

Virtual Regional Wealth Scanner: A Geodesign Approach

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**Hodjat Ghadimi
School of Design and Community Development
West Virginia University
Hodjat.Ghadimi@mail.wvu.edu**

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- The Key: Wealth/Capital
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- Geodesign for Wealth Estimation
- Next Steps

The Context

- Optimal Depletion Computable General Equilibrium (CGE) model for Exhaustible Energy Resources – A dynamic economy-wide model
- Back to Design broadly defined
- Key to Linking Design with Economic Modeling? Creativity + Rigor
- Geodesign Summit 2010 & 2011
 - Virtual Wealth Scanner poster

Wealth & Capital

- Long interest in wealth of nations, regions, ...
- Wealth is arguably a more accurate measure of society's economic progress and wellbeing than GDP.
- Wealth is generally measured in the various assets or capital forms in which it is embodied: Physical, Natural, and Human capital forms.

Wealth & Sustainability

- Wealth a key indicator of national and regional well-being and economic & ecological sustainability.
- **Sustainable development** is defined from a **capital** perspective as "... a development that ensures non-declining per capita national wealth by replacing or conserving the sources of that wealth; that is, stocks of produced, human, social and natural capital."

United Nations Handbook of National Accounting - Integrated Environmental and Economic Accounting (commonly referred to as SEEA)

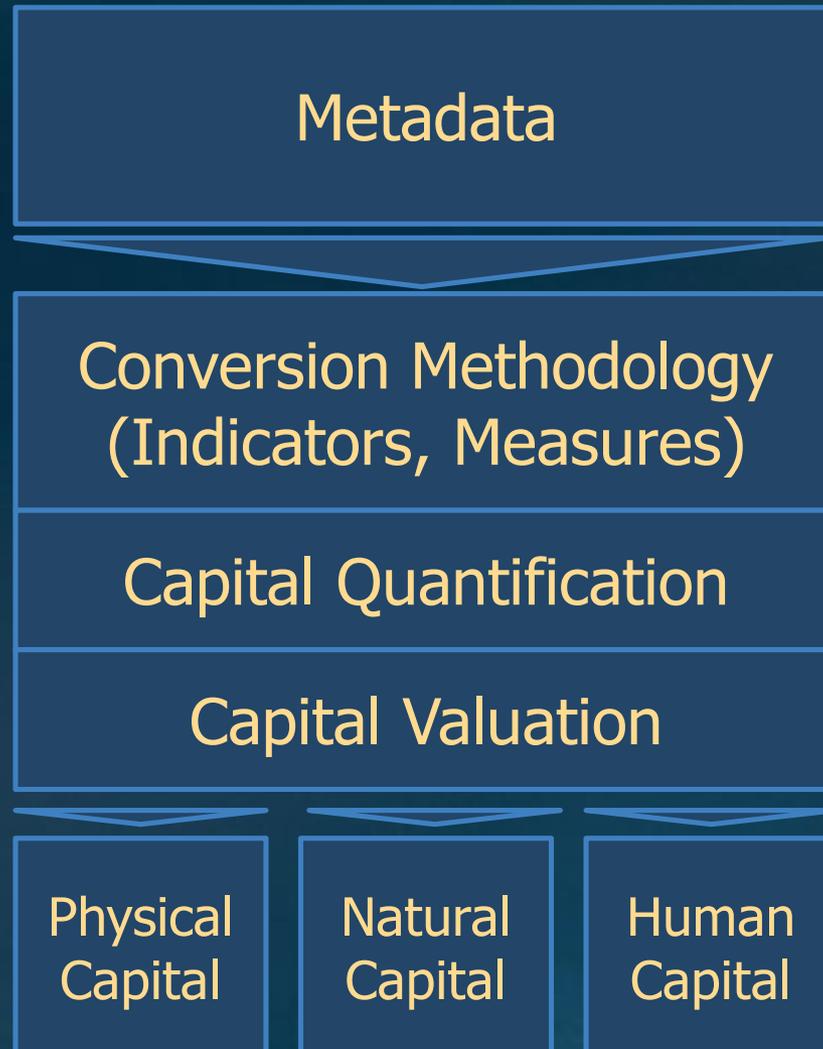
Wealth Estimation

- Major initiatives
 - World Bank 2006, 2013, 2018
 - European Natural Capital Accounting
- Most studies of wealth and capital assets are based on estimates from national statistics
- Only few sub-national assessments of regional wealth

Regional Wealth Estimation

- The “Wealth” , W , is the social worth of all physical, natural, and human capital stocks
- Multiplication of each capital’s quantity the corresponding social valuation, which acts as a weight in the index.
- $W = S_K C_K + S_N C_N + S_H C_H$

Virtual Wealth Scanner



Regional Wealth Estimation: Case of WV

- Geodesign Approach: Technologies & Data
 - GIS and Remote Sensing
 - Using tools for handling vast quantities of spatial data for physical, natural, economic, and socio-cultural systems
 - Geospatial data repositories
 - Empirically capable of augmenting and enhancing capital estimation and calibration of indicator estimates at a variety of spatial scales

Initial indicators tested for the case of WV:

- Physical capital
 - Buildings (Residential)
 - Infrastructure (Roads)
- Natural capital
 - Coal
 - Eco-system services
- Human capital
 - Educational attainment
 - Skills and training levels

Physical Capital: Buildings

WV State Address Mapping Board

- 1:4800 scale

- Designed for E911

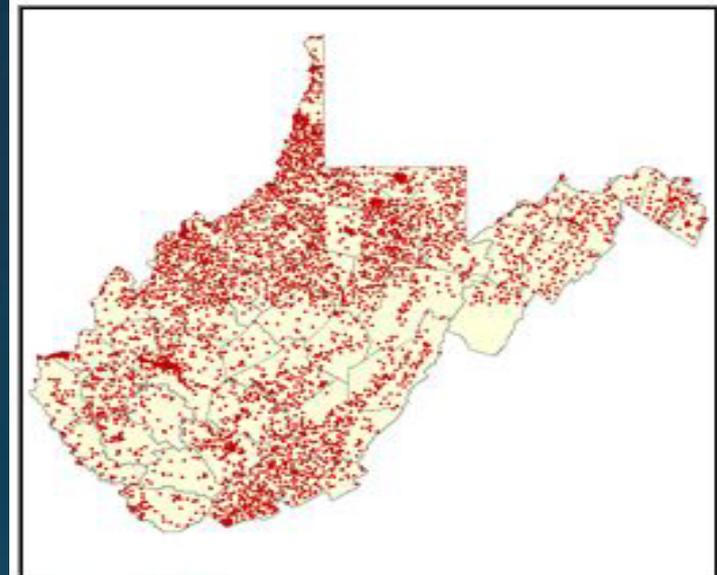
- 621,000 features for WV

USGS Geographic Names Information System (GNIS)

- Schools
- Buildings
- Churches
- Correctional facilities
- Government buildings
- Waste water treatment plants



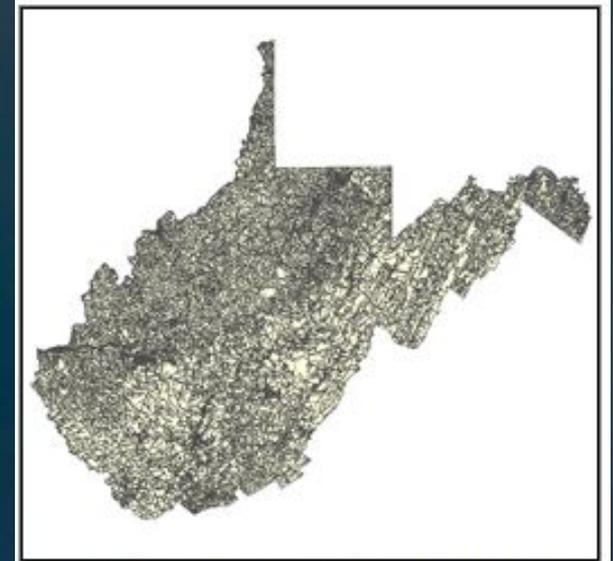
SAMB Building Points and Polygons



Schools (GNIS)

Physical Capital: Infrastructure (Roads)

- Obtain comprehensive road geometry and attribution from a variety of databases
 - USGS Digital Line Graph maps
 - 1:250000, 1:24000
 - Census Tiger/Line files
 - State Dept of Highways based on State Address Mapping Board initiative 1:4800
- Very good data resources
- What is the optimal scale of analysis?
 - The larger the scale the more accurate the road length estimation
- Generate valuations based on construction costs per mile for interstate, major highway, minor roads



Roads and Railroads (1990 and 2000 Census TIGER/Line)



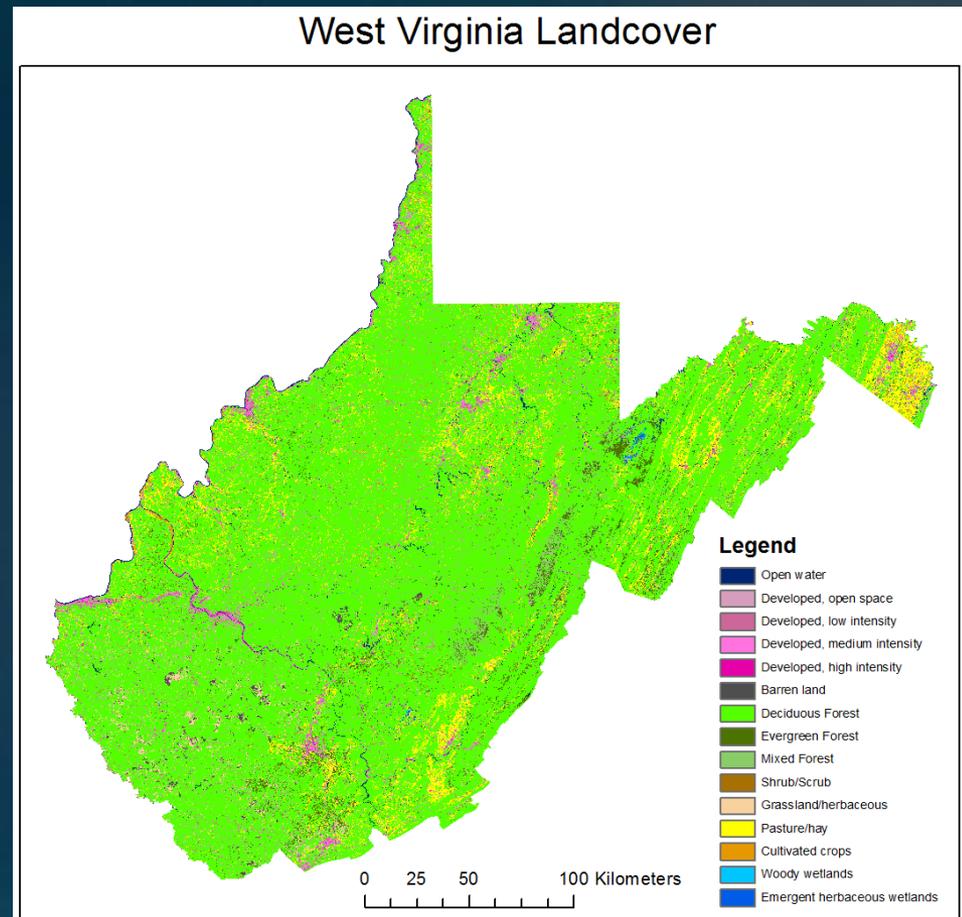
Roads - 1:4800 Scale, Major Roads (WV DOT)

Natural Capital: Coal

- Coal is a major component of natural capital in WV
- Excellent data of resource production history (rate of exploitation)
 - County-level data
- Well understood spatial distribution of current reserves
 - West Virginia Geological Survey mapping
 - 30 m grid (i.e. highly detailed)
 - ~ 50 coal beds
 - Attributes
 - Thickness
 - Depth

Natural Capital: Ecosystem Services...

- Satellite-based remote sensing land cover information
 - Highly detailed
 - 30 m grid
 - Repeatable
 - Entire US every 5 yrs
 - Objective
 - Most of the world covered

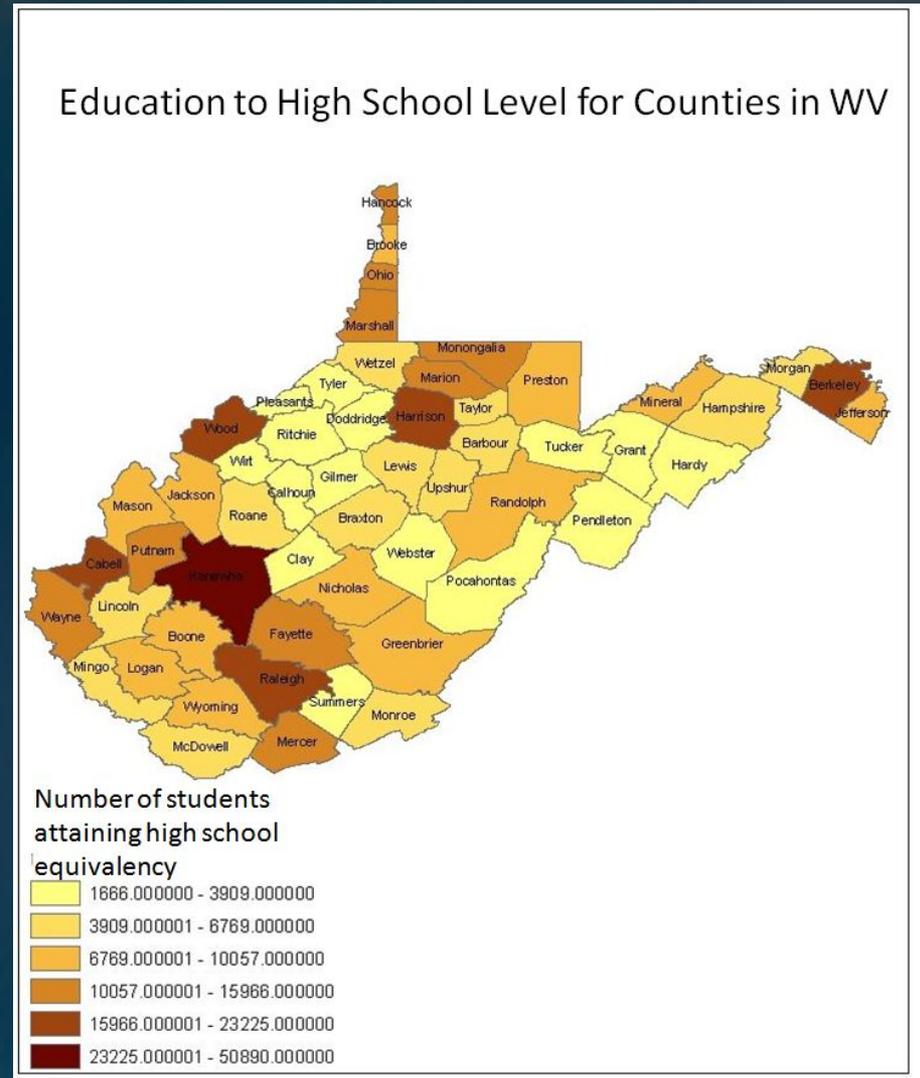


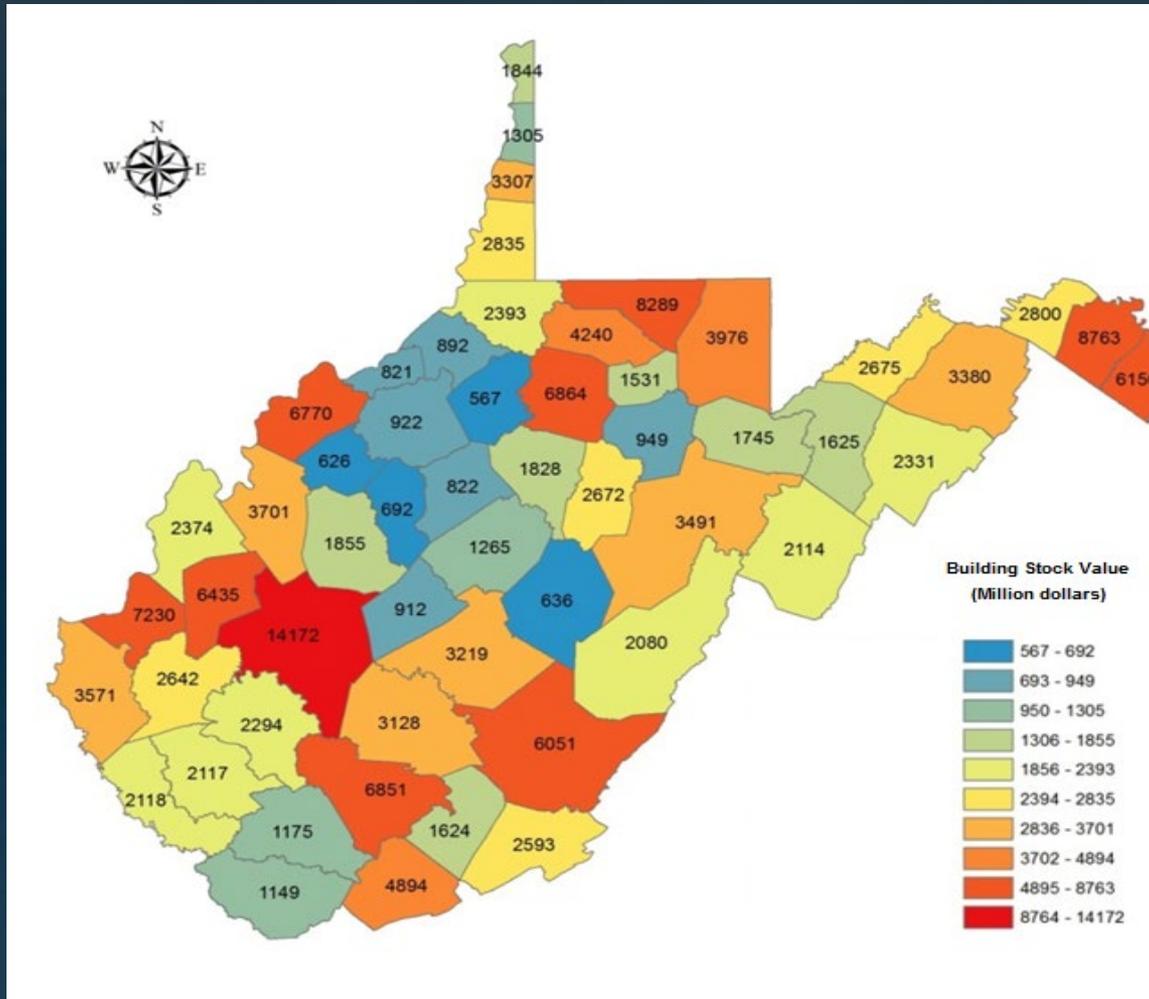
Source: USGS NLCD 2006 data

Human Capital

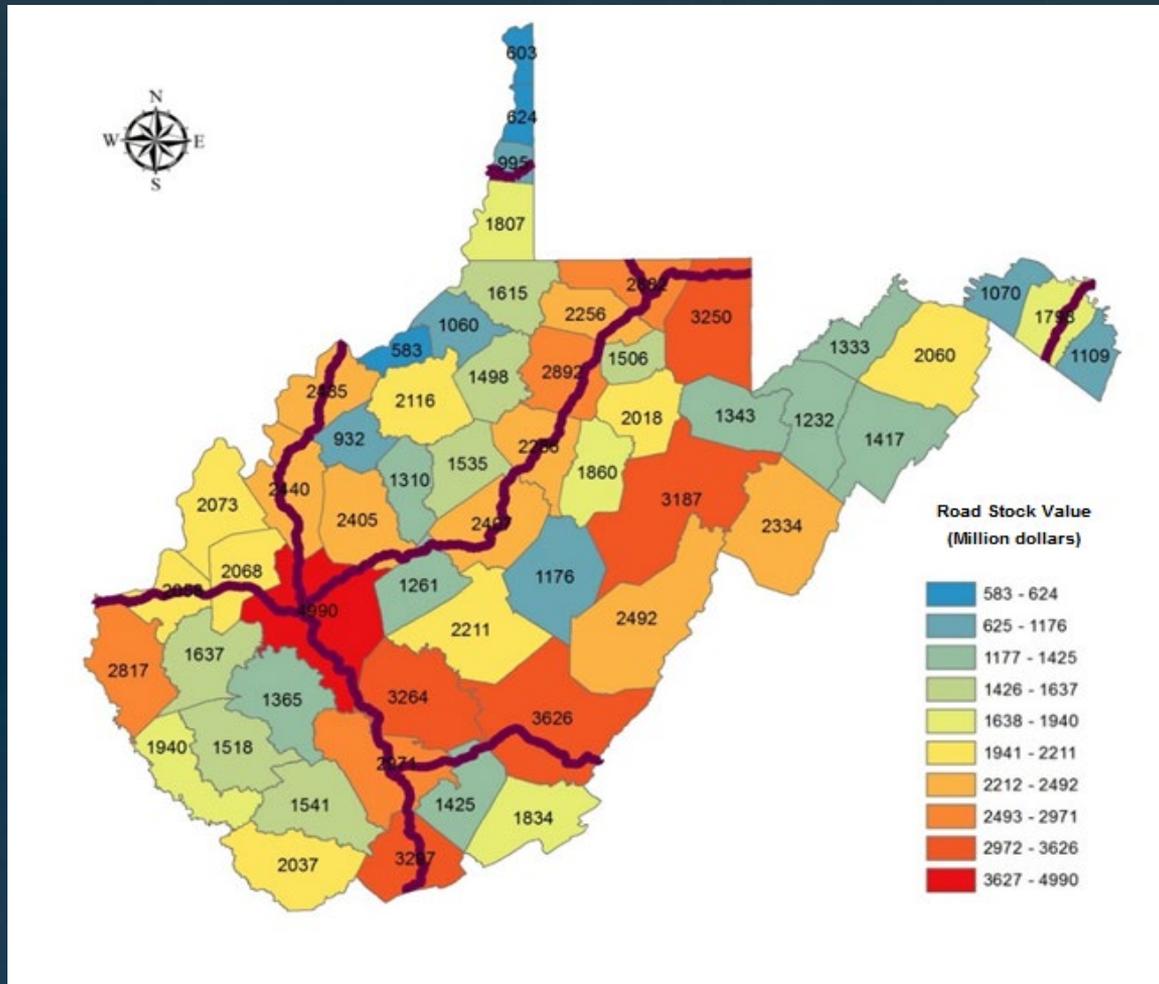
Knowledge: Educational attainment is the most common measure of the skills and knowledge that shape a population's capacity to engage in productive activities.

Talent: Technology-based knowledge occupations are hypothesized to have higher contribution to wealth generation and to be located at places where more talented people reside.

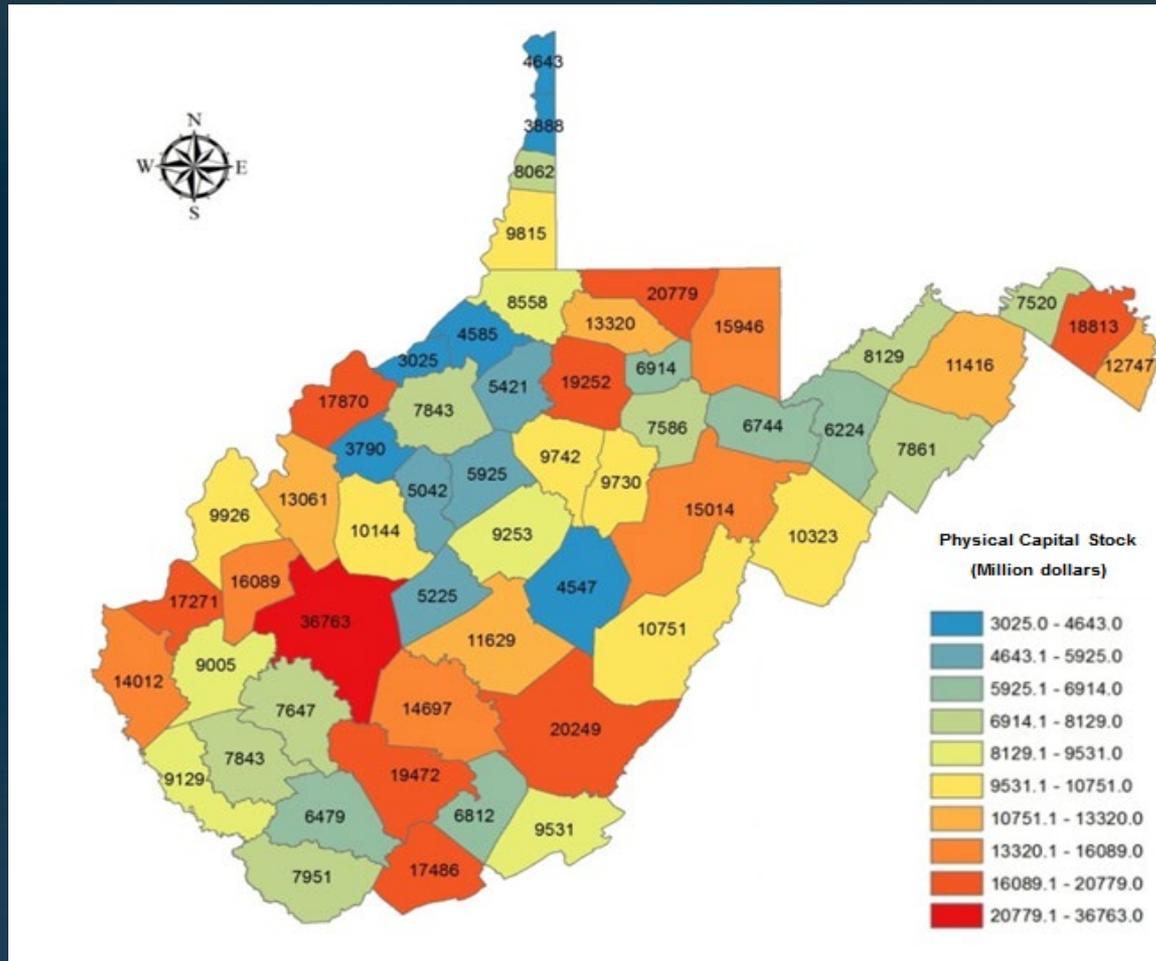




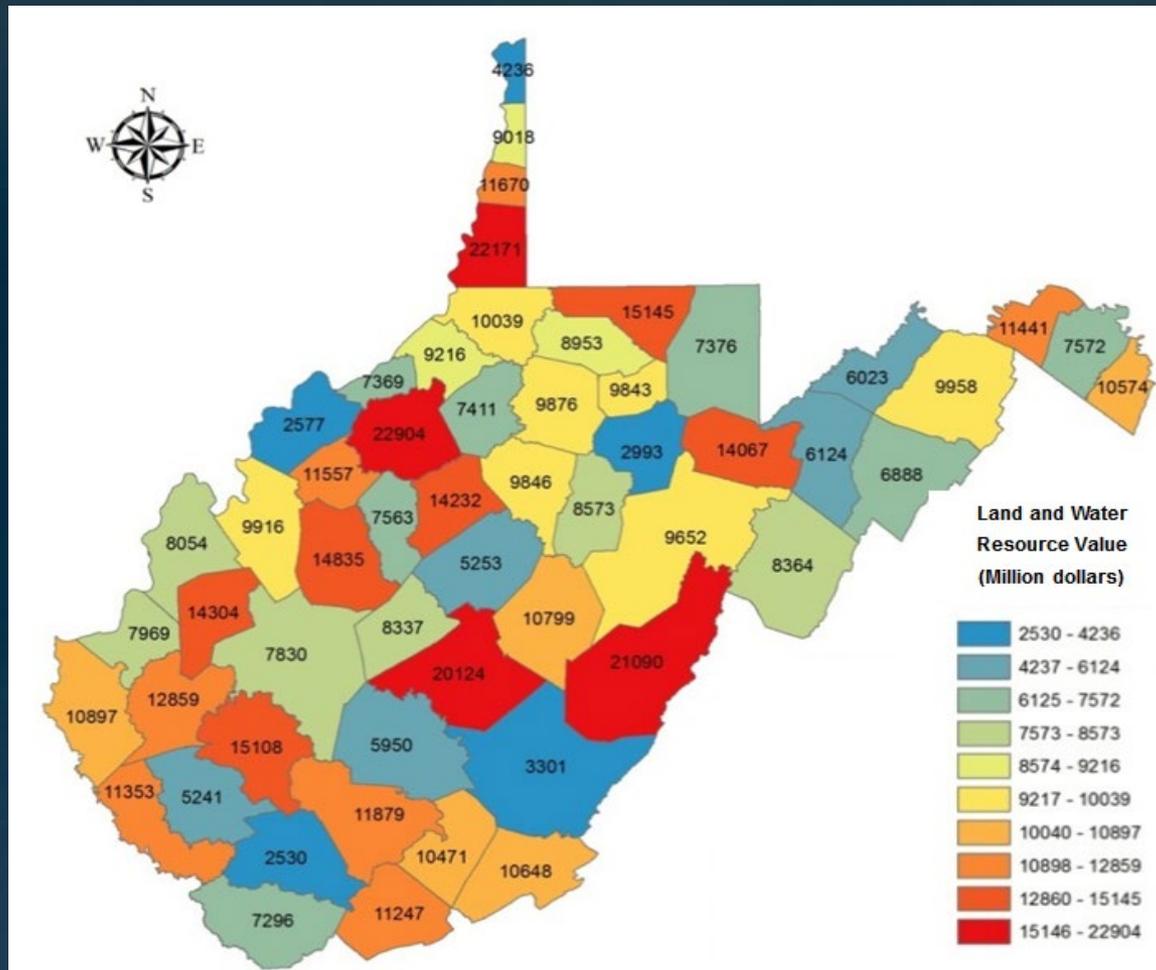
Physical Capital-Buildings
 \$173 Billions



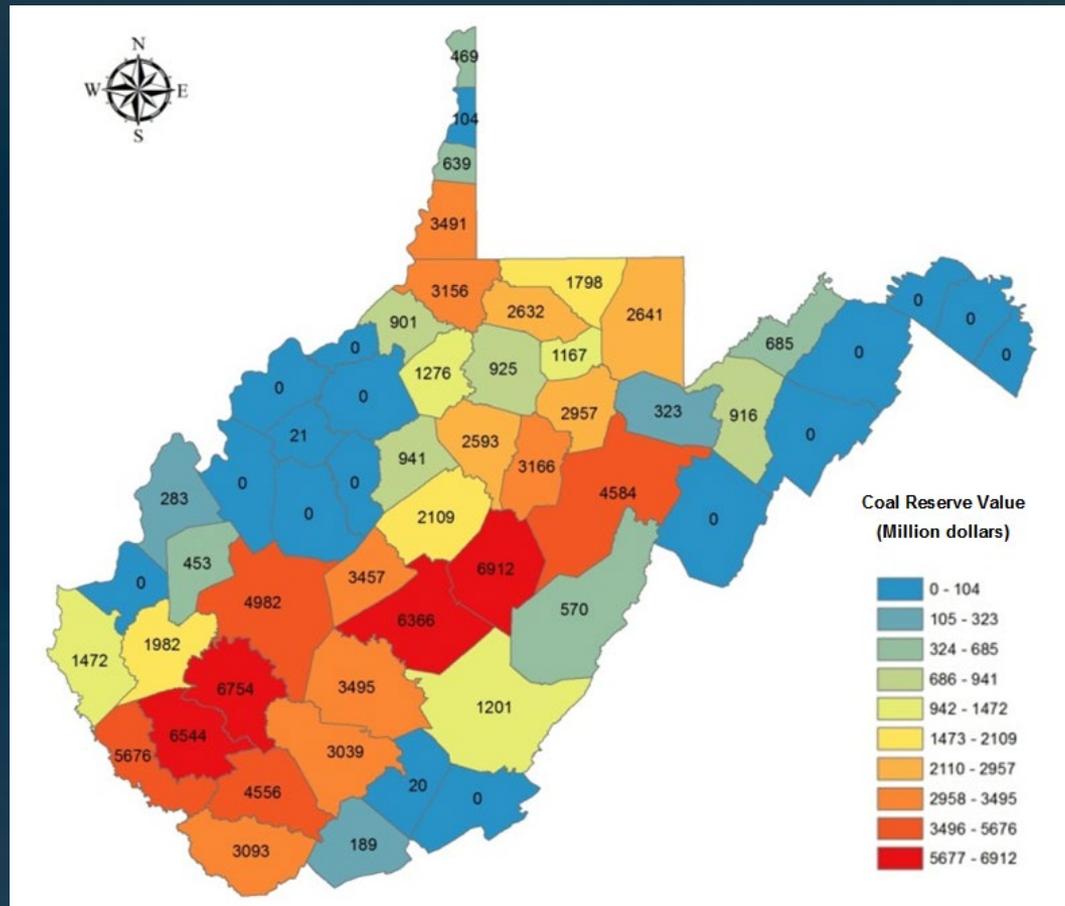
Physical Capital-Infrastructure
\$107 Billions



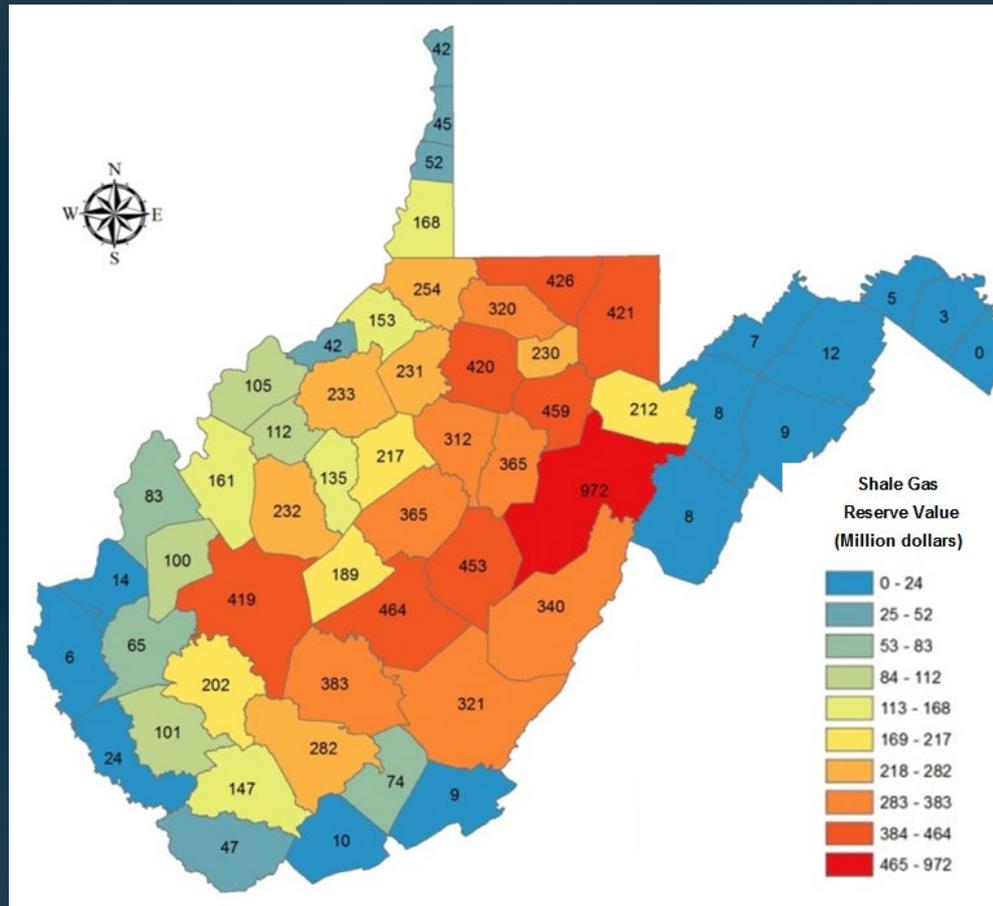
Total Physical Capital \$589 Billion



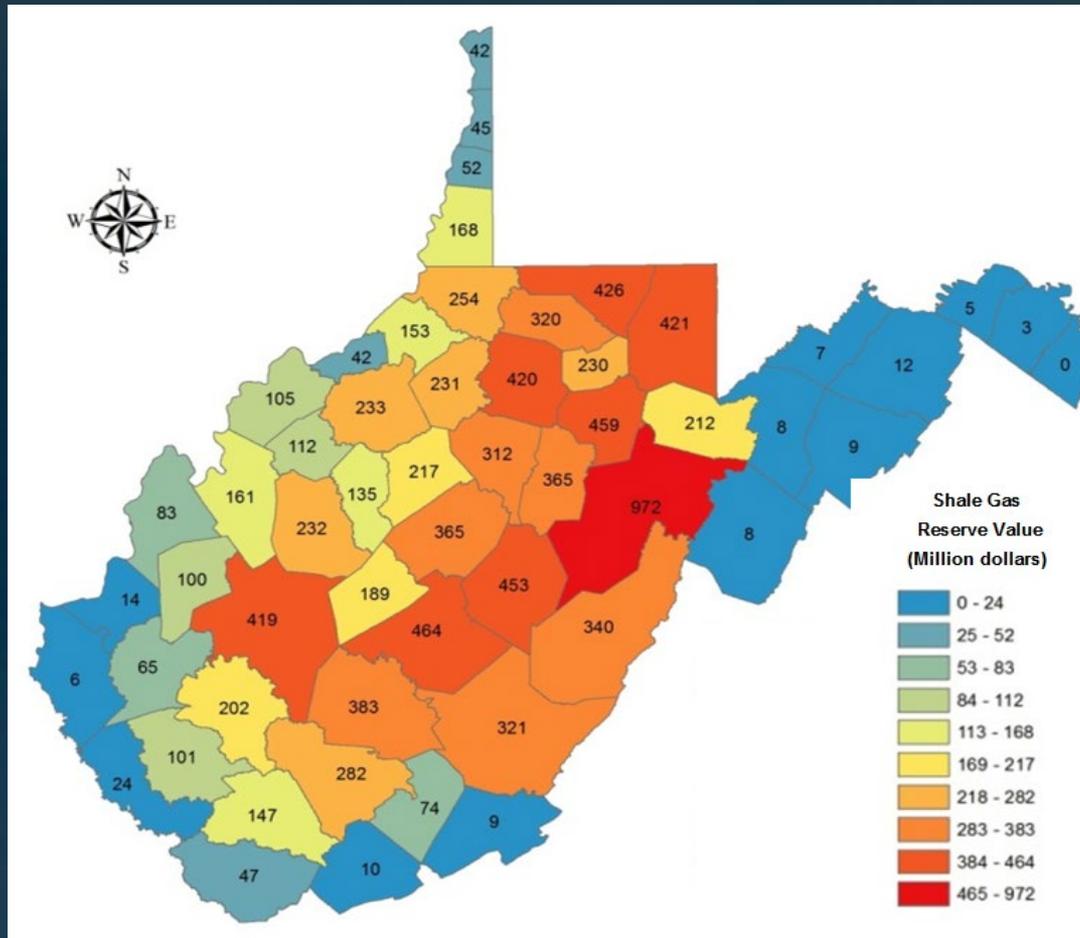
Natural Capital – Land and Water Resources. \$550.5 Billion



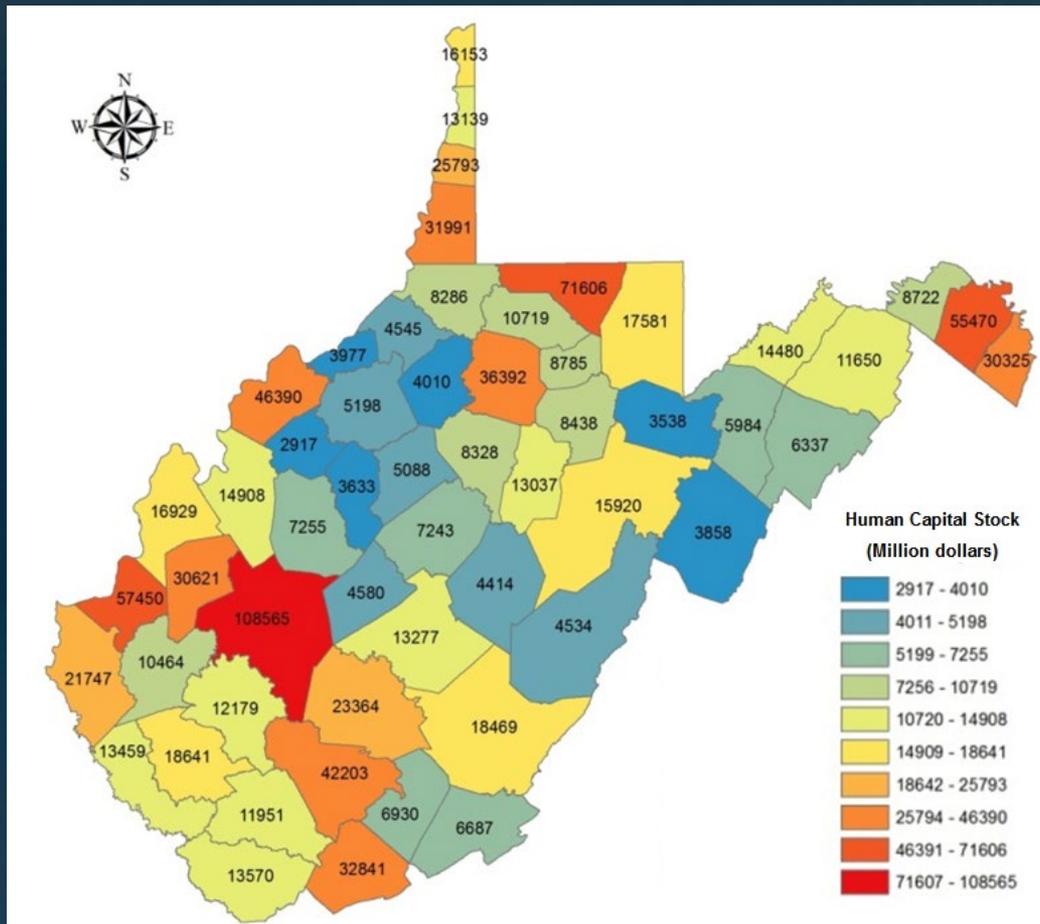
Natural Capital – Subsoil Assets, value of coal reserves



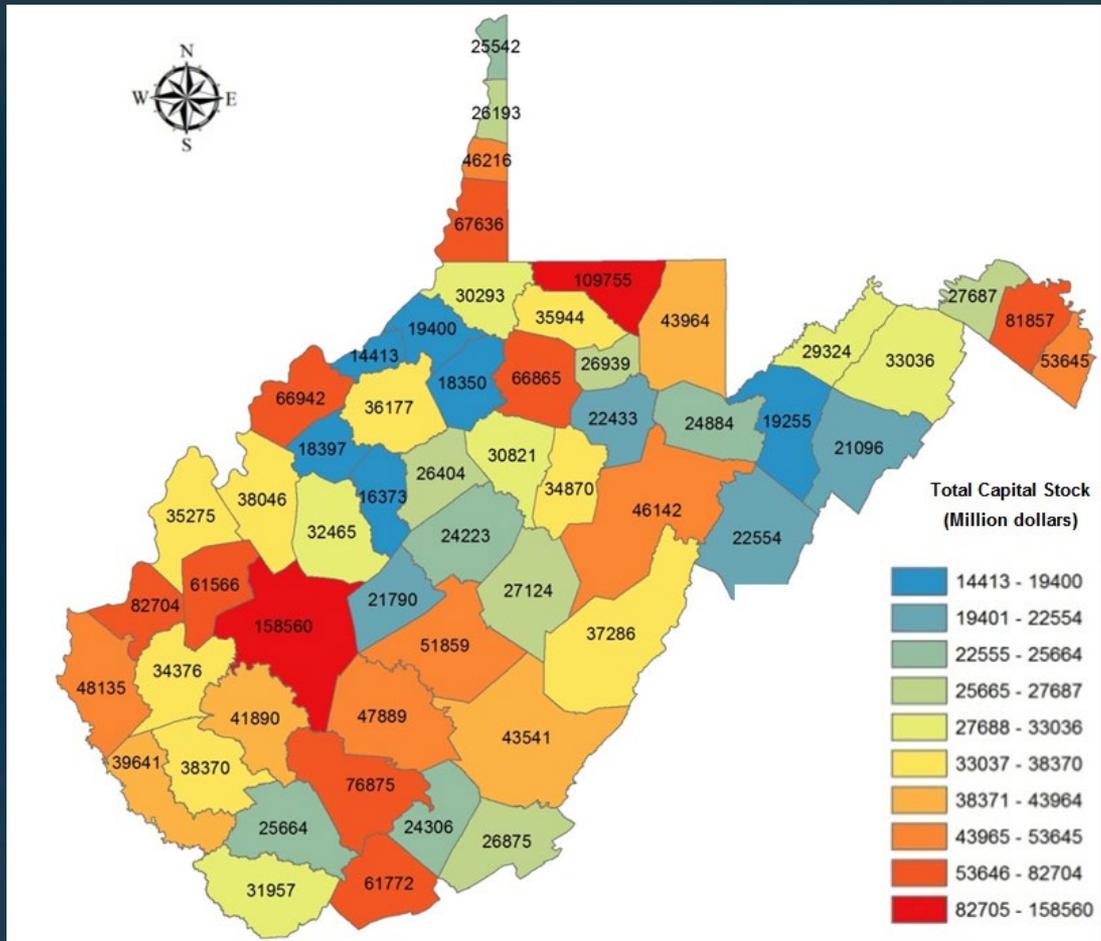
Natural Capital – Subsoil Assets, value of shale gas reserves



Total Natural Capital – Land & water plus energy resources
(coal & gas)
\$660 Billion



Human Capital – Lifetime Labor Income Approach
 \$1005 Billion



Total Capital Wealth in WV Counties (\$ Million)

Total Capital Wealth in WV: \$2.25 Trillion

Next Steps

- Development of the Database
 - **Web Scraping** for automated collection of data
 - **Remote sensing** technologies, satellite and aerial imagery for assessment of natural capital & ecosystem services
 - **LiDAR** high and medium data for assessing physical capital
 - **Drone technology** for physical and natural capital estimation at a finer scale

Next Steps

- Geodesign for Data Analytics
 - ArcGIS for Analyzing Geospatial Patterns of Wealth:
 - **Hot/cold spot analyses** to identify statistically significant clusters of wealth and poverty in the region
 - **Interpolated surfaces** of wealth for a better understanding of the distribution over the whole region
 - **3D visualizations** of the results to create “Wealth Topography” of the region

Concluding Remarks

- Virtual Capital Scanner, a flexible, dynamic, low cost, wealth monitoring system
- Capital estimation key to sophisticated modeling
- Regional & National policy making
- Visual analyses and simulations

- Linking Geodesign with sophisticated economic modeling
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