

Forge the Future – Pennsylvania's Path to an Advanced, Energy-Enabled Economy

September 2018








Forge The Future: Three Phase Project

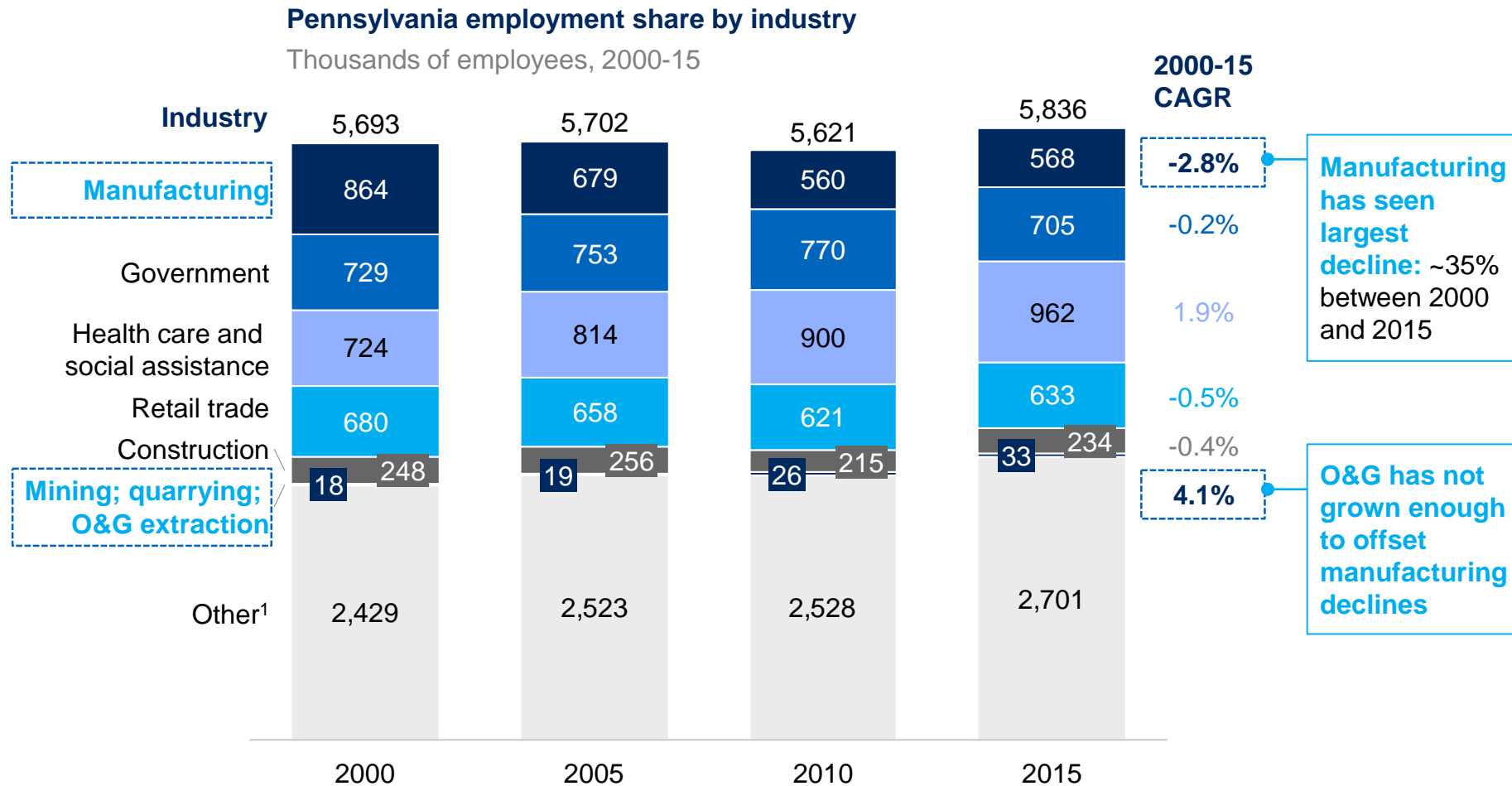
- Steering Committee
- 2017 Phase I – Conduct study with McKinsey, deliver report
- 2018 Phase II – Partnership with PA Chamber of Business/Industry to engage PA business community, others
 - Actionable ideas/initiatives against the report's five strategic pathways
- 2018 Phase III – Implement initiatives/ideas
 - Coordination with existing economic development organizations and initiatives

Overview of the opportunity – Harnessing Pennsylvania’s low-cost energy to promote economic growth and competitiveness

End-state objective by 2025

1 Pennsylvania power and heating		<ul style="list-style-type: none">▪ Build ~6,000 MW of new natural gas power in Pennsylvania▪ Convert ~500,000 homes heating from fuel oil to natural gas▪ Install ~2,200 MW of distributed combined heat and power	
2 Pennsylvania clusters	Petrochemicals		<ul style="list-style-type: none">▪ Build a world-class petrochemical hub with 3-5 ethane crackers, 3-5 PDH plants, 2-3 ammonia plants and inorganic chemical plants▪ Expand into high-value specialty plastics manufacturing
	Advanced materials		<ul style="list-style-type: none">▪ Be the leading materials supplier for US northeast infrastructure growth (2-3% annual growth), harnessing historical strength in steel, aluminum, cement, and glass▪ Establish the commercial hub of advanced materials technology (e.g., fiberglass, advanced cement) drawing on R&D leadership
	Data-driven automated manufacturing		<ul style="list-style-type: none">▪ Achieve national Top 3 position in data-hungry advanced manufacturing focusing on Pennsylvania leadership in robotics, artificial intelligence, and additive manufacturing▪ Develop data center network (6-8 major centers) harnessing low-cost power, preparing for worldwide rollout of data-hungry Internet of Things
3 Gas exports		<ul style="list-style-type: none">▪ Expedite key pipelines (including Transco, Texas Eastern, Columbia Gulf, PennEast/UGI) to increase gas exports by 3.6 Tcf by 2025, ensuring stable gas production needed for Pennsylvania long-term competitiveness and investor confidence	

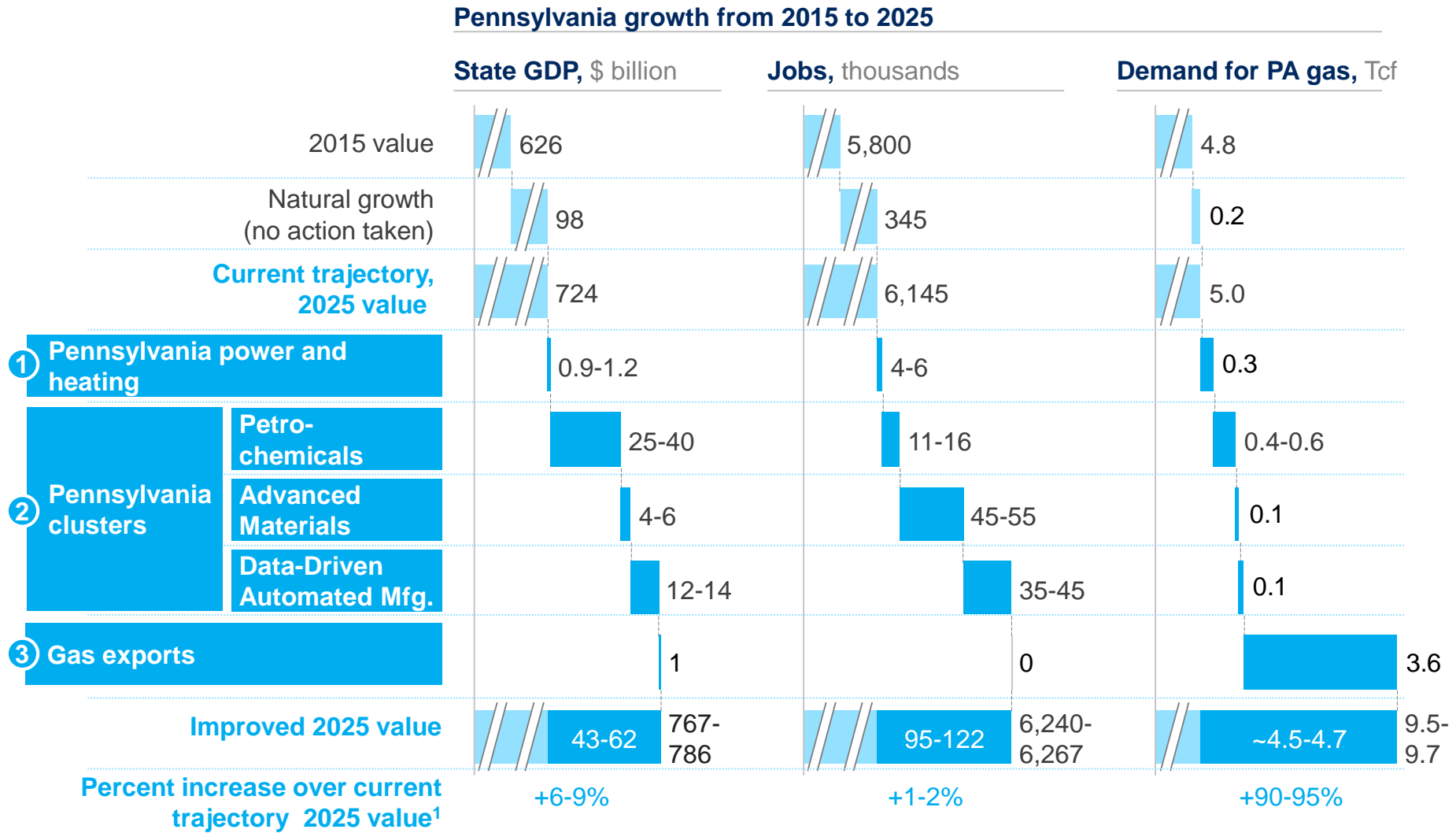
Over the past 15 years, energy has seen the fastest growth, but it will need to catalyze broader growth to offset ~35% decline in manufacturing jobs



¹ Other sectors include accommodation and food services, professional and technical services, admin services and waste management, finance and insurance, transportation and warehousing, educational services, wholesale trade, mgmt. of companies, arts/entertainment, information, real estate and rental/leasing, utilities

Potential impact of energy-driven economic growth in Pennsylvania

Energy-driven economic growth



¹ 2015-2025 CAGR increase due to economic development: GDP = ~0.9%, jobs = ~0.2%, gas demand = ~6.7%

2 Based on the analysis, Pennsylvania should focus on developing three energy-based clusters that enable leadership in future high-value sectors

Potential economic clusters

Petrochemicals



Build chemicals value chain through specialty plastics to serve U.S. manufacturing, and ammonia to serve Midwest agriculture

A Energy-intensive anchor sectors

- Ethane cracking/ Polyethylene
- PDH plants/ Polypropylene
- Ammonia plants
- Inorganic chemicals

B High-value growth sectors

- Specialty plastics (e.g., foam, surfactants, drilling additives)
- » ▪ Extruders
- Auto industry plastic components

Advanced Materials



Expand existing Pennsylvania infrastructure and production capacity to capture next wave of regional infrastructure buildout

- Glass
- Cement
- Steel
- Aluminum

- » ▪ Advanced glass (e.g., electronics and fiber optics)
- Advanced construction material (e.g., lightweight concrete, nanofiber)

Data-Driven Automated Manufacturing



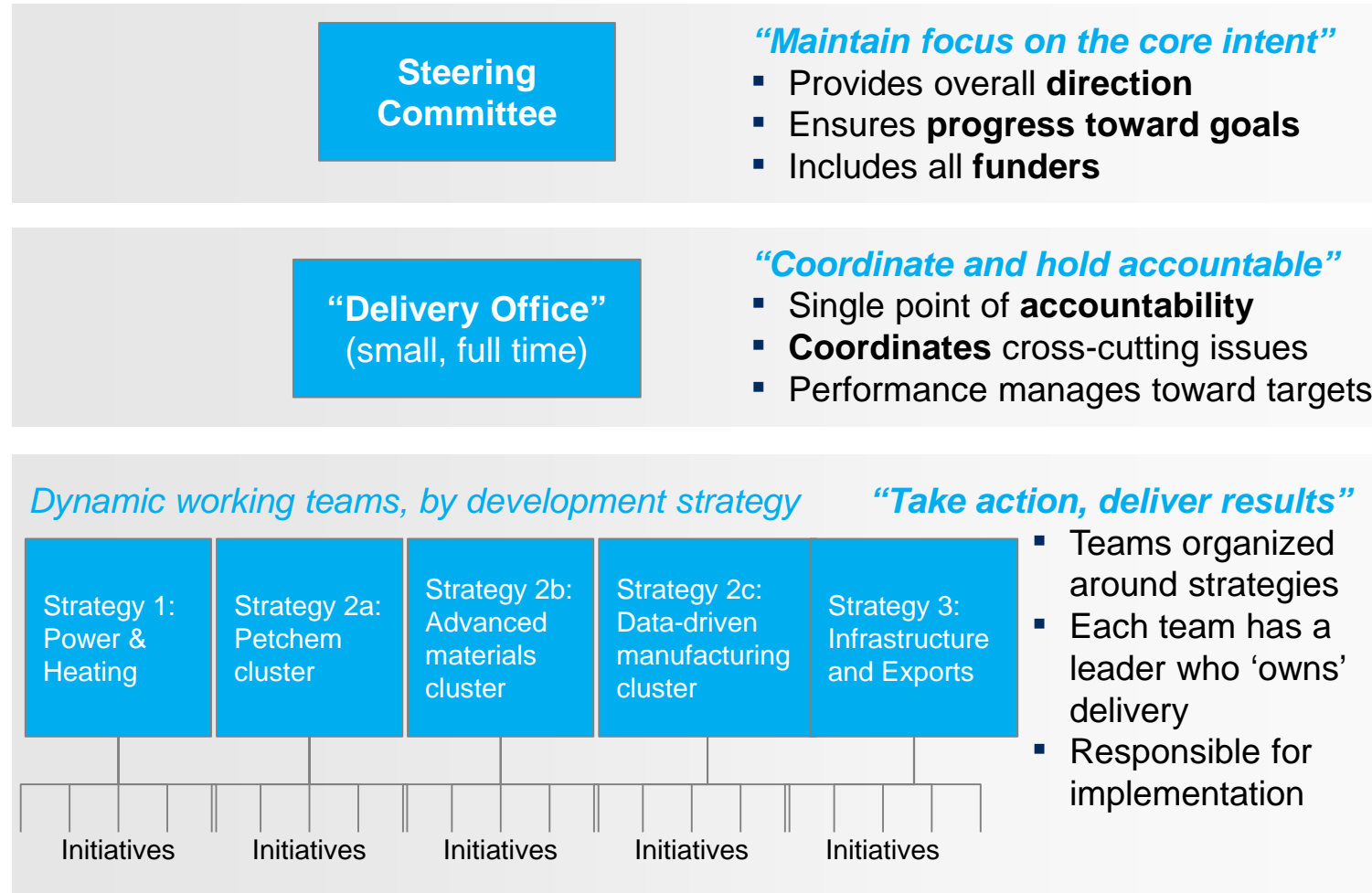
Commercialize PA's leading innovation in analytics, AI and robotics to supply the next generation of manufacturing

- Data centers¹
- Fabricated materials (e.g., machine shops)

- » ▪ Robotics
- Artificial intelligence
- Additive manufacturing (plus the other Clusters as local markets for scale)

¹ Enabler for advanced mfg. tech growth (e.g., IOT, AI, additive manufacturing); proximity may matter as data becomes more closely linked with mfg. operations

Lessons from other development efforts suggest a basic formal setup is needed to drive focus, accountability, and results (vs. ideas on a shelf)...



This structure **still allows for varied design choices** around level of formality, resourcing, and focus