Cyberinfrastructure in Higher Education Research

Where Do We Stand?

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Higher Education Policy Commission

Executive Summary

- Numerous national studies have demonstrated the value and economic impact of research investments.
- High-tech jobs are created as a **direct result of research investments**; the state's economy is strengthened by the influx of revenue—every $1 spent adds $2.30 to the economy—and job growth.
- **States are now competing for available research funds**, where in the past competition was limited.
- **Cyberinfrastructure** supports traditional research, and **opens new avenues for research activities**.

West Virginia Background Basics

Current Population Data & Projections

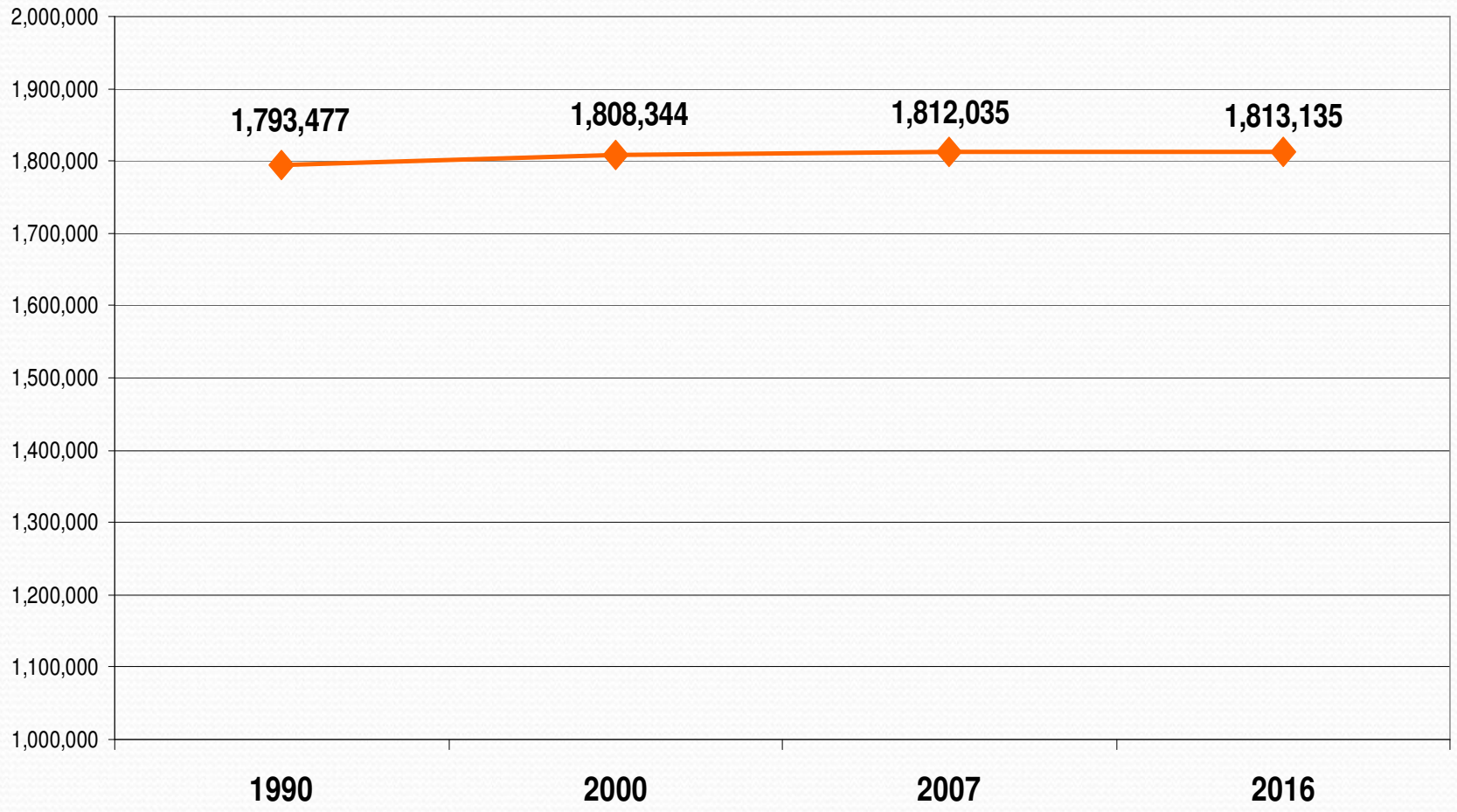
Sources: SREB, US Census Bureau

Population Growth Projections

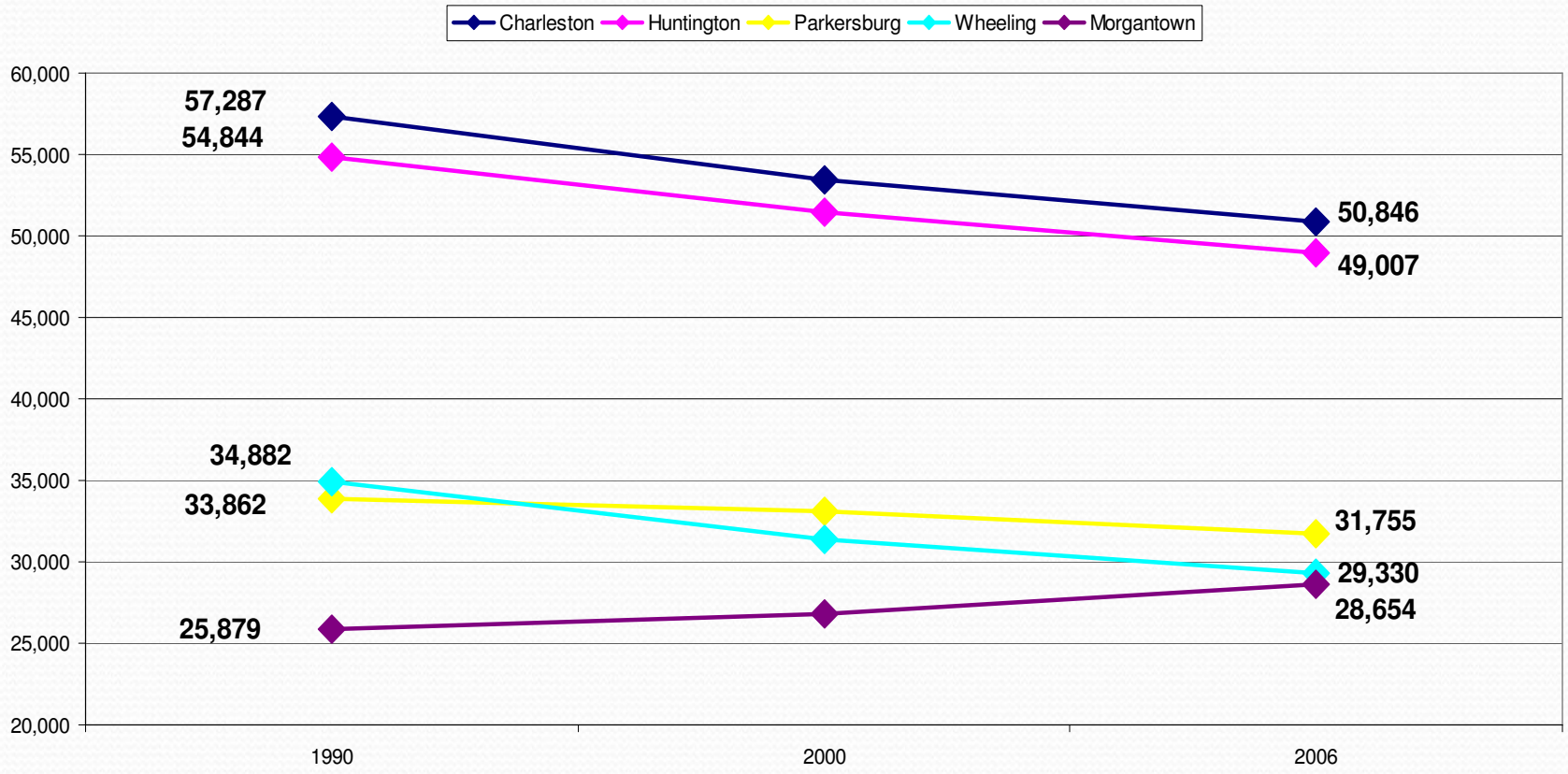
- The population of the United States is expected to grow 9% between 2006 and 2016 (+25.7 MM)
- Half of that growth is expected in SREB States, which is expected to grow 12% overall (+12.8 MM)
- West Virginia is expected to grow only 0.1% (+1,100) during this same period (lowest in the SREB region)

SREB States

WV Population / Projected



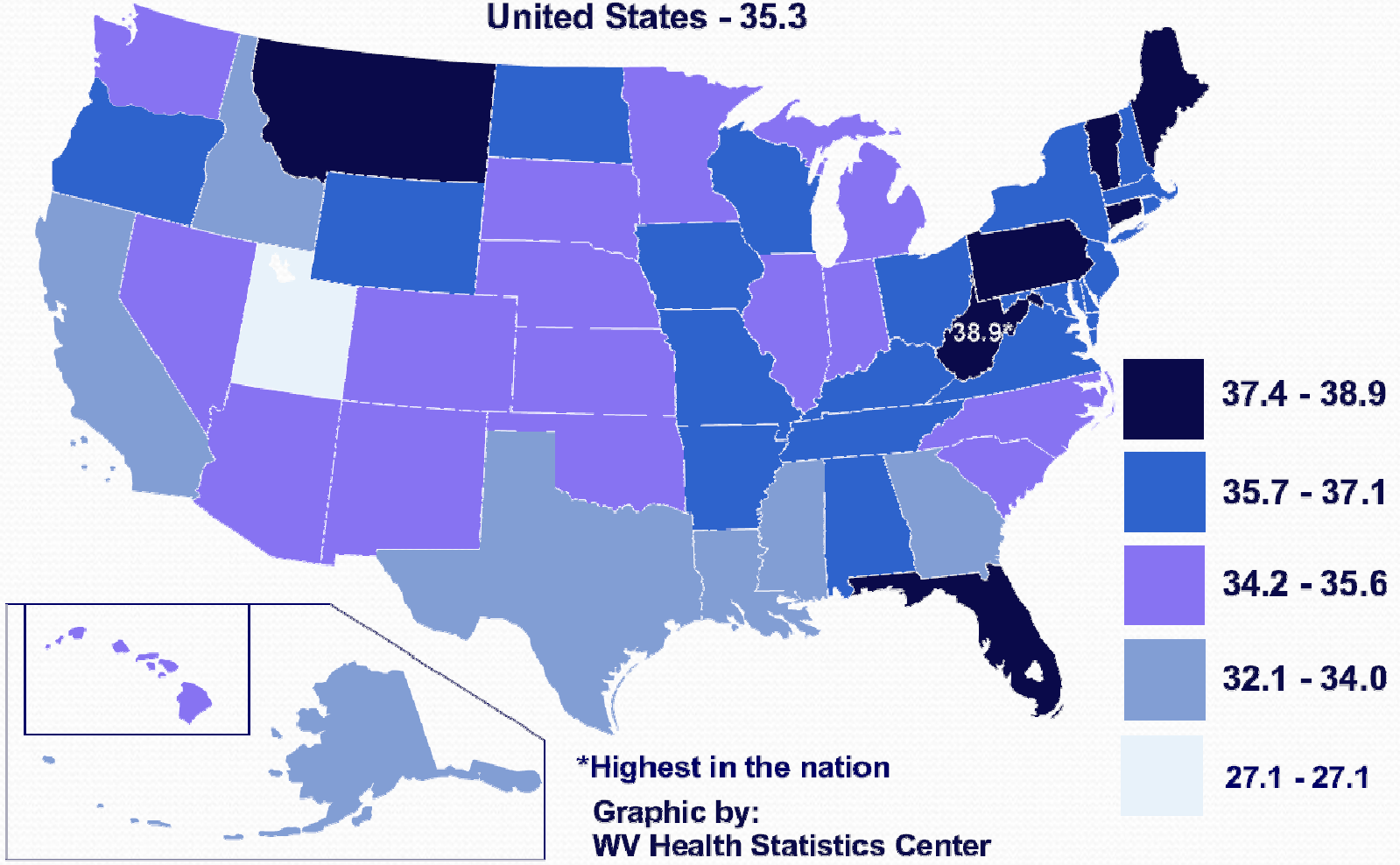
Select Cities Population Trend



Median Age: 2000

Source: Census 2000

United States - 35.3



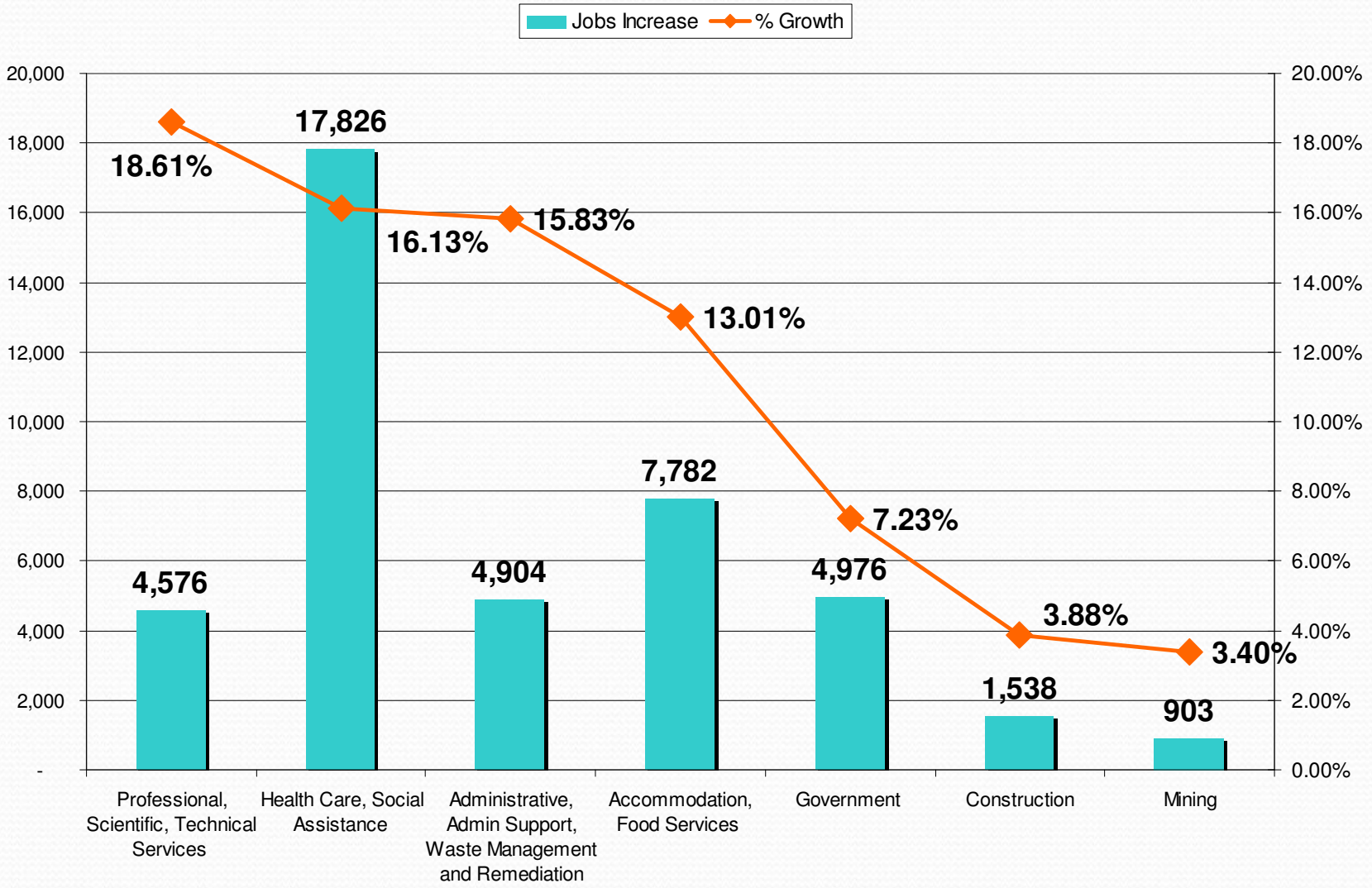
*Highest in the nation

Graphic by:
WV Health Statistics Center

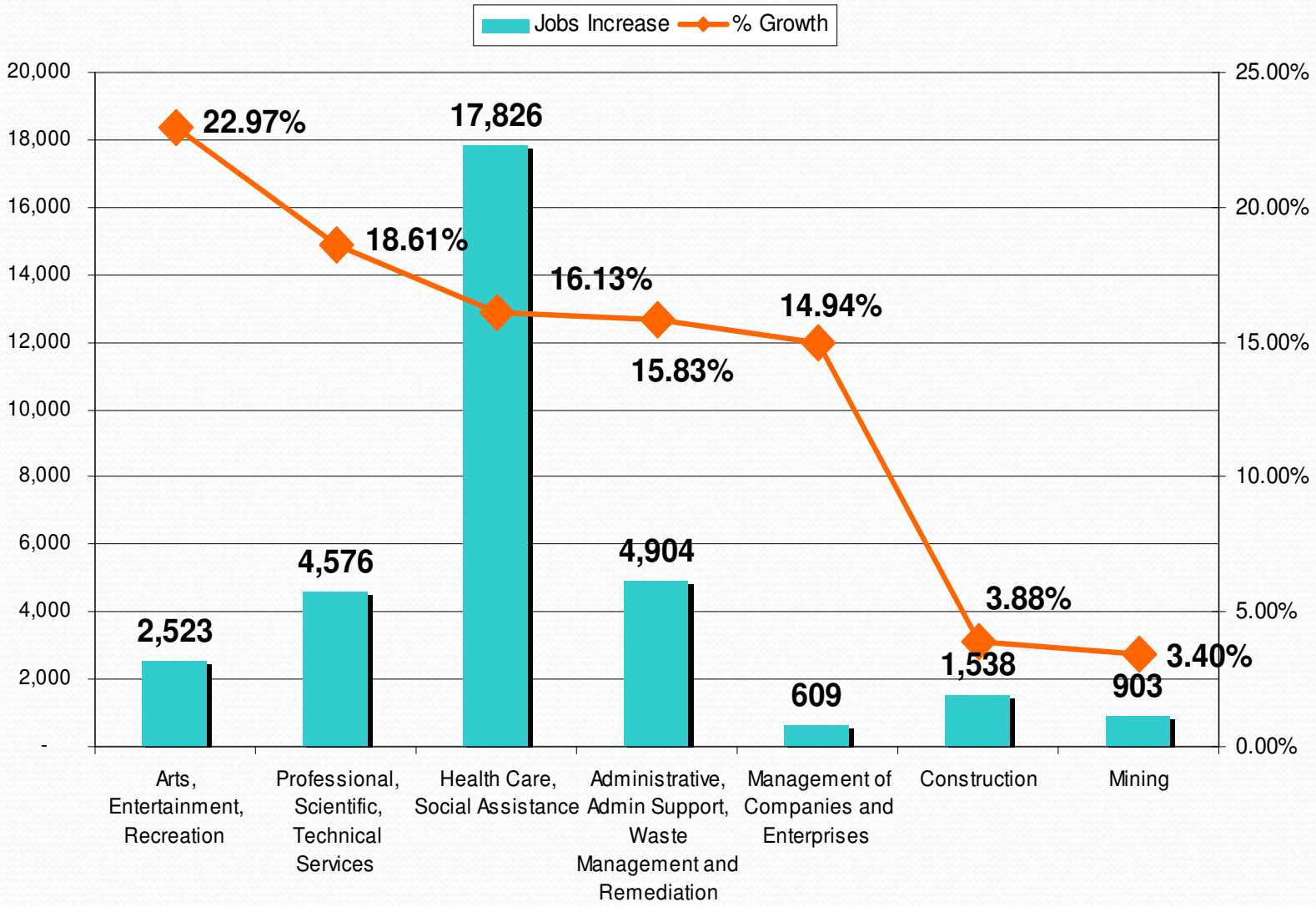
Top 5 Growth Leaders: Industry Projections 2016

Source: WV Bureau of Employment

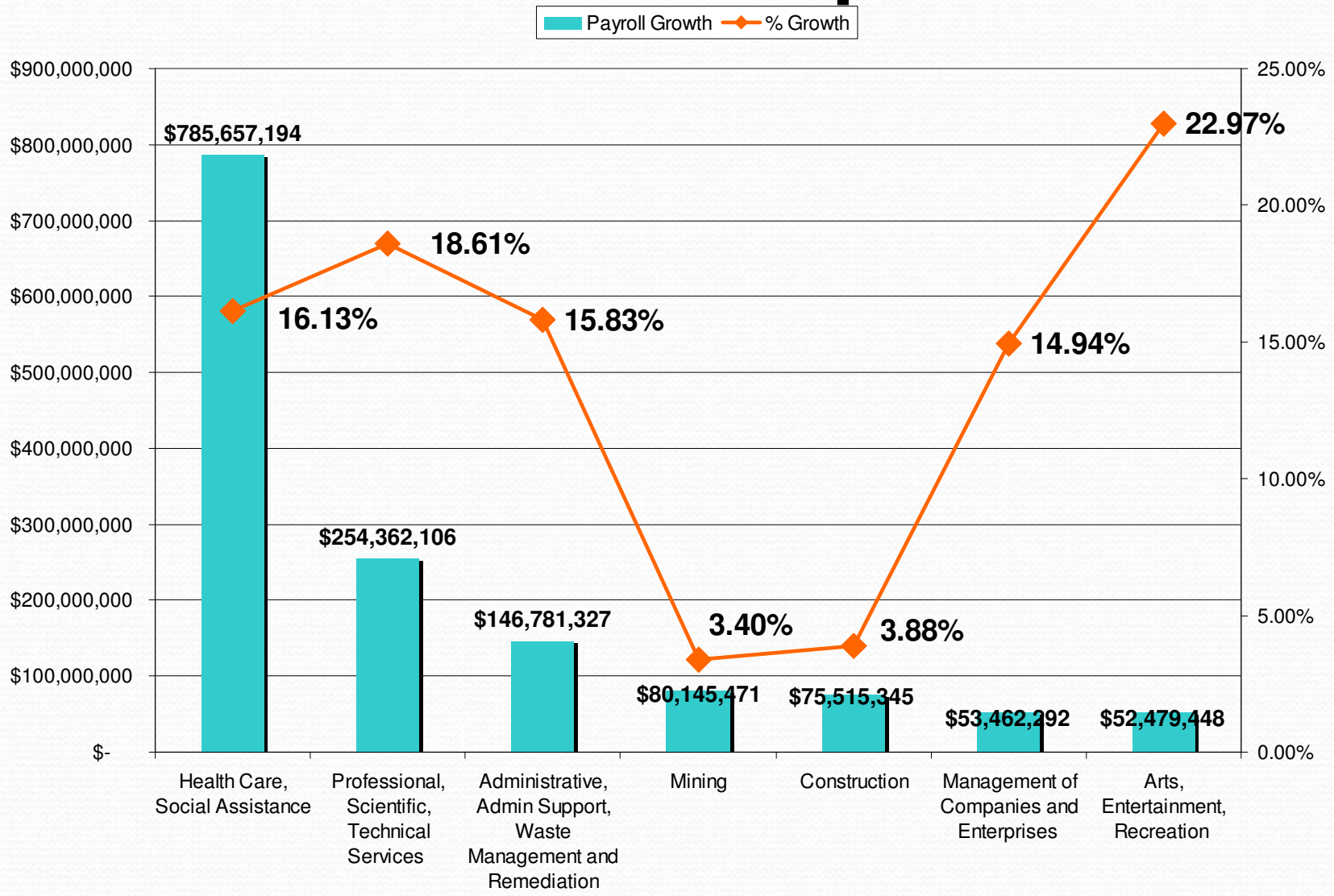
Overall Growth



% Overall Growth



Economic Impact



"Take Away Points"

- By 2016, an additional $1 Billion in wages will be generated from Health Care and Professional / Scientific Services as the workforce shifts toward these industries.
- Higher Ed will develop much of the workforce or "spin off" the services behind these industries.

WV Higher Education Background

Primary Research Centers

- **West Virginia University**, Main Campus – Morgantown
  - Land Grant, RU/H: Research University (high research activity)
  - Budget $749MM - $125MM in Grants and Contracts
- **Marshall University**, Main Campus – Huntington
  - Master's L: Master's Colleges and Universities (larger programs) with 5 doctorates & MD
  - Budget $215MM - $74MM in Grants and Contracts

Secondary Research Centers

- **West Virginia State University**, Main Campus – Institute
  - HBCU, Land Grant
  - Op Budget $40MM - $22MM in Grants and Contracts
- **Fairmont State University**, Main Campus – Fairmont
  - Op Budget $55MM - $32MM in Grants and Contracts

Other Higher Ed

- Seven other four-year public colleges/universities and School of Osteopathic Medicine
- 10 Community and Technical Colleges
- **HEPC** – Higher Education Policy Commission
  - WVNET

Campus Profiles

Source: HEPC, 2008 HEPC CI Survey

WVU Profile

- 28,113 Students
  - Undergrad - 21,145
  - Graduate - 5,595
  - First Professional - 1,373
- Faculty – 2,936
- Staff – 3,349

- Regional Campuses
  - Potomac State
  - WVU Institute of Technology
  - RCB HSC Charleston
  - RCB HSC Eastern Division (Martinsburg)
  - Rural Health Care Sites

MU Profile

- 13,659 Students
  - Undergrad – 9,608
  - Graduate - 3,806
  - First Professional - 245
- Faculty – 1,107
- Staff - 832

- 13 Colleges and Schools including the Joan C. Edwards School of Medicine
- Main Campus and Two Branch Campuses
- Five remote learning centers

Fairmont State Profile

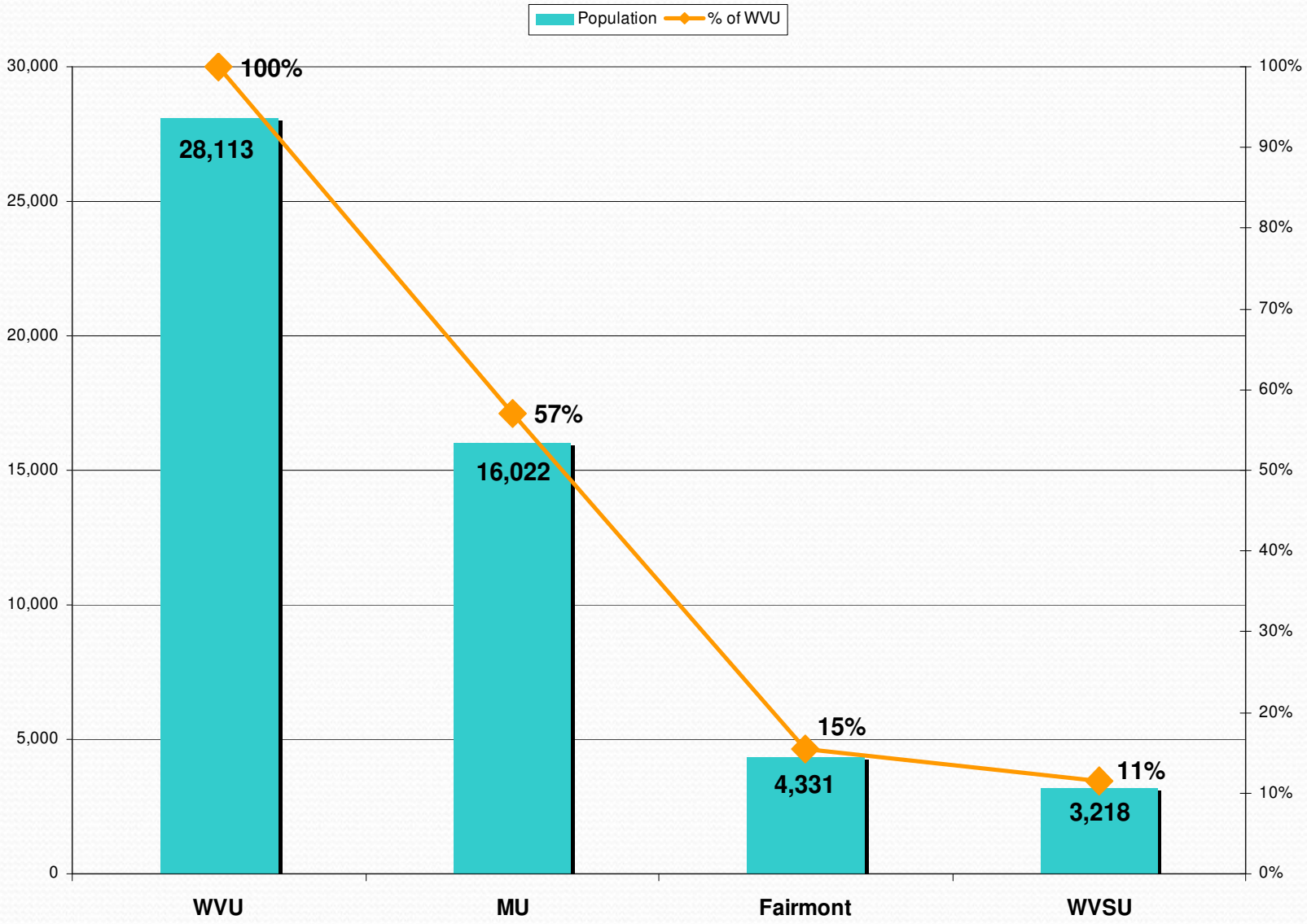
- 4,331 Students
  - Undergrad – 3,976
  - Graduate - 355
- Faculty - 319
- Staff - 265
- Main Campus and six remote learning centers

WVSU Profile

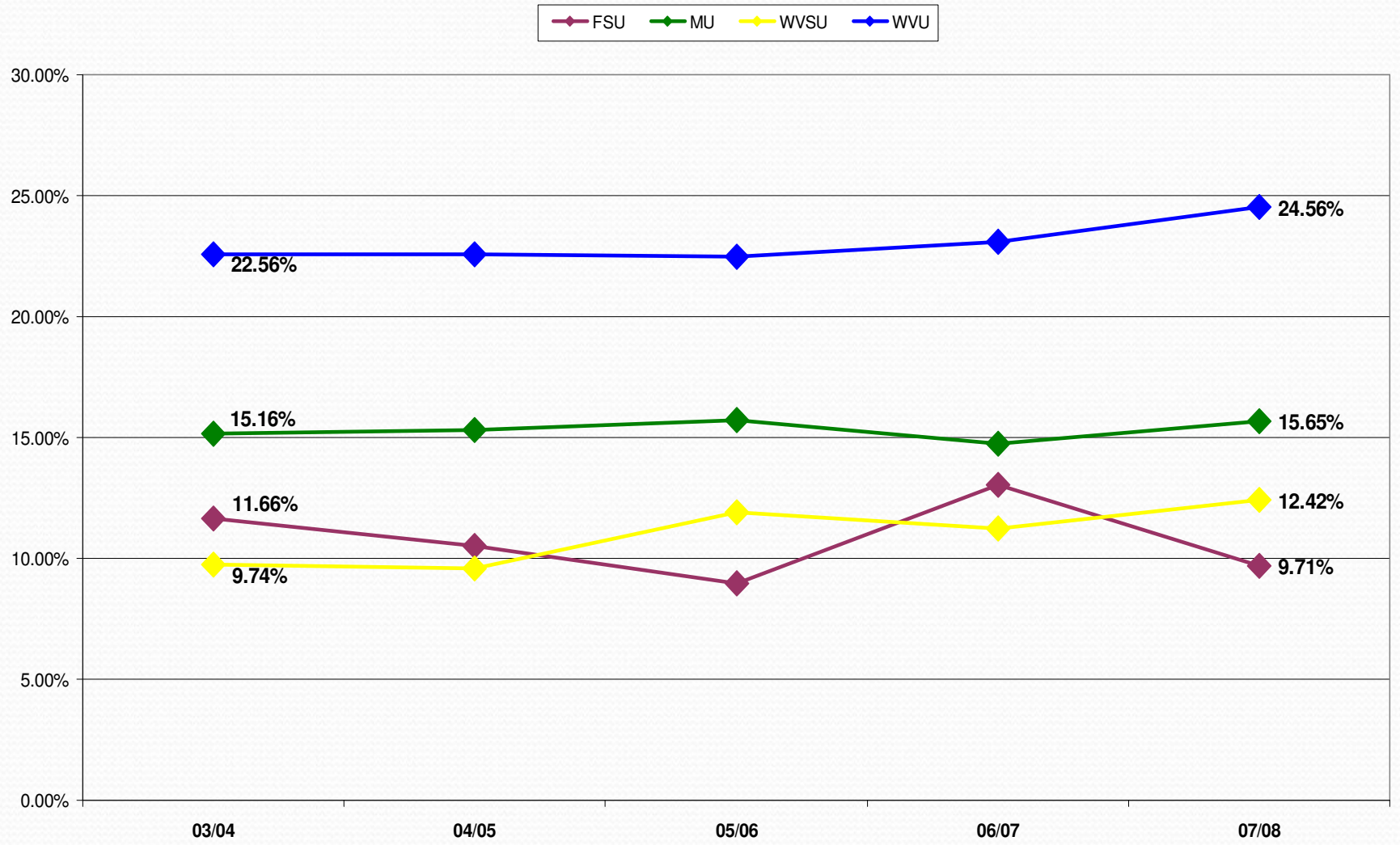
- 3,218 Students
  - Undergrad - 3,175
  - Graduate - 43
- Faculty - 210
- Staff - 232

- Main Campus, remote learning centers, and extensions offices throughout southern WV

Student Population Relative to WVU



STEM % of Degrees Awarded



Cyberinfrastructure Profiles

Sources: Alan Taylor (MU), Don McLaughlin (WVU), 2008 HEPC CI Survey

WVU CI Profile

- 300 Mb Commodity Internet
- Regional Campus Connectivity
  - WVU Parkersburg 6 Mb ATM
  - WVU Institute of Technology 15Mb ATM
  - WVU Potomac State 10Mb ATM
- Gigabit Core Backbone

WVU CI (cont)

- Internet2
  - 155 Mb Internet2 (shared) – Channelized OC-12 – likely bandwidth upgrades in the future
  - Internet2 connectivity via 3ROX GigaPop (Pittsburgh) - a consortium of WVU, Penn State, University of Pittsburgh and Carnegie Mellon.
- High-Performance Computing
  - Several HPC clusters - total processor count approx. 224
  - Additional HPC clusters in various academic departments
  - Member of the Super Computing Sciences Consortium (SC2)
  - Collaborative work on high performance and scientific computing and access to computational resources at PSC.
- Grid Computing
  - WV Global Grid
  - SABER Grid

MU CI Profile

- 400 Mb of Commodity Internet Service
- Intercampus and Internet Access via Verizon TLS Service at 100Mb & 1Gb and nTelos MPLS Service
- 10 Gbs Backbone extending to all Research and Clinical Science Buildings on Main Campus
- All end node ports are Switched Gigabit Ethernet
- 7,824 node network moving to just over 9,000 in 2008
- 273 Servers – Windows / Linux
- 80% of campus has 802.11 wireless coverage

MU CI (cont)

- Internet2
  - Federal Communications Commission (FCC) / WV TeleHealth Alliance Internet2 access to OARnet – 1 Gigabit
  - Considering SEGP Services to other entities in WV to assist in sustainability
- High-Performance Computing
  - Two 16-node HPC Clusters in basic science departments
- Grid Computing
  - Participated with 100 desktop computers in the WV Global Grid Exchange (Optiplex 745 - Intel Core 2 Duo 3.0GHz)
  - Researcher participation in Oklahoma Condor Grid and others

Fairmont State CI Profile

- 36 Mb of Commodity Internet Service
- 1Gbs Backbone to all buildings on Campus
- Metro WAN Service (20 Mb) and Point-to-Point (T1) service for remote learning centers links
- 1Gbps/100Mbps end node ports
- 1,500 node network (Windows XP)
- 120 Servers – Windows / Linux
- 54 802.11 wireless access points

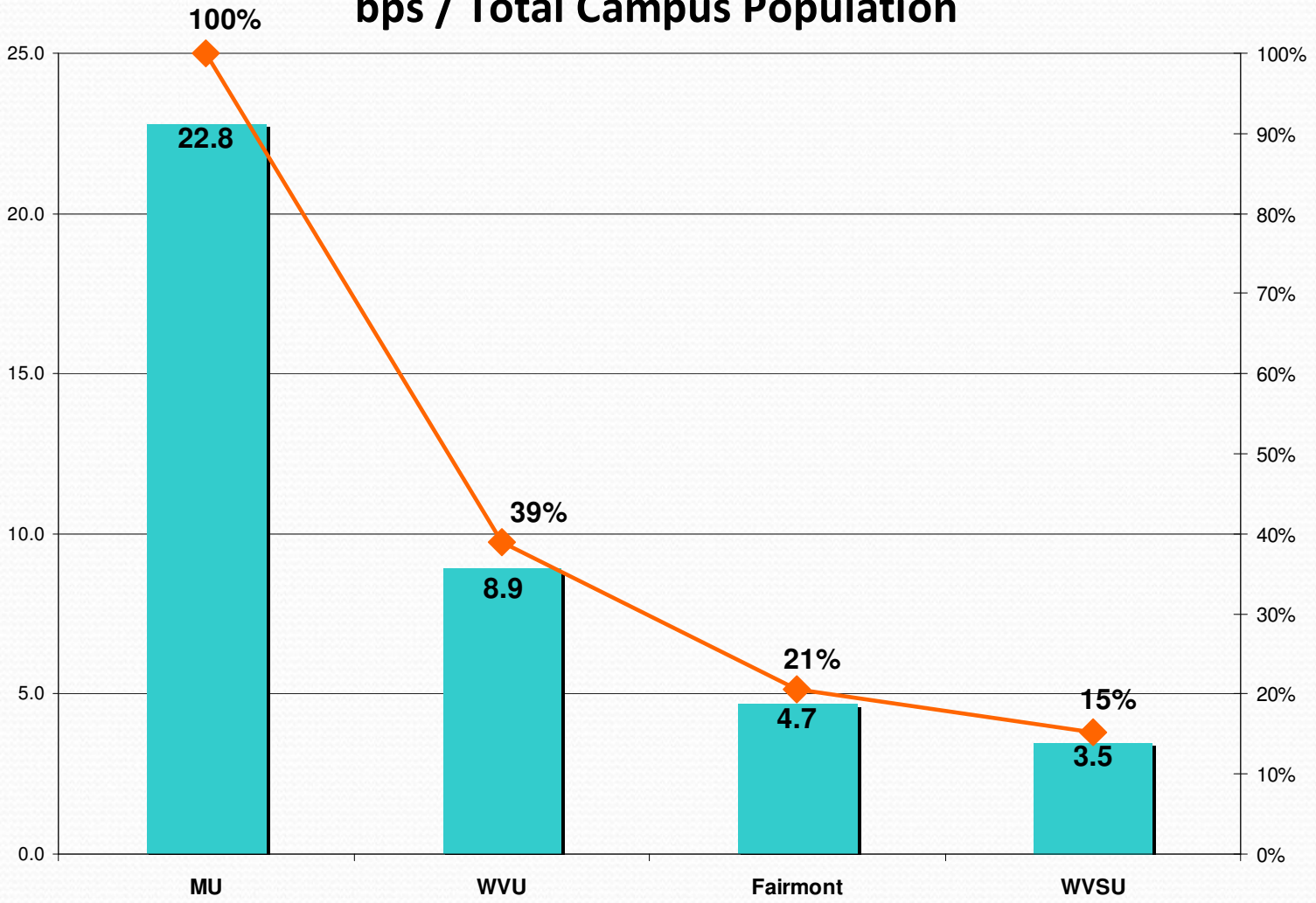
Fairmont CI (cont)

- High-Performance Computing
  - New HPC cluster operational this quarter
  - 2 HPC-class servers available this quarter for student researchers
- Grid Computing
  - WV Global Grid participant with 923 CPUs available ($10MM in donated CPU cycles to date)

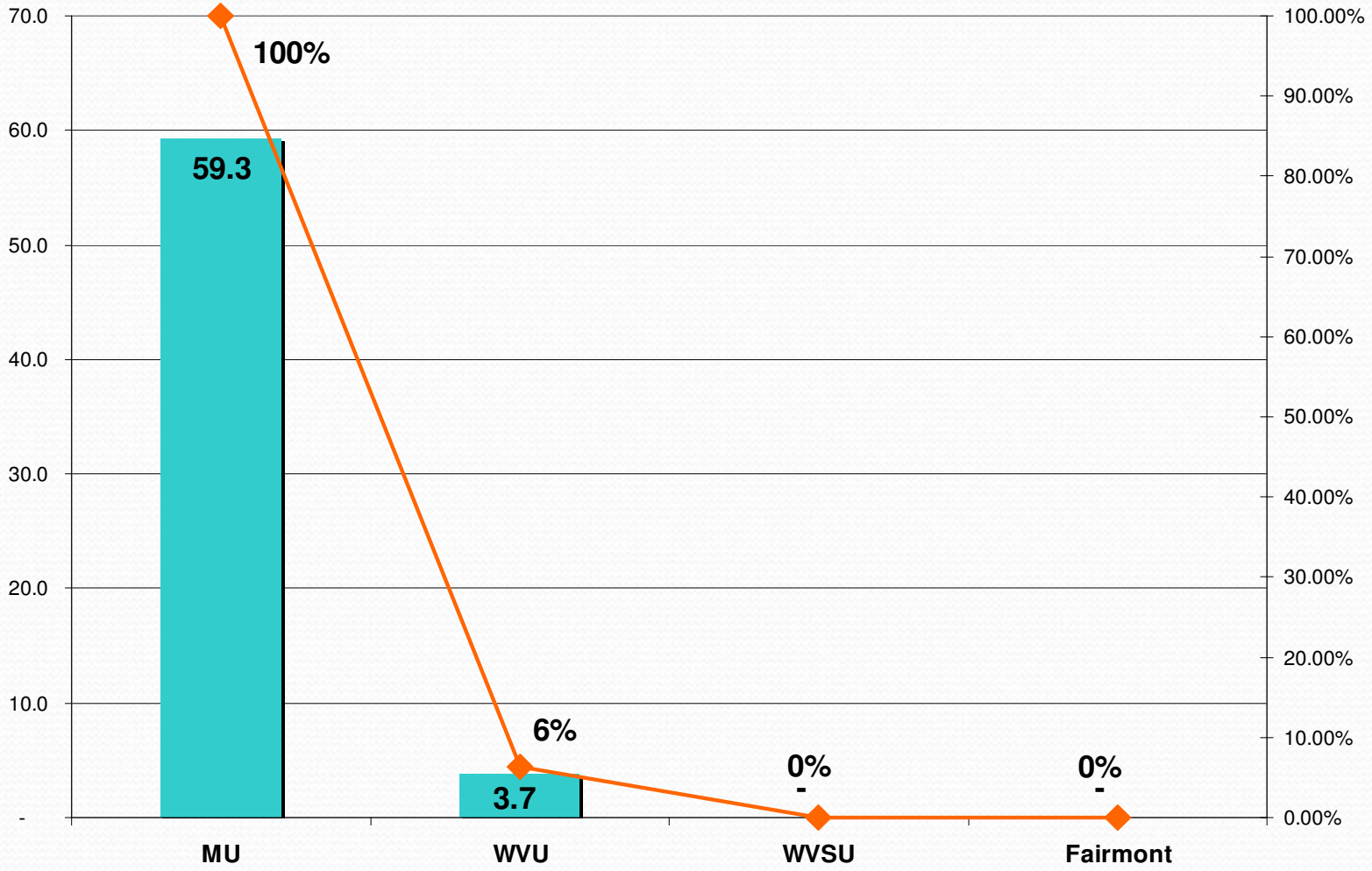
WVSU CI Profile

- 18 Mb of Commodity Internet Service
- 1Gbs Backbone to most of Campus
- 3 Mb and Point-to-Point (Frame T1) service for remote facility links
- 1Gbps/100/10Mbps end node ports
- 3,700 node network (Windows)
- 36 Servers – Windows / Linux
- 802.11 wireless in Library and Student Union

Commodity Internet
bps / Total Campus Population



Internet2
bps / Faculty & Students



WV Research Climate

Sources: Alan Taylor (MU), Don McLaughlin (WVU), 2008 HEPC CI Survey

Legislative

- "Bucks for Brains" $50MM total investment (2008)
- Vision 2015, The West Virginia Science and Technology Strategic Plan, calls for
  - Increased number of STEM researchers (20%) at WVU and Marshall
  - Increased funding for electronic journals at WVU and MU Libraries
  - Building of new science and engineering research facilities at WVU and Marshall with a minimum of 100,000 NASF by 2010
    - Over $100M of Medical and Biotechnology Research facilities were completed in FY07 at Marshall
  - Increase by 10% per year the number of doctorates awarded in STEM fields through 2015 at both WVU and Marshall
  - A doubling of competitive funding by federal agencies every five years through 2015 for both WVU and Marshall

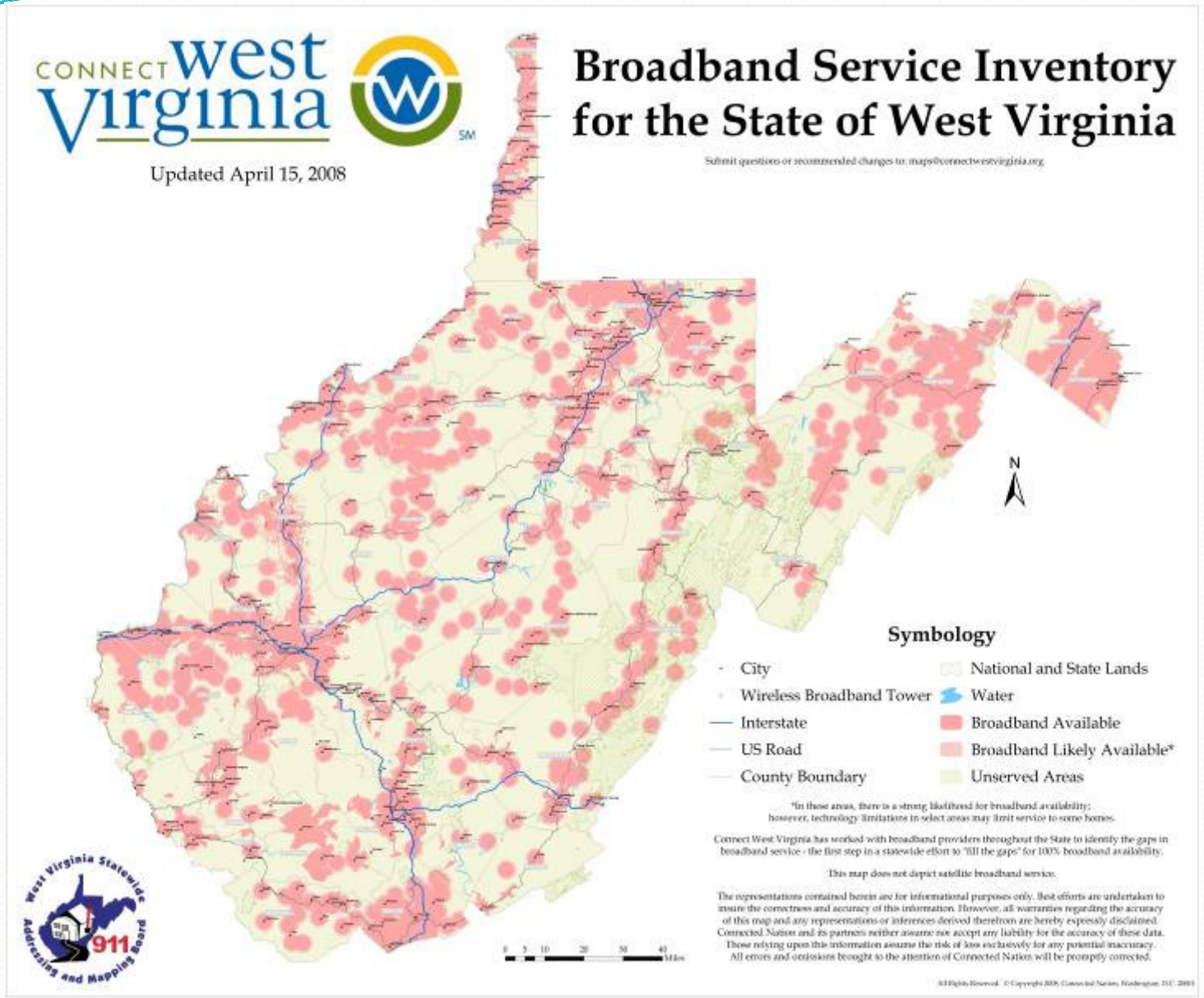
WVU

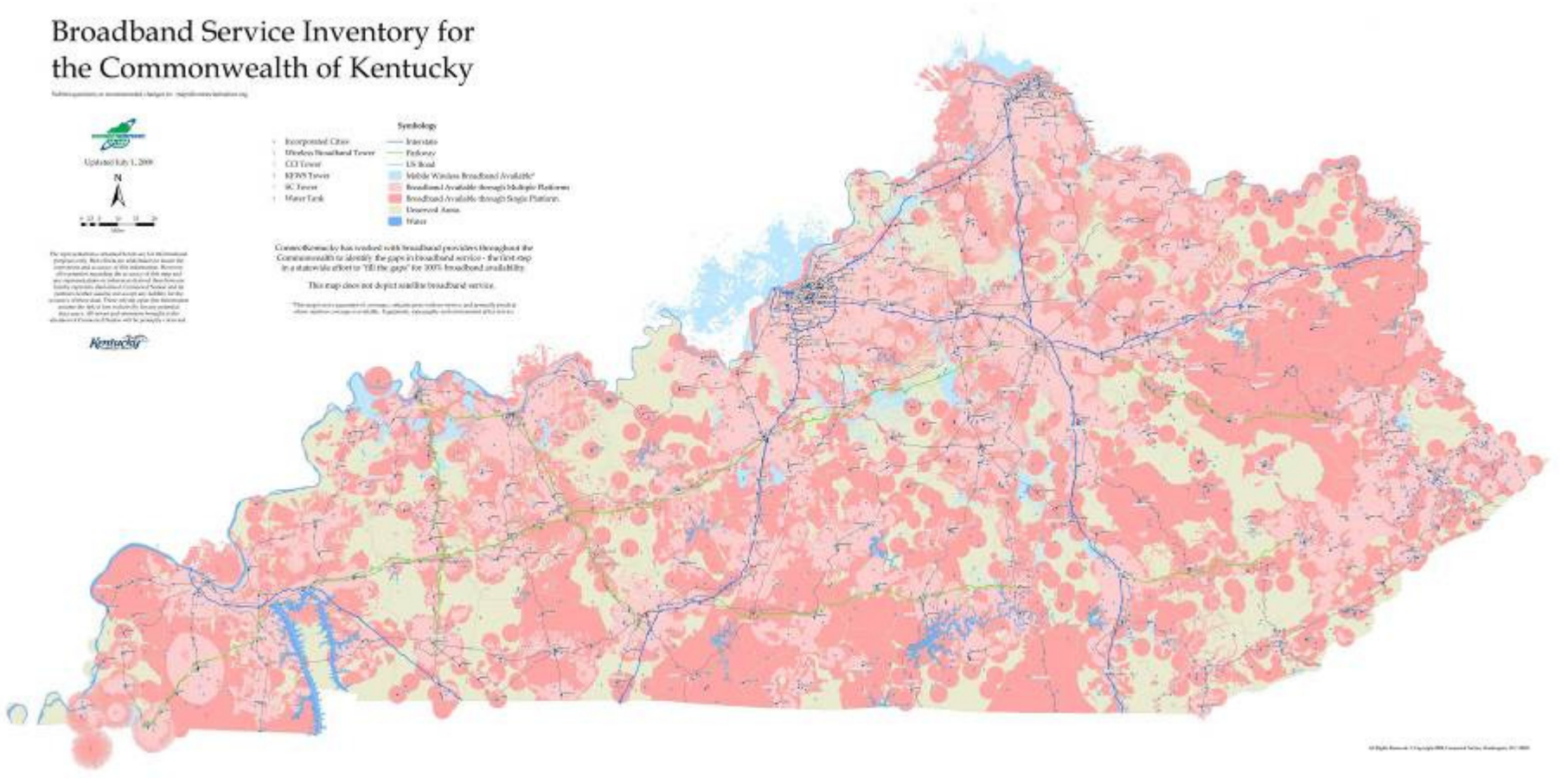
- "Bucks for Brains" $35MM of $50MM potential matched investment
- Nanotech
  - Photonics
  - Molecular Electronics and Electronic Transduction
  - Multifunctional Heterostructures
  - Nano- and Microfluidics
  - Nanokinematics
  - Spintronics and Magnetism
- Immersive Visualization Systems
- Biotech
  - Bioinformatics and biomarker identification
  - Flow cytometry
  - Advanced imaging
  - Proteomics
  - Molecular modeling
  - Cancer nanotech
- Fossil Energy Technology
  - Carbon Capture and Sequestration
  - Computational and Basic Sciences
  - Energy System Dynamics
  - Geological and Environmental Systems
  - Materials Science

MU

- "Bucks for Brains" $15MM of $50MM potential matched investment
- Commitment to move to a Research Extensive Doctoral Institution in the next decade
- Presidential and Board Initiative – "Marshall Institute for Interdisciplinary Research" (MIIR)
  - Focused on Biotechnology
  - Anchored by the new Robert C. Byrd Biotechnology Science Center at Marshall University
  - Funded through a new University Endowment
  - A self sustaining Earning Culture and Research Model
  - Involves active Undergraduate and Graduate student research

Statewide Broadband Coverage


CONNECT west Virginia
SM
Updated April 15, 2008
Broadband Service Inventory for the State of West Virginia
Submit questions or recommended changes to: maps@connectwestvirginia.org
N
Symbology
City
Wireless Broadband Tower
Interstate
US Road
County Boundary
National and State Lands
Water
Broadband Available
Broadband Likely Available*
Unserved Areas
*In these areas, there is a strong likelihood for broadband availability; however, technology limitations in select areas may limit service to some homes.
Connect West Virginia has worked with broadband providers throughout the State to identify the gaps in broadband service - the first step in a statewide effort to "fill the gaps" for 100% broadband availability.
This map does not depict satellite broadband service.
The representations contained herein are for informational purposes only. Best efforts are undertaken to insure the correctness and accuracy of this information. However, all warranties regarding the accuracy of this map and any representations or inferences derived therefrom are hereby expressly disclaimed. Connected Nation and its partners neither assume nor accept any liability for the accuracy of these data. Those relying upon this information assume the risk of loss exclusively for any potential inaccuracy. All errors and omissions brought to the attention of Connected Nation will be promptly corrected.
0 5 10 20 30 40 Miles
West Virginia Statewide Addressing and Mapping Board
911

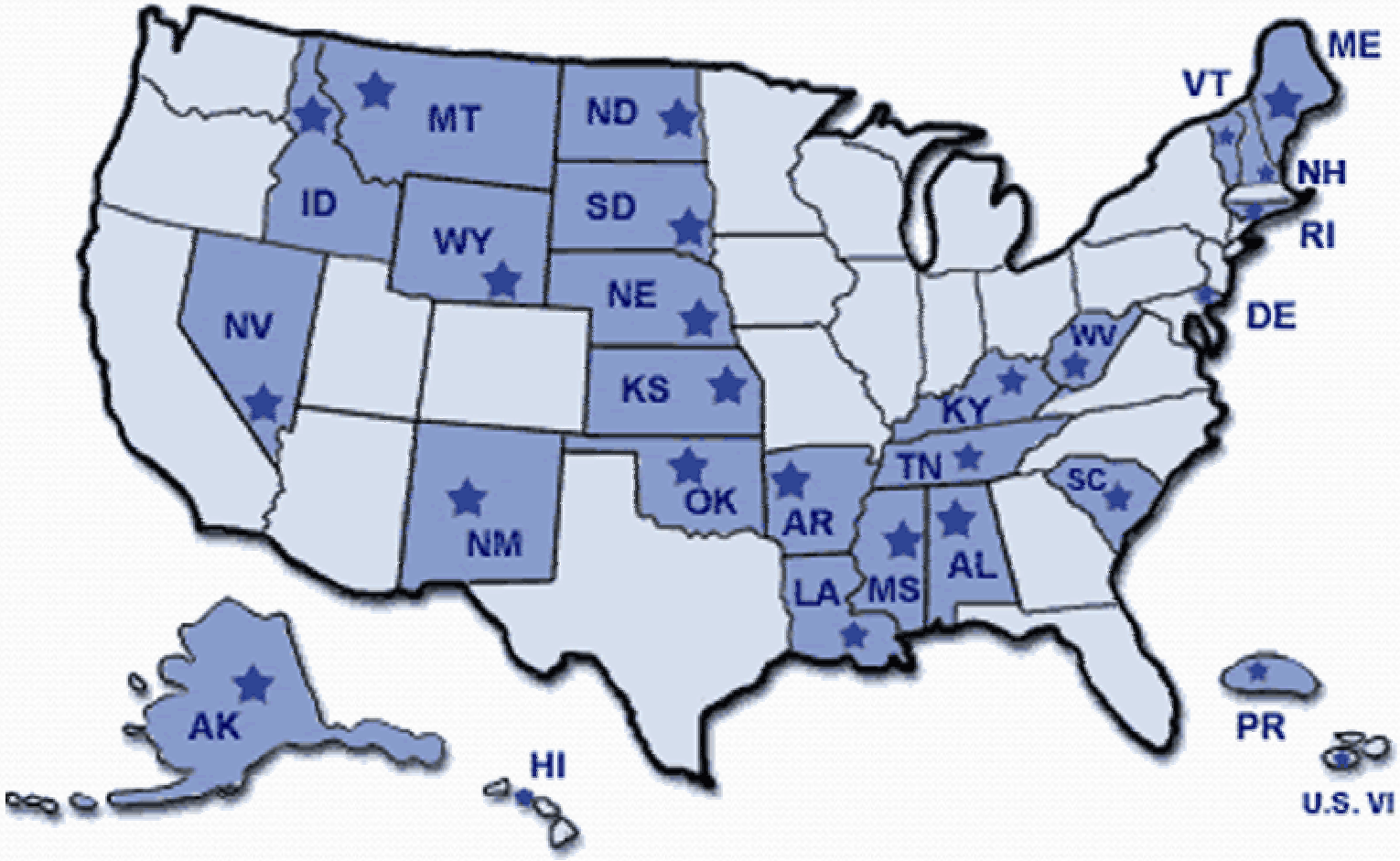

Broadband Service Inventory for
the Commonwealth of Kentucky
Updated July 1, 2009
N
Symbology
Incorporated Cities
Wireless Broadband Tower
CCI Tower
KEWS Tower
RC Tower
Water Tank
Interstate
Parkway
US Road
Mobile Wireless Broadband Available*
Broadband Available through Multiple Platforms
Broadband Available through Single Platform
Unserved Areas
Water
ConnectKentucky has worked with broadband providers throughout the Commonwealth to identify the gaps in broadband service - the first step in a statewide effort to "fill the gaps" for 100% broadband availability.
This map does not depict satellite broadband service.
Kentucky

Role of NSF in CI

The mission of the NSF is to strengthen research and education in STEM fields throughout the US and to **avoid undue concentration of such research and education**.

The NSF EPSCoR program is directed at those **jurisdictions that have historically received lesser amounts** of NSF Research and Development (R&D) funding.

NSF EPSCoR States



SREB States

Significant CI gaps exist between non-EPSCoR States and EPSCoR States

Budget Gap

- 97% of the NSF Office of Cyberinfrastructure funding goes to non-EPSCoR states.

- EPSCoR CI **funding has not risen to the level** where their cyberinfrastructure is adequate **to support competitive efforts in emerging cyber-enabled research**.

Access Gap

- EPSCoR states have 20% of the population but had only 11% of allocations to TeraGrid in 2005. Allocations dropped to 6% in 2006.

- This suggests that researchers in **EPSCoR states lack the background, skills and/or support to perform research** based on advanced HPC technologies, such as simulation and modeling.

Human Capital Gap

- A **limited percentage of researchers** in EPSCoR states **actively participate in cyber-enabled research** initiatives at the investigator, team or national level.

- Lack of a cyber-research culture is **attributed to the lack of physical facilities**, such as advanced networks, as well as a **lack of resources committed** to institution-wide outreach to researchers and a **lack of dedicated technical support** for researchers who wish to engage in these new modes of research.

“Show of Hands”

- Still use dial-up internet?
- Use broadband internet (DSL, cable, etc)?
- Would give up broadband and go back to dial-up?

- We can’t confuse access with participation.

Capacity Gap

- Many EPSCoR **jurisdictions do not reach the current connectivity standard** for NationalLambdaRail / Internet2 participation of 10 Gbps.

- Cyber-enabled research benefits greatly from increased bandwidth by gaining access to extremely large data sets as well as data in near real-time.

Related NSF Funding Vehicles

- RII - Research Infrastructure Improvement
  - Track-1
    - Primary focus is Human Capital research investments
  - Track-2
    - CI Specific Funding
- Other opportunities available from NSF, FCC, NIH, others (DSR Weekly Grant Alert)

NSF RII Track-2 Activities

- **Connecting** multiple institutions **to the national and international networking research** and education fabrics
- Deployment and operation of **scientific instruments and sensors**
- Acquisition and support of new and distributed **scientific computing resources and data storage services**

Activities (cont)

- Existing CI **component integration** to create a cohesive collaboration, research and learning environment
- Integration, validation, and support of **software tools, applications, and services**
- Deployment of nationally competitive **high-performance computing and networking capabilities**

Activities (cont)

- Development of **computing professionals, interdisciplinary teams, and enabling policies** and procedures necessary to achieve scientific breakthroughs
- Development of **technical expertise** to install, and maintain sophisticated CI
- Deployment and support of **collaboration tools**

Role of the HEPC DSR in CI

The Division of Science and Research provides strategic leadership for infrastructure advancement and development of competitive research opportunities in STEM disciplines.

Vision 2015

- A **strategic framework** of actions and initiatives that will position West Virginia **to achieve measurable growth in technology-based economic development**.

Vision 2015 Will …

- Attract $1.4B in federal-external funding
- Create 33,000 jobs
- Have total economic impact of $3.3B

Vision 2015 Components

- Investment of $250MM in new research
- Recruitment of 89 new scientists and engineers spread across Primary Higher Education Research Centers
- Construction of two state-of-the-art science and engineering facilities; one at each Primary Higher Education Research Center
- Increased production of West Virginia scientists and engineers with advanced degrees
- Development of new tech-based businesses as research spin-offs from Primary Higher Education Research Centers

Vision 2015: Cyber Plan

- As an extension of Vision 2015, the DSR is working to develop a statewide Cyberinfrastructure Plan

- We must do this to help our researchers compete on a more equal footing with non-EPSCoR states.

Why be concerned with CI?

America COMPETES Act (2007)

- The National Science Foundation **must report to Congress the current status of broadband access for scientific research purposes** in EPSCoR-eligible States, at institutions in rural areas, and at minority serving institutions;
- and, **outline actions that can be taken to ensure that such connections are available** to enable participation in those NSF programs that rely heavily on high-speed networking and collaborations **across institutions and regions**.

Research & CI Improvement Funding

- CI improvement and cyber-enabled research is a significant funding focus of the National Science Foundation's Office of Cyberinfrastructure

Outreach & Workforce Development

- With adequate CI, smaller colleges and universities, CTCs, and K-12 can actively participate in research activities hosted at larger institutions

- Involving young learners early on in STEM enrichment activities increases the likelihood that they will enter into post-secondary STEM fields

Economic Development

- High-tech jobs are created as a **direct result of research investments**; the state's economy is strengthened by the influx of revenue—every $1 spent adds $2.30 to the economy—and job growth.

- **Cyberinfrastructure** supports traditional research, and **opens new avenues for research activities**.

CI Shortfalls?

- It's up to us—the Higher Ed community, HEPC, our stakeholders, and constituents—to identify and address these.

- The Vision 2015 CI Plan, with the help of those above, will offer a framework to ensure our research community becomes more cyber-enabled and competitive.

HEPC
Division of Science & Research

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