O requirements, which have typically been outside the realm of virtualization. An architecture that provides virtual I/O and facilitates workload mobility — which is core to the dynamic datacenter of the future — is where organizations will increasingly make their datacenter investments.

Datacenter managers are looking to build an architecture that is modular and offers a repeatable design that can be reused across the datacenter and multiple datacenters.

Product Profile

Cisco Systems is a San Jose, California–based provider of networking hardware and software products and is known for its core routing and switching technologies, as well as its advanced technologies such as application networking, unified communications, and virtualization.

The products in the Cisco portfolio are designed to meet the needs of the next-generation virtualized dynamic datacenter. The following capabilities are consistent across the portfolio:

- **High availability.** Operational continuity that is integral to the design goals to meet the needs of an environment in which system availability is assumed and maintenance windows are rare, if not totally obsolete
- **High performance.** A highly dense, cost-effective, scalable infrastructure that enables increased efficiency in datacenter energy and budget resources
- **Unified fabric.** Transport that can navigate the transition to 10 Gigabit Ethernet and unified fabric and can handle architectural changes such as virtualization, Web 2.0 applications, and cloud computing

The Cisco portfolio includes Cisco Nexus switches, which consist of the following:

- **NX-OS.** NX-OS is an operating system designed specifically for the datacenter and engineered for high availability, scalability, and flexibility.
- **VN-Link.** VN-Link provides virtual machine–aware network services.
- **XML management.**
- **Network interface virtualization (NIV).** NIV decouples I/O from compute. It enables I/O flexibility by creating greater numbers of I/O connections to a given server while limiting the number of required physical connections to the server.

The Nexus products fit into Cisco's Datacenter 3.0 strategy, which is built around the company's Unified Computing System (UCS), an integrated solution of compute, network, storage access, and virtualization resources. Cisco's UCS is initially targeted at the growing virtualization market and is designed to address the major challenges that customers are currently facing in very large datacenter environments by easing the increasing complexities of the future datacenter.

Challenges

Cisco does face market challenges, however. The company needs to educate customers on the benefits of a unified network architecture in the datacenter.

Additionally, because Cisco is the only provider on the market with a software switch that integrates directly with the server hypervisor to deliver VN-Link virtual machine–aware network services, Cisco needs to continue to educate customers about the TCO benefits of deploying its virtualization capabilities.

Conclusion

As IT organizations continue the journey to the virtualization-enabled dynamic datacenter, the importance of the network increases. The advent of blades and server virtualization is causing the network infrastructure to support higher-density configurations. Virtualization technology is reshaping networking products and the delivery of network services. In effect, the datacenter of the future — one that is characterized by an ability to be agile and quickly and reliably support the changing needs of the business in an efficient, cost-effective manner — will be marked by virtualization-enabled mobility. In such an environment, virtualization will be deployed throughout the entire IT infrastructure, including servers, storage, and networks.

IDC believes that a true unified fabric is on the horizon. The tidal wave of innovation that continues to accelerate around Ethernet will make this a reality. The capital savings around parts and the reduction in cabling, coupled with the operational savings from utility costs and associated cooling costs, are compelling. The need for more energy-efficient datacenter designs and equipment will make the unified fabric a reality and pave the way for automation in the datacenter. As organizations embark on designing datacenter strategies for the future, they will seek to implement network virtualization technologies that can enable agile and on-demand IT services. To the extent that Cisco can address the challenges outlined in this paper, IDC feels that the company has an opportunity to succeed in this market.

History of HP in Northern Colorado

Here is a weblink to the story of HP's relocation to Loveland, CO in 1960's (and copied below): http://www.hp9825.com/html/hp_loveland.html

With HP's move to Loveland initially and eventually opening a campus in Fort Collins, there were several large corporate spin-offs that I am aware of:

- **Agilent Technologies: (http://www.home.agilent.com/agilent/home.jspx?cc=US&lc=eng) - Advanced electronics measuring devices - They were housed on the old HP campus in Loveland until about 3 years ago when they closed the Loveland campus.**

- **Celestica: (http://www.celestica.com/Home/Home.aspx) - Circuit board manufacturer - They used to have a large campus right across the street from the IBM campus on Harmony Road in Fort Collins but they outsourced their operations to overseas approximately 7-8 years ago. It is now the home of Intel Corporation.**

- **Avago Technologies: (http://www.avagotech.com/pages/home/) - Semi-conductor chip makers - They are housed on the back side of the HP campus in Fort Collins**

- **AMD - Advanced Micro Devices: http://www.amd.com/us/Pages/AMDHomePage.aspx - power processors - they are located not far from the HP campus in Fort Collins.**

HP Loveland

For 20 years, from its founding in 1939 until 1960, HP centered its R&D and manufacturing operations in the San Francisco Bay area radiating out from Palo Alto, the company's home town. HP issued its first stock offering in 1957. At that point, the company started growing rapidly. In 1959, it expanded into international sales offices in Geneva, Switzerland and Böblingen, near Stuttgart in Germany (West Germany at the time).

It was during this period that the company also decided to open its first manufacturing plant outside of California. Packard was born in Pueblo, Colorado so that's where HP sent Stan Selby to look for a suitable plant site. His first stop was the area around Boulder, a beautiful community nestled into the foothills of the Rocky Mountains northwest of Denver. Boulder was home to both the University of Colorado at Boulder and the National Bureau of Standards (NBS,

later renamed the National Institute of Standards and Technology or NIST). HP was attracted to both of these organizations—the university as a source of new HP engineering recruits and NBS as a potential customer and development partner.

However, Paul Rice and Bob Hipps of Loveland, Colorado had other ideas. Rice was president of the Loveland First National Bank and Hipps was a local appliance dealer who would later become Loveland's mayor. Rice and Hipps had realized that Loveland, a sleepy agricultural and retirement community in northern Colorado, needed new industry to revitalize the town's economy. The two men had started the Loveland Development Fund to acquire land for an industrial site.

When Rice and Hipps learned that a representative from HP was scouting for a plant site nearby, their first move was to investigate HP. The company was hardly a household name in the late 1950s because it sold products almost exclusively to engineers and scientists. Local Colorado bankers and appliance dealers had no reason to have ever heard of the company. Reassured that HP was a reputable firm, the Loveland businessmen invited Selby up to see the town and he reciprocated by inviting Rice, Hipps, and a representative from the Colorado governor's office to Palo Alto so they could make the case for a Loveland plant site. Apparently, they were convincing because HP selected Loveland as the location for its first manufacturing plant outside of California.

Centralized R&D

During the 1950s, HP's centralized R&D labs in Palo Alto would develop products and then hand them over to manufacturing divisions for production. Back then, HP had four product groups (frequency & time, microwave, audio & video, and oscilloscopes). The R&D manager in each group reported to HP's VP of R&D, Barney Oliver.

HP's Loveland Division was established in 1960 while the company's R&D was centralized. Consequently, the new Loveland Division's charter was manufacturing when it opened in rented facilities. Initially, the Loveland Division manufactured voltmeters and power supplies that had been designed in California. It started manufacturing the HP 3440A digital voltmeter in 1963. By 1968, it had made more than 10,000 of this particular voltmeter model, which means that the HP 3440A was a very successful product for its day. Eventually, all of HP's audio-video instrument production moved to Loveland. In 1962, HP opened another site in Colorado Springs to manufacture HP's oscilloscopes.

Decentralizing R&D

With geographic dispersion, HP's centralized R&D structure started to unravel. It became much harder for the R&D engineers in Palo Alto to learn about manufacturing issues arising at a remote location and they could not easily benefit from the knowledge manufacturing engineers were developing when ironing out design problems and manufacturing-process bugs. As it grew from both internal organic growth and by acquisition, HP developed a more decentralized R&D structure. Each HP division became more independent of Palo Alto by starting and nurturing its own R&D lab.

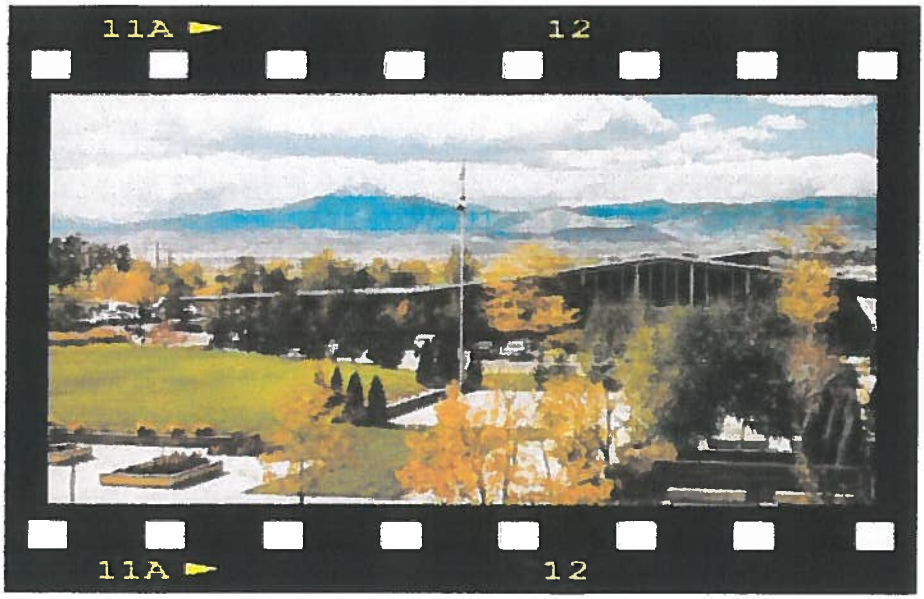
As an early step in the decentralization of HP's R&D, the Loveland Division started its own R&D lab in a Quonset hut in 1961. The metal hut had no air conditioning so it was evaporatively cooled in the summer by a lawn sprinkler set at the apex of the hut's curved roof. The Loveland R&D lab was run by Marco Negrete, who moved to Colorado from HP in Palo Alto to start the new R&D lab. The Quonset hut also housed Loveland Division's transformer-manufacturing operation. Over time, HP Loveland assumed responsibility for the development of HP's voltmeters, signal generators, and several other instruments.

The R&D Lab at HP's Loveland Division opens in this rented Quonset Hut on Lincoln Avenue in downtown Loveland. The metal building is cooled by a lawn sprinkler.

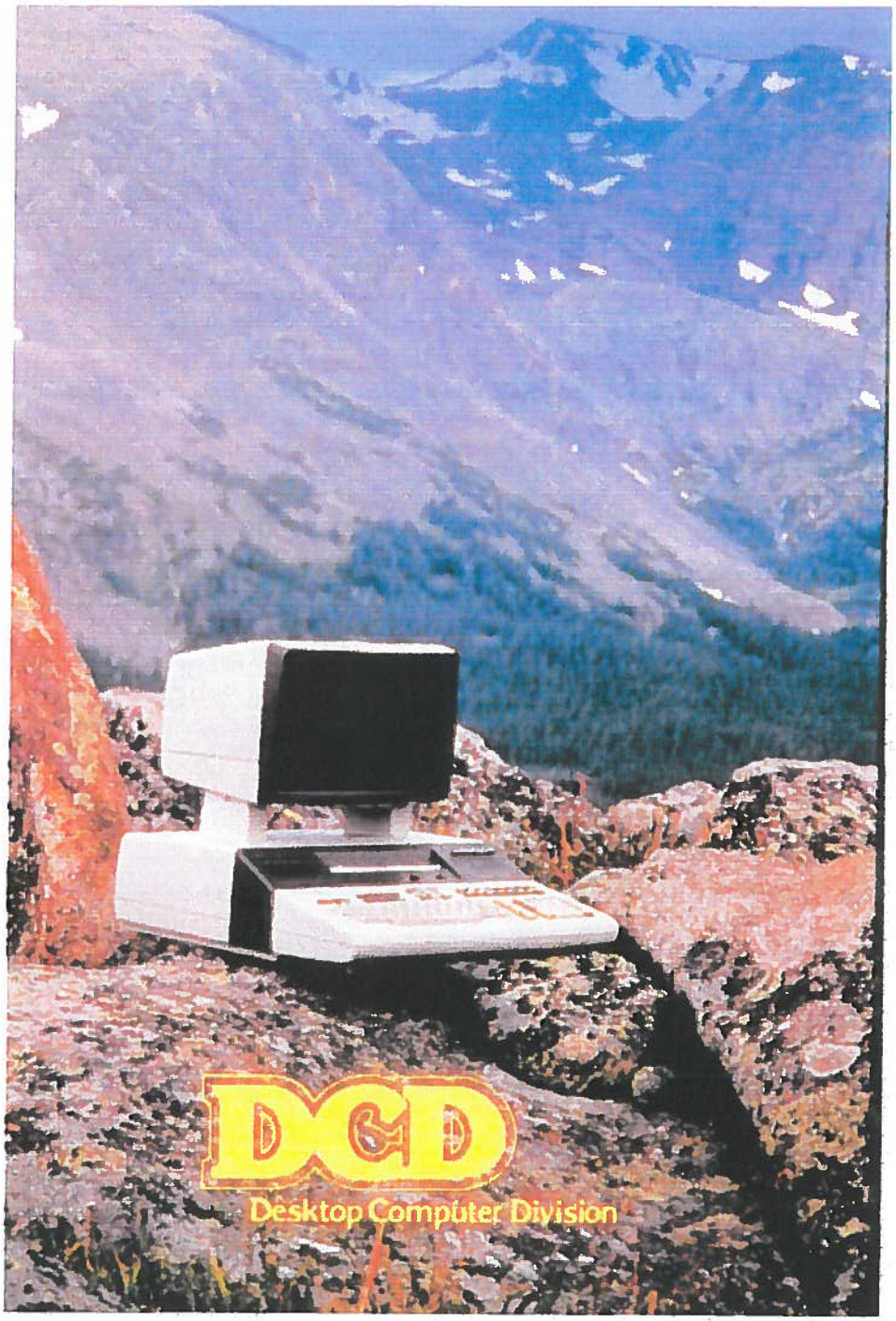
A new building purpose-built for HP on land originally purchased by the Loveland Development Fund was ready to occupy by mid 1962. The HP Loveland campus started with one building, tersely called "A," which had the largest manufacturing floor under one roof in all of HP at that time. Over the decades, buildings "B," "C," and "D" were added. Eventually, the HP Loveland facility would house the Loveland Instrument Division (LID), the Calculator Products Division (CPD), and the Civil Engineering Division (CED). CPD would become the Desktop Computer Division and move north to nearby Fort Collins. CED would flourish for a time making distance-measuring equipment but would close in 1982.

The Start of HP Labs

The decentralization of HP's R&D culminated in 1966 with the formal creation of a separate corporate R&D entity within HP called HP Labs, headed by Barney Oliver and located in Palo Alto. Shortly after its creation, HP Labs finished development on a radical new product: a programmable, scientific desktop calculator. The first impulse was to move this new computing machine into production at HP's brand new minicomputer division in Cupertino, California. The calculator obviously fit in with HP's new computing division, which introduced HP's first minicomputer, the 16-bit HP 2116A, late in 1966. However, the new calculator looked absolutely nothing like a "real" computer and HP's Cupertino Division wouldn't touch it but forward-looking lab manager Marco Negrete at HP's Loveland Division saw a bright future for the calculator and made room for it amongst the voltmeters and signal generators in Colorado.



The HP Loveland Division in Colorado was the company's first manufacturing operation to open outside of California. This photo of the Loveland facility is from the 1974 HP annual report.



MORE ▶

Historical notes: HP split off its instrument business in 1999. The new instrumentation company, which included the Loveland facility, adopted the name Agilent. Part of the the Loveland facility was sold in 2003 to an international EMS (electronic manufacturing services) company named Benchmark Electronics, which is based in Texas. The facility, now more than 40 years old, continues to crank out

product. Meanwhile, the old Loveland R&D Quonset hut at 106 S. Lincoln Avenue is now occupied by Handy Glass.

Source materials for this Web page about the HP Loveland facility include:

Kenneth Jessen, "How it all began, Hewlett-Packard's Loveland Facility," J. V. Publications, Loveland, Colorado, 1999.