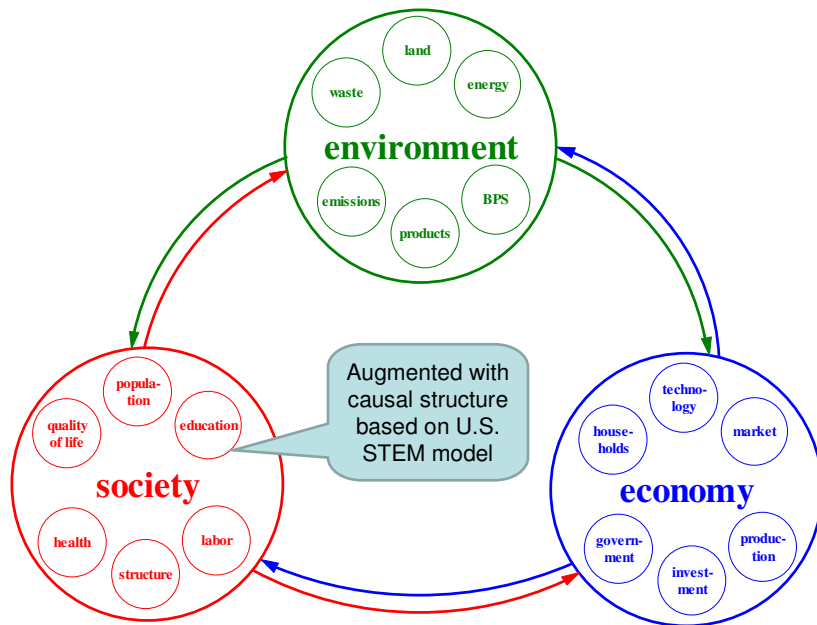


## Overview

- **Central premise:** STEM education and workforce/economic dynamics must be modeled more realistically to meet state needs
- Developed model structure needed to enhance U.S. STEM model and coupled it to existing socio-economic model (T21-Ohio)
- Convened stakeholders to elicit knowledge of priority research questions, key variables, causal relationships and sources of data

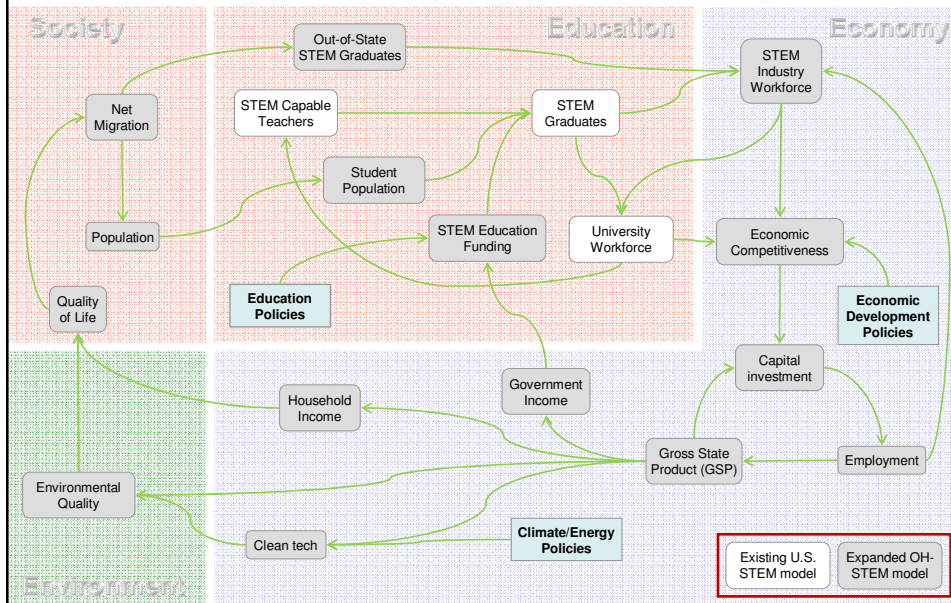
## From T21-Ohio to OH-STEM



## Rationale for OH-STEM Approach

- States are major loci of STEM education policy
  - Regional clusters also significant in many areas
- Current STEM educational initiatives typically linked to workforce and economic development aims
- T21-Ohio models comprehensive state/region-level dynamics, including economic, social, and environmental factors
- Coupling U.S. STEM and T21-Ohio models is an efficient way to build a model that allows rigorous study of intertwined policies and outcomes across these spheres and examination of factors affecting STEM talent supply and demand

# Coupling of STEM Model with T21-Ohio System Dynamics Model



## Dayton STEM Goals

### Student

- K-12, Higher-STEM
- GRAD Rate ↑
- STEM Skill Identification
- ENG. / STEM Rate ↑

### Social

- STEM is cool
- Access for Disadvantage
- Recruit to Prevent Poverty
- Culture
- Credit
- Raise Bandwidth

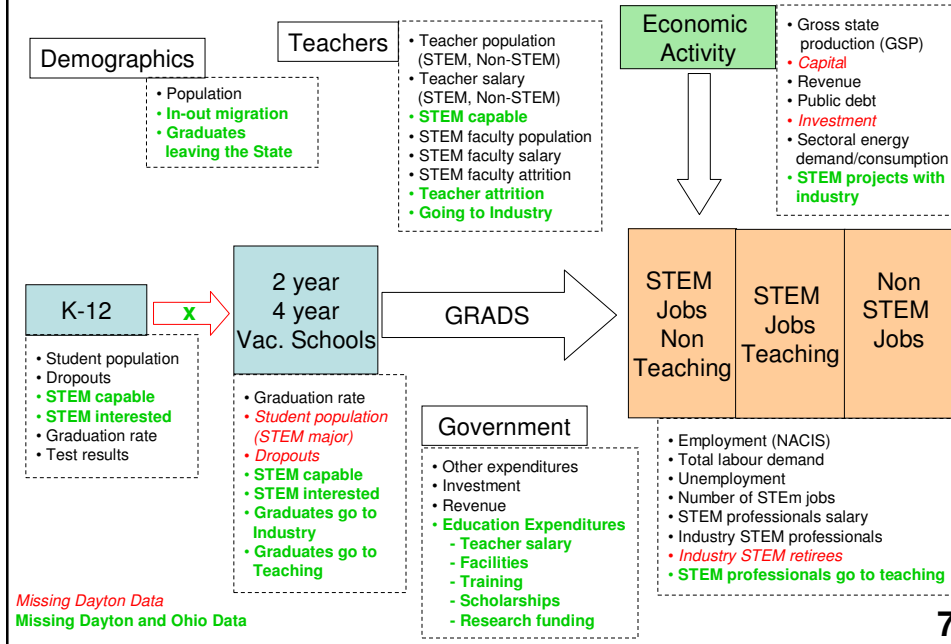
### Workforce

- Local Retention
- Employment ↑
- Lead in R&D
- Lead in STEM Employment

### STEM Quality/Capacity

- High STEM Quality
- Pre K-12
- STEM Everywhere
- Test Scores ↑
- STEM Rigor ↑
- Teacher Training and Evaluation

# Ohio and Dayton Region Data Availability



# Stakeholder-Defined Obstacles / Barriers

Marketing & Understanding Options  
 Counselor Training  
 Depend on Government  
 Private Sector Engagement  
 Imperfect Assessment Tools  
 Teacher Quality and Training  
 Teacher Pool  
 Skills Gap After K-12  
 No Funding for Talent Development  
 Financial Aid  
 Students Lack of Career Vision

Dayton Bias  
 Lack of Skilled Workforce  
 High-Cost Economy  
 Program Rich – System Poor  
 Resource Alignment  
 Disconnect Job vs. Skills  
 Poor Information for Students  
 Race  
 Family and Community Support  
 Private Sector takes brights  
 Student Preferences

# Potential Interventions

Factors of Interest	Key Indicators
STEM teacher salaries vs STEM industry salaries	Student STEM Proficiency
Classrooms (class size; equipment)	College STEM attrition rate
Scholarships	No. of STEM graduates go to industry/teaching
STEM capable/non-capable teachers (recruitment, retention, professional development)	No. Of STEM graduates go to grad. school
Curriculum	No. Of STEM capable teachers
Instructional methods	No. of jobs created
Computer based teaching	Gross state product
Distance learning opportunities	Net migration
Internships for students	Environmental quality
Research funding	
Private sector help (help teachers teach certain topics, and volunteers in schools; provide funding; tax incentives)	

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## Summary: Developing a State Model

1. Assemble a model development team: Researchers + Modelers
  - Expertise and knowledge of data sets across education, workforce and economic development
2. Convene or interview stakeholders to identify key causal relationships and identify questions of interest for the state
  - Example: How can we double the number of STEM graduates by 2020?
3. Modelers create stock and flow model based on stakeholder feedback
4. Data gaps are identified and missing data is tracked down; where there are no data, assumptions are made
5. Calibrate and run the model
6. Reconvene key stakeholders to validate model and default assumptions

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# A Scenario

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# Scenario

## **Base Case:**

- No changes to the system

## **STEM Non-Capable Teacher Attrition:**

- 15% increase in attrition rate among STEM non-capable teachers with 0 to 3 year experience for 9th-12th grades

## **STEM Non-Capable Teacher Attrition and New STEM Jobs:**

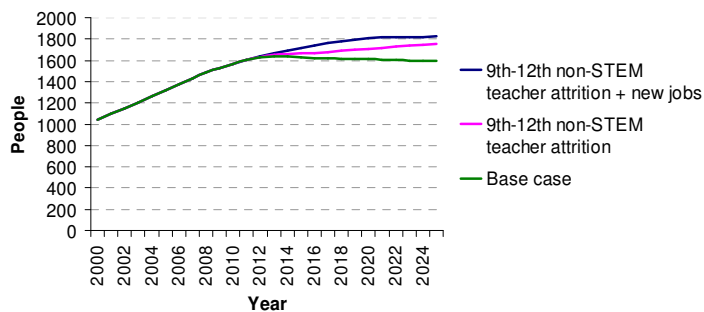
- STEM non-capable teacher attrition scenario
- 10,000 new STEM jobs added between 2010 and 2025
  - Industry STEM jobs introduced = 5000
  - Service STEM jobs introduced = 2000
  - High Tech STEM jobs introduced = 500
  - Healthcare STEM jobs introduced = 2500

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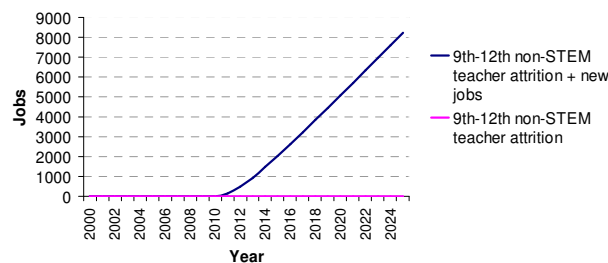
# Scenario: Results

STEM Non-Capable Teacher Attrition	STEM Non-Capable Teacher Attrition and New STEM Jobs
<p><b>Total STEM jobs created:</b> none</p> <p><b>GSP generated:</b> none</p> <p><b>GSP per employed person:</b> same as base case</p> <p><b>Government revenues:</b> same as base case</p> <p><b>STEM graduates:</b> increased by average 4% compared to the base case</p>	<p><b>Total STEM jobs created:</b> 17,320 (direct and indirect)</p> <p><b>GSP generated:</b> on average about \$120 million/year</p> <p><b>GSP per employed person:</b> on average about \$123,000 person/year</p> <p><b>Gov't revenues:</b> approximately \$163 million in 15 years (increased compared to based case)</p> <p><b>Unemployment rate:</b> down by 0.85% in the short term;</p> <p><b>STEM graduates:</b> increase by average 3.7% compared to Scenario 1</p>

### High School STEM Graduates



### Annual STEM Jobs Created



## Conclusion

- We find strong interest in the potential of systems models among stakeholders engaged in STEM education/workforce initiatives
- Developing state-level model structure is fairly straightforward; data availability and quality challenges can be significant
- Less comprehensive model structure may be adequate to capture basic workforce/economic dynamics
- Awaiting confirmation of award under NIH “Modeling the Scientific Workforce” initiative

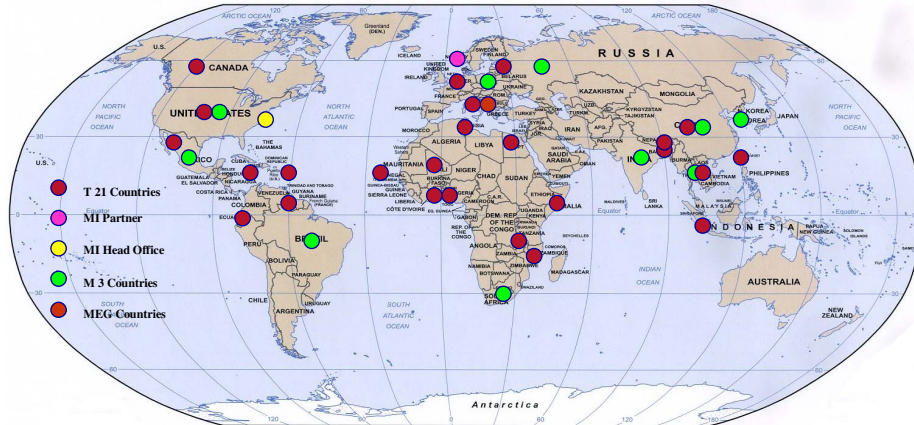
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## Backup Slides

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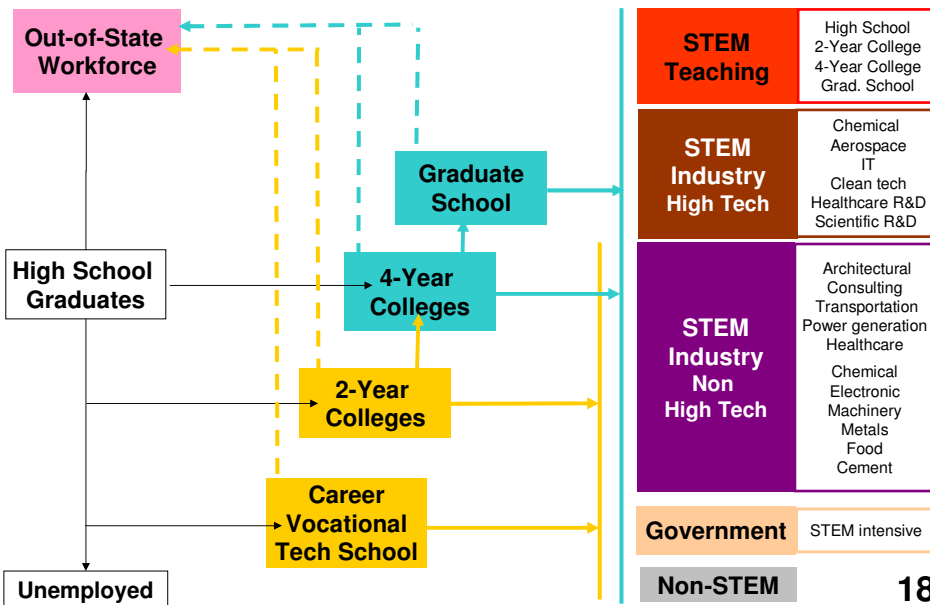
## Threshold 21 (T21)



- T21 can be applied to most countries or regions
- More than 25 unique, customized T21 models have been developed to date.

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## Potential Student Pathways (data needed to quantify flows)



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## Workforce Demand

<b>STEM Teaching</b>	High School 2-Year College 4-Year College Grad. School
<b>STEM Industry High Tech</b>	Chemical Aerospace IT Clean tech Healthcare R&D Scientific R&D
<b>STEM Industry Non High Tech</b>	Architectural Consulting Transportation Power generation Healthcare  Chemical Electronic Machinery Metals Food Cement
<b>Government</b>	STEM intensive
<b>Non-STEM</b>	

## Ohio State Level and Dayton Region STEM Data Acquired

Data Type	Collected	Source
<b>Demographics</b>	Population (1992-2008) Median Income (1999-2008)	U.S. Census
<b>Education</b> K-12 2-year col. 4-year col.	No. of high school graduates (1996-2008) Student populations (K-12) (1992-2008) High school dropouts (1996-2003) Test results (1999-2009) Total enrollment (2005-2008) Number of teachers (2001-2009) Avg. teacher salary (2001-2009)	Ohio Department of Education Interactive Local Report Card Ohio Higher Education Information System (HEI) National Center for Education Statistics (NCES)
<b>Labor</b>	No. of Sectoral Workforce (1992-2009) No. of STEM jobs (1999-2008) No. of Non-Teaching STEM Jobs (1999-2008) No. of Teaching STEM Jobs (1999-2008) No. of High Tech Jobs (2000-2008) Avg. Non-Teaching STEM Salary (1999-2008) Avg. Teaching STEM Salary (1999-2008) Avg. High Tech Salary (2000-2008)	Ohio Labor Market Information U.S. Bureau of Labor Statistics

## Missing STEM Data Required for Models

Data Type	Ohio	Dayton
<b>Education</b> K-12 2-year col. 4-year col.	STEM capable students STEM interested students STEM teacher attrition College grads go to Industry/Teaching College grads. leaving the state STEM capable teachers STEM teachers go to industry	Student populations (college - major) STEM capable students STEM interested students STEM teacher attrition College dropouts College grads go to Industry/Teaching College grads. leaving the state STEM teachers go to industry Cost of K-12 education/college Government education expenditures
<b>Labor</b>	STEM professionals go to teaching	Industry STEM professionals (ages) Industry STEM retirees STEM professionals go to teaching