SAND2020-5052PE

COVID19 Pandemic Economic impacts study: *Current Status*

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What is the cumulative economic impact of COVID-19 and different recovery strategies?

Introduction

Goal

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Layers and Scenarios

Creating a New Baseline

Current Status

Previous studies performed for DOE/Office of Radiological Security and Department of Homeland Security have shown that large-scale disruptive events can have large economic impacts.

Previous studies have shown that coordinated policy response can reduce economic loss.

The purpose of this study is to:

1. Examine the effects of COVID-19 pandemic

2. Determine the cumulative economic impact and the loss drivers

3. Test recovery strategies

THE BOTTOM LINE:

There is a high potential for the COVID-19 pandemic to have a large impact upon all of America.

Our goal is to estimate the cumulative economic impacts of COVID-19 and recovery strategies.

Our approach is to generate a national baseline forecast with the REMI model, then modify the baseline to reflect national COVID-19 impacts, then examine response and recovery strategies.

The impact is sizeable, according to our analysis:
- Using data as of April 24th with assumptions about the duration of the COVID-19 event as projected now combined with scenario assumptions about recovery results range from 9.2% to 15.9% reduction in 2020
- That is equivalent to ~$2 to $3.4 trillion loss (annualized)

Potential response and recovery strategies should be carefully examined for effectiveness.

U.S. GDP Percentage Difference From Baseline
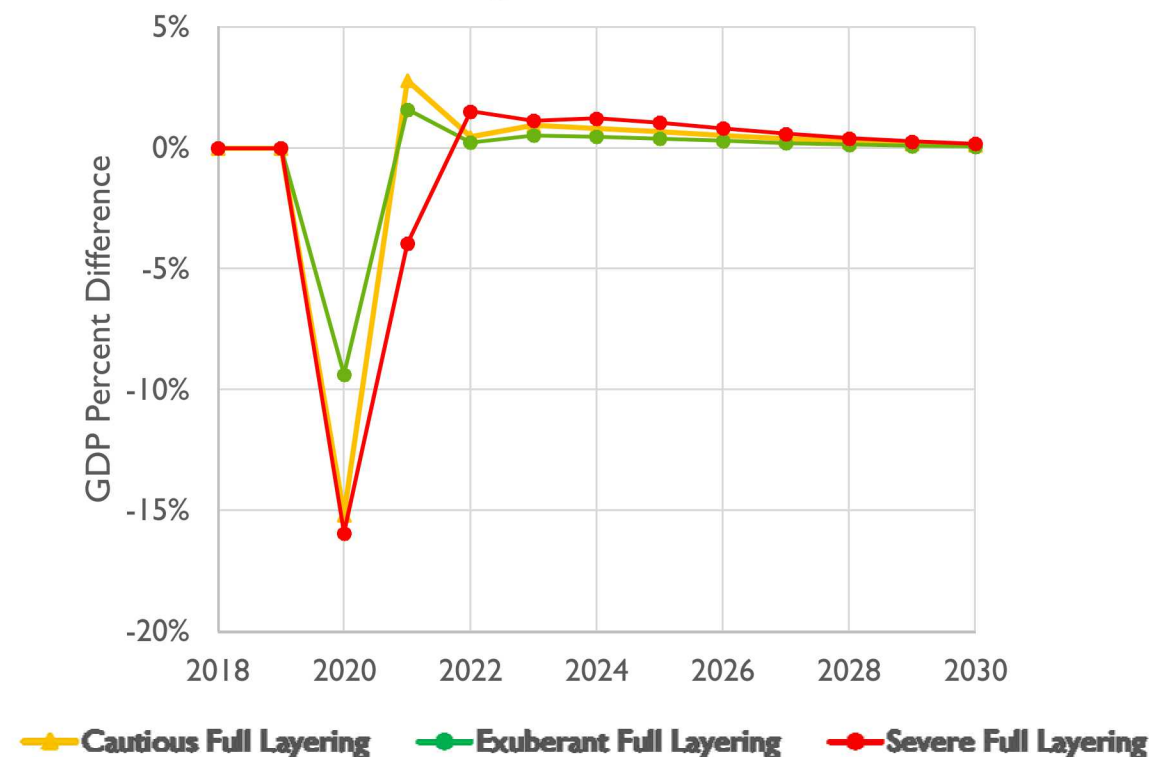
How this briefing will progress
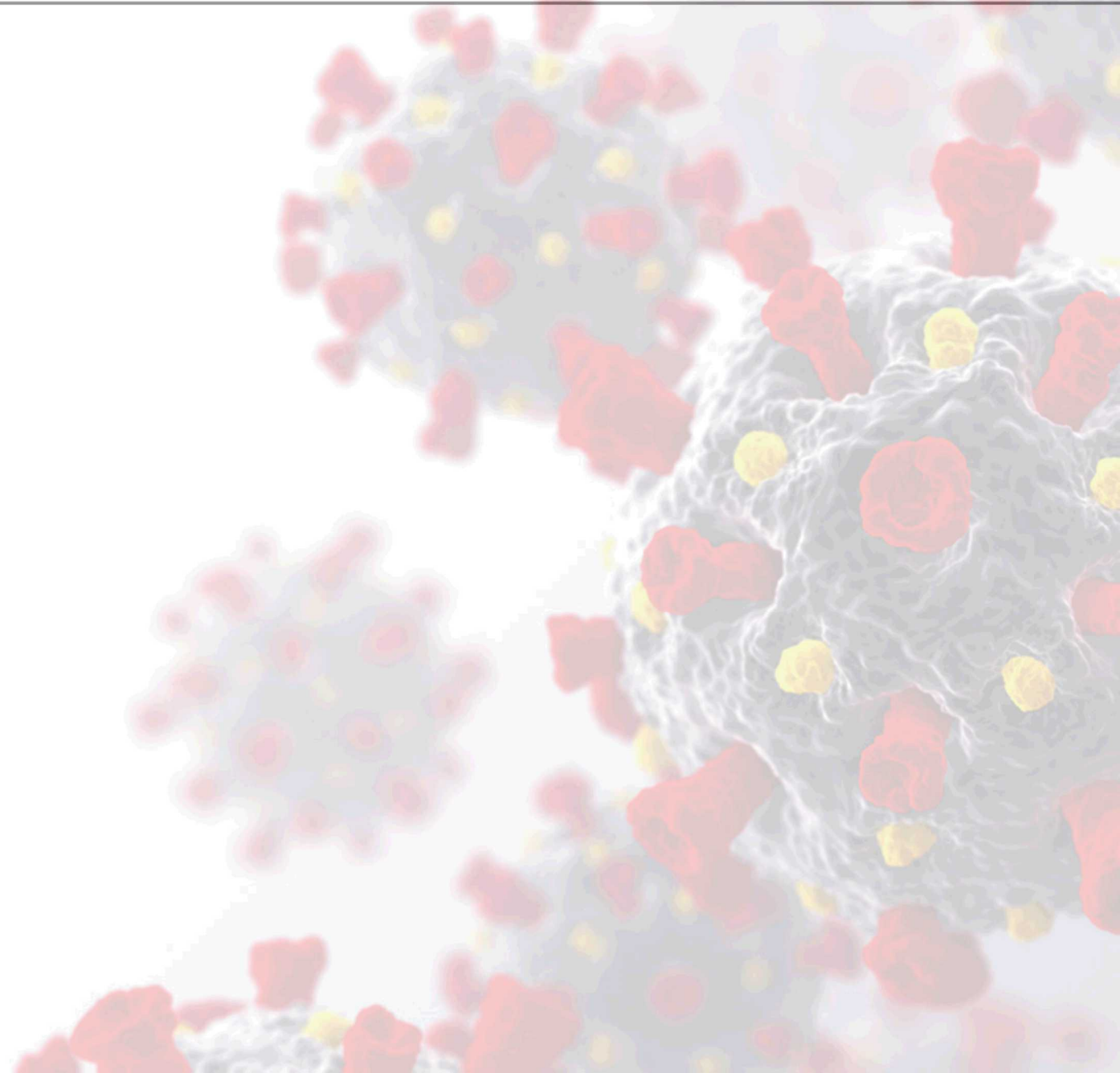
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Our goal is to estimate the cumulative economic impacts of COVID-19 and recovery strategies

State-by-state impacts
- Essential vs non-essential businesses
- Staged return to work
- Other mitigation or intervention policies

Temporal adjustments
- Scaling of short-term to annual adjustments
- Continuous data mining

Integrate other modeling efforts
- Output from epidemiological (epi) models
- Health resource models

Psychosocial effects
- Consumption switching
- Avoidance behavior
- Work from home policies
- Demand elasticities

% | 0-3 | 4-7 | 8-11 | 12-15 | 16-19 | 20-23 | 24-27 | 28-31
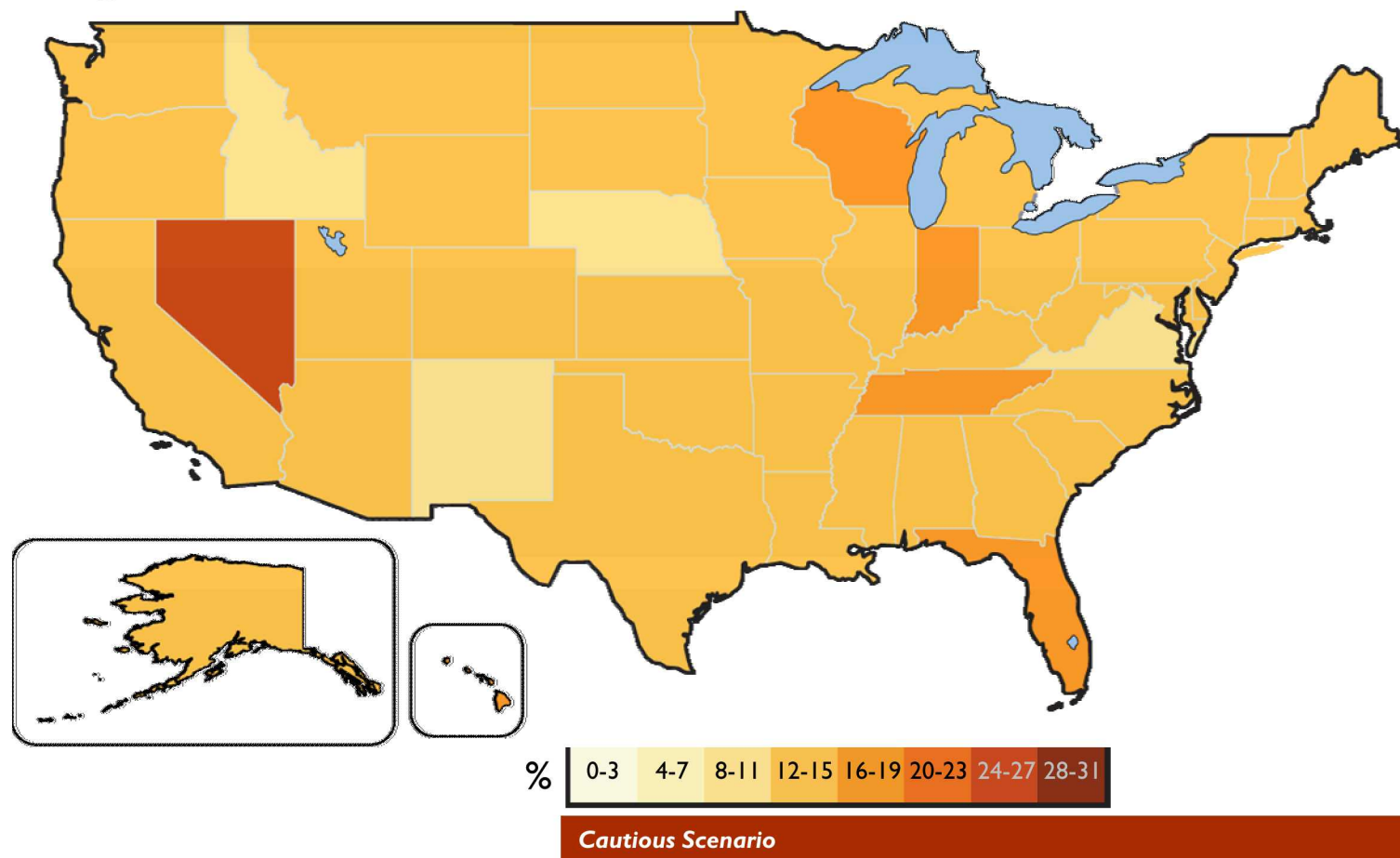
Cautious Scenario

We aim to achieve not only a useful product for policymakers, but also improve Sandia's capability

We have several modeling objectives

Simple
- Facilitate Quick-turn analysis

Flexible
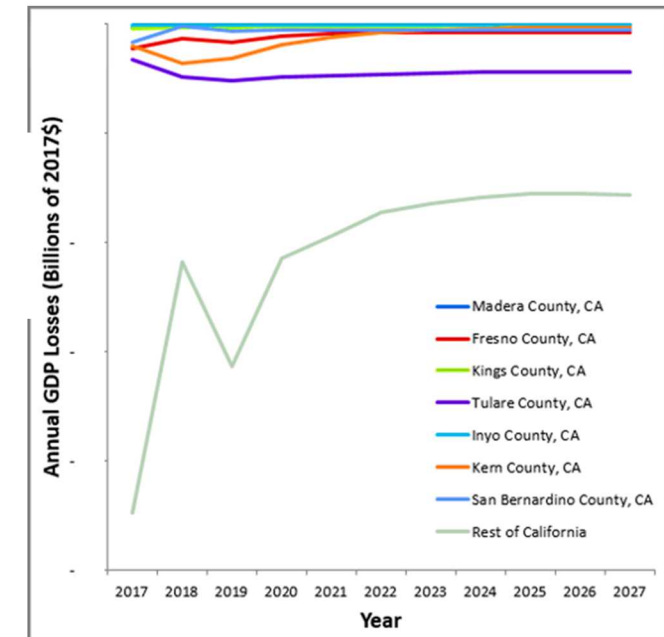- Easily modified from baseline to various scenarios

"What-ifs?"
- Allows for analysis of various shocks, policies, and other model output

Lessons
- Applying similar techniques from similar projects
- Ongoing peer review

Deliverables
- Deliver a product including national and state GDP losses, employment impacts, and other useful information

The current work builds off previous disruption studies and expertise

How this briefing will progress
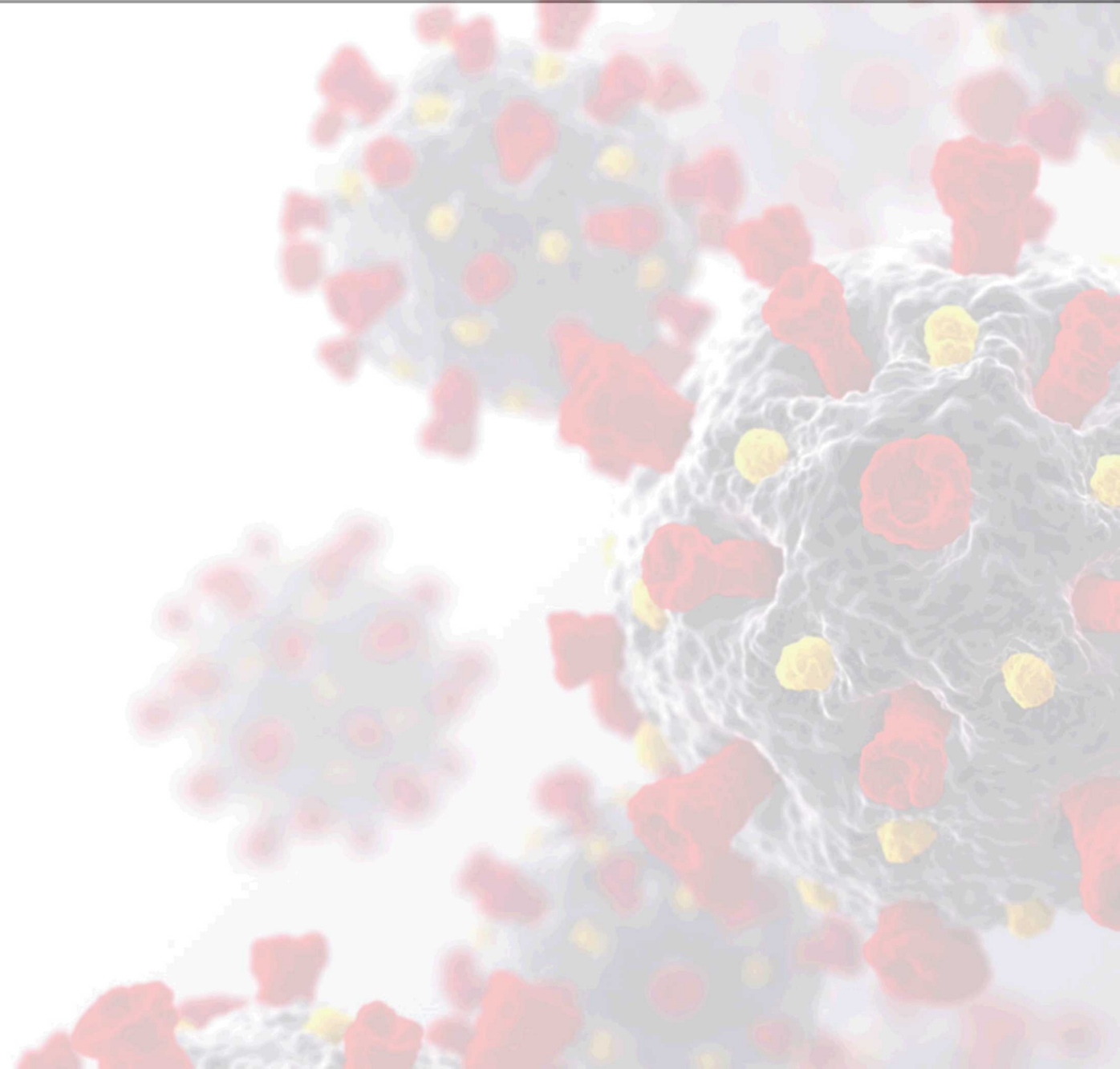
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We have performed pandemic modeling before These are 2009 Pandemic Study results

Key epidemiological parameters drive workplace absenteeism and mortality for seven scenarios.

The clinical attack rate drives the pandemic's absenteeism and is highly positively correlated to the mortality rate.

The range of GDP listed for each scenario reflected variations in the demand response.

- Assumed a reduction for select goods and services.
- Assumed an increase of healthcare expenditures.

Sponsor: Department of Homeland Security

Scenario Name	Clinical Attack Rate	Mortality Rate
Baseline	0.26	0.0053
Antiviral	0.25	0.0047
Fear-40	0.21	0.0043
CMG-SE[1]	0.10	0.0055
Anticipated	0.0092	0.000064
CMG	0.0045	0.000027

Pandemic Scenario	Year 1	Years 1-10
Baseline		
Level $Billions	$120 to $350	$810 to $1,100
% GDP[1]	1.1 % to 3.1 %	N/A
Fear-40		
Level $Billions	$140 to $400	$770 to $1,000
% GDP	1.2 % to 3.5 %	N/A
Antiviral		
Level $Billions	$120 to $340	$710 to $960
% GDP	1.0 % to 2.9 %	N/A
Anticipated		
Level $Billions	$140 to $400	$430 to $580
% GDP	1.2 % to 3.5 %	N/A
CMG-SE[2]		
Level $Billions	$93 to $270	$310 to $410
% GDP	0.8 % to 2.3 %	N/A
CMG		
Level $Billions	$95 to $280	$290 to $400
% GDP	0.9 % to 2.6 %	N/A

# Between FY16-20 SNL performed considerable work on radiological dispersion device (RDD) events:

Results showed net 10's of $Billions GDP Loss over 10 Years from a significant event

The economy: circular and dynamic

**Output (GDP) contributed by activity**
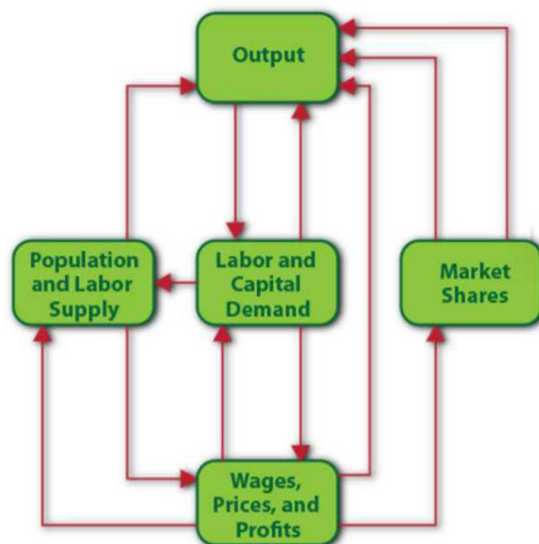
Output generates employment, employment generates income, income generates demand for and spending on new output, new output generates new employment, *and so on.*
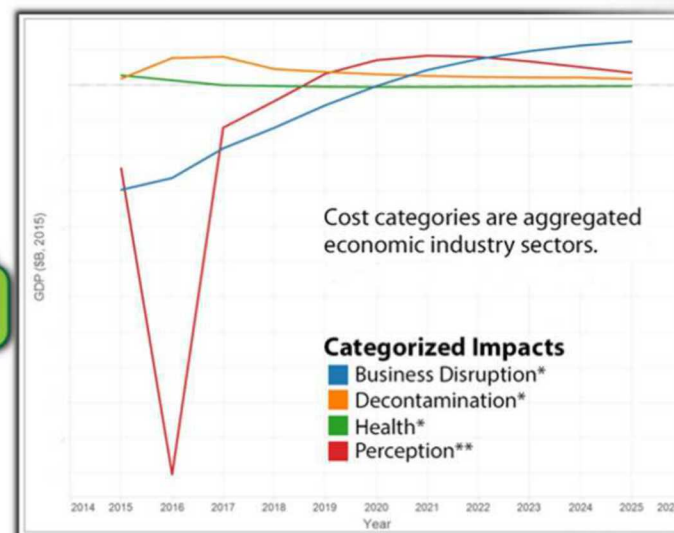
*Recovery efforts are likely to be funded by federal government spending, resulting in increases in output.
** Perception is based on tourism patterns observed post-Fukushima.
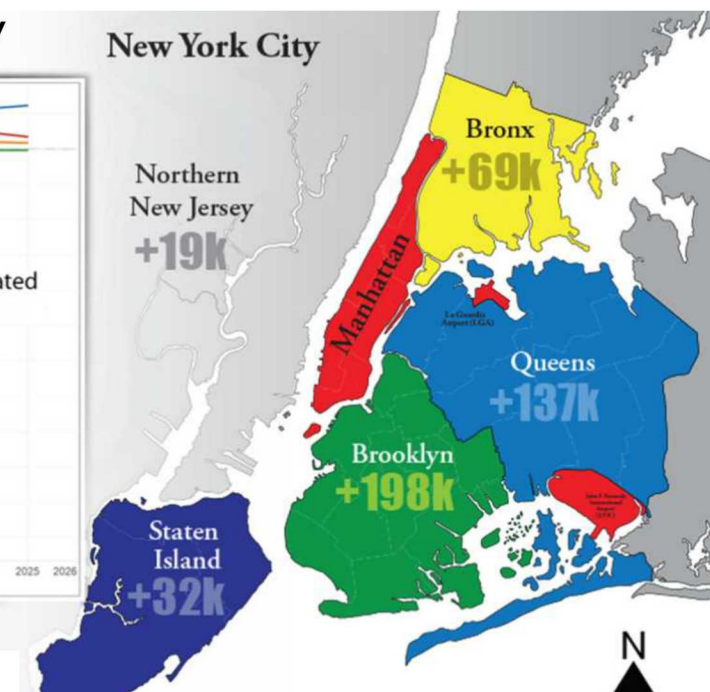
Relocation of economic activity within the **NYC MSA**. It is assumed businesses and employees will behave similar to observed post 9/11 relocation patterns.

GDP impacts are not intuitive. Regions of analysis include urban and rural. Impacts can be negative or positive, but all represent economic disruption.

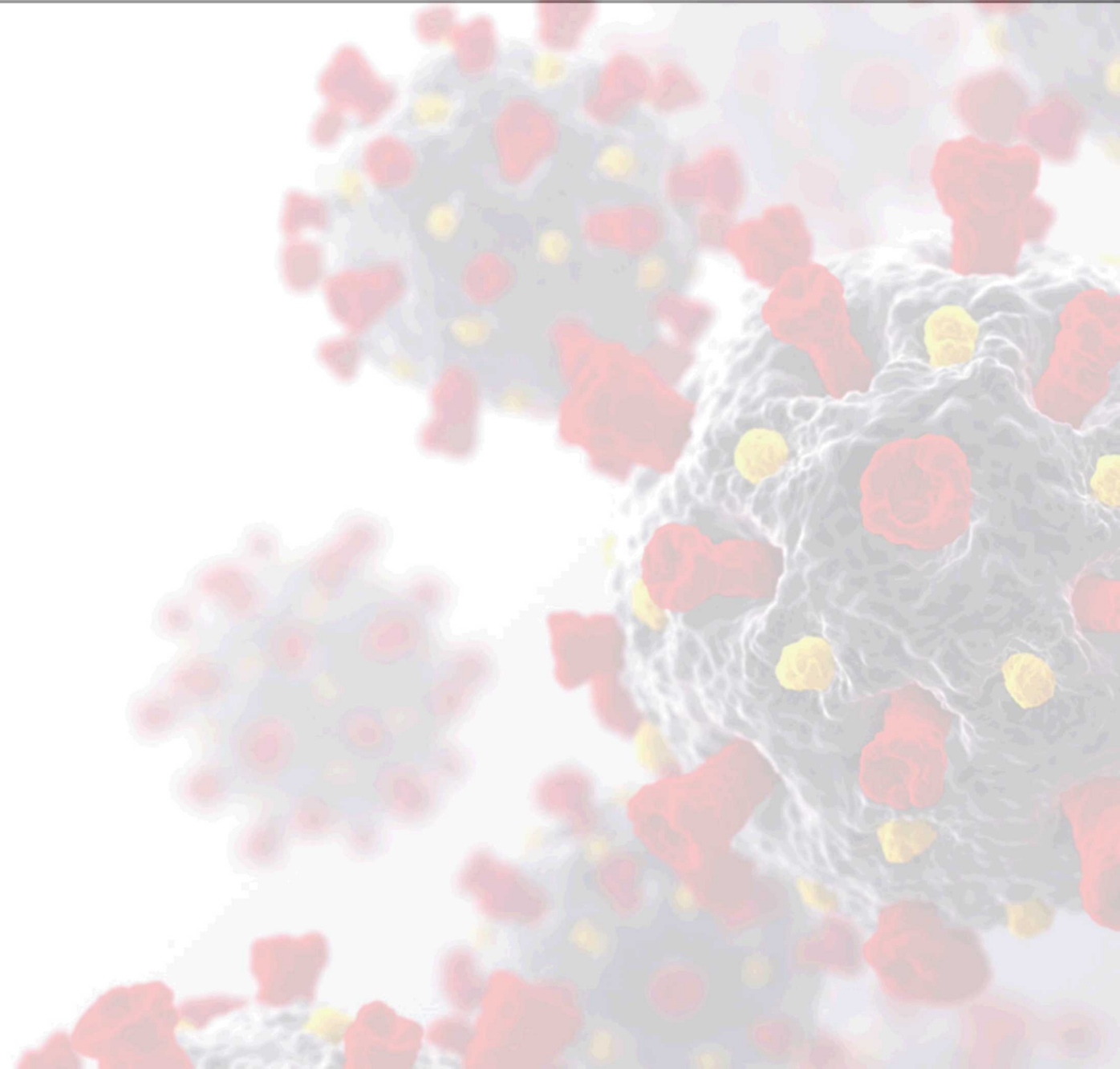# How this briefing will progress

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How does the present work differ from past Sandia studies?

	Past	**Present**
Event	Completed scenario Known virus	On-going Unknown virus
Driving factors	National response Changes to labor	National and separate state by state responses Constricted supply
Industry changes	Absenteeism Productivity	Essential vs. non-essential Avoidance behaviors
Scale of the event	Spread was seasonal Assumed levels of herd immunity Vaccine availability Familiarity with virus	Unknowns dominate this environment Waves of infection are indeterminate Policies are driven by best intentions Psychosocial factor could be crippling

Hypothetical scenarios vs playing catchup to real-world event

How does our study differ from others outside Sandia?

As of April 24, 2020 GDP Forecasts	As of May 1, 2020 GDP Forecasts	What our sources are saying?	Regional analysis path

As of April 24, 2020 GDP Forecasts

UCLA Anderson
- -0.4% (Q2 -6.5%, Q3 -1.9%)

IHS Markit
- -0.2%

Moody's
- Q1 -1.6%, Q2 -2.5%

Morgan Stanley
- Q2 -4%

Deutsche Bank
- -1% (Q2 -13%)

Pantheon
- Q2 -10% (annualized)

As of May 1, 2020 GDP Forecasts

UCLA Anderson
- -0.4% (Q2 -6.5%, Q3 -1.9%)

IHS Markit
- -13% Q2
- -1.7% 2020 (year over year)

Moody's
- Q1 1.6%, Q2 -4.2%

Morgan Stanley
- Q2 -38%
- -5.5% (annualized)

Deutsche Bank
- -4.2%% (Q2 -13%)

Pantheon
- Q2 -30% (annualized)

What our sources are saying?

Declines of 53% in sales tax revenue

City and County budgets bankrupt by May and June

Businesses refusing to hand over tax revenue

More layoffs coming

Increased suicides

Agriculture and food & beverage supply chains are holding
- Depends on worker protection

Regional analysis path

Use new GDP growth forecasts from Moody's (others)

Using prescribed forecasts

This serves as the new driver for estimating regional forecast differences

Additional modifications for "What-if" scenarios for regions

Forecasts ranging from -0.4% to -13% are informing regional "best guess" forecasts and "what-if" scenarios.
Little information on what informs other forecasts.
Anecdotal evidence is interesting but it remains hard to quantify.

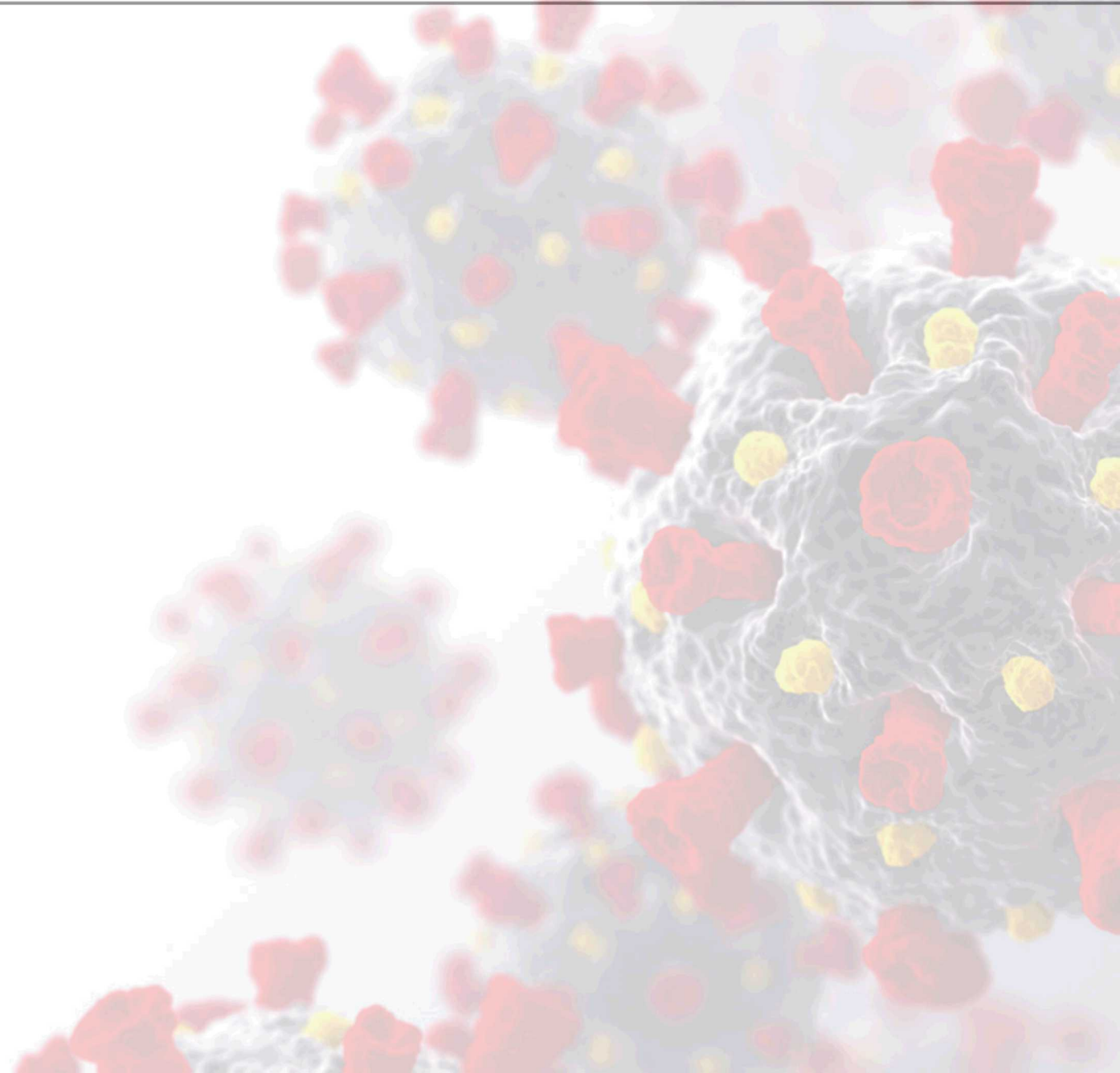# How this briefing will progress

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What is our methodology?

Using the REMI code, modify a baseline national forecast to reflect national COVID-19 impacts

- Supply and demand shocks
- Results in new national COVID baseline forecast
- Slowdown or recession scenario

Test mitigation strategies

- Epidemiological
- Economic
- Resource model
- State and federal

Overall

- All weekly, monthly, or quarterly data is scaled to annual
- Stimuli +/- will occur over the year at differing time intervals
- Base year in model for inflation is 2017
- Output will be reported in 2020 dollars
- Perform sensitivity analysis on principal parameter estimates or UQ analysis to assess uncertainty
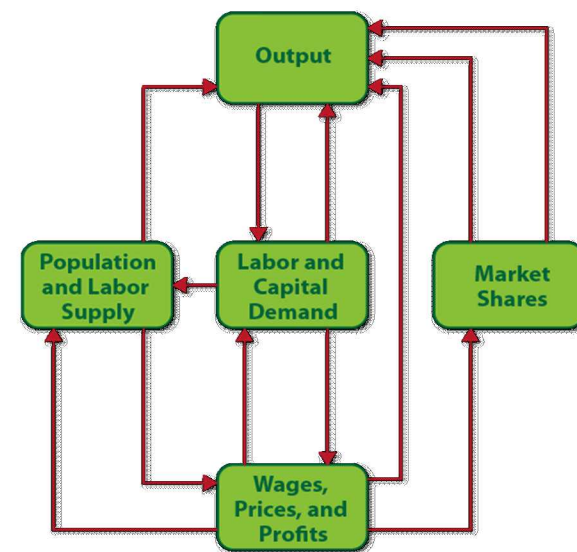
Example Output

GDP ($ trillion)

Baseline

With COVID-19

Impact of the Event

Notional

Year
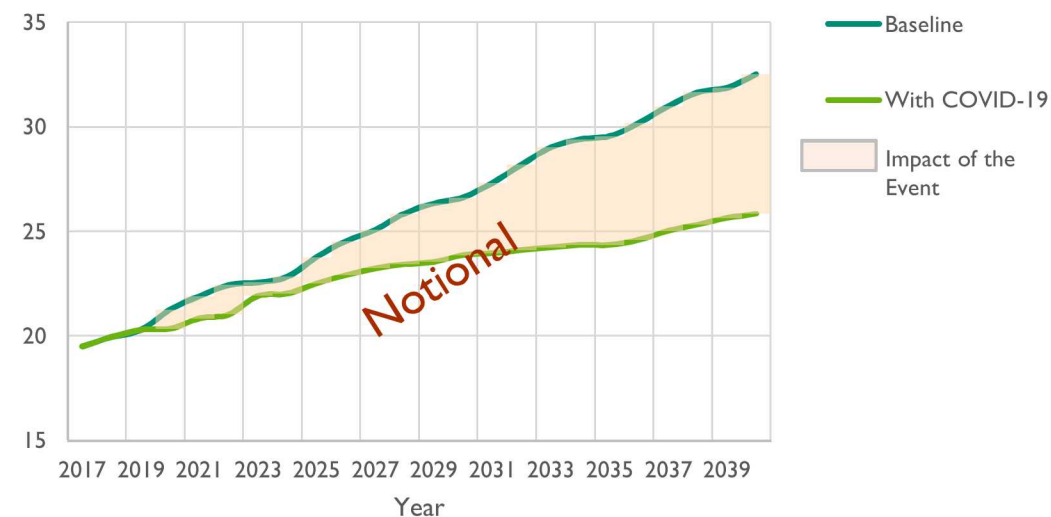
Response phases inform the temporal breakdown of the course of events

Emergency Phase

- March 1, 2020 to June 1, 2020
- Characterized by stay-at-home orders
- Essential vs. non-essential
- Psychosocial responses
- Tracking weekly, quarterly, or monthly changes
- Informed by real-world observation and estimates

Stabilization Phase

- June 2, 2020 to December 31, 2020
- Characterized as a loosening of stay-at-home orders
- Reduced restrictions on essential or non-essential businesses
- Reduced avoidance behaviors
- Primarily informed by scenario assumptions or real-world policies

Recovery Phase

- January 1, 2021 to TBD
- Return to normal operations or new normal
- Ongoing stimulus and health mitigation strategies
- Health and economic policies
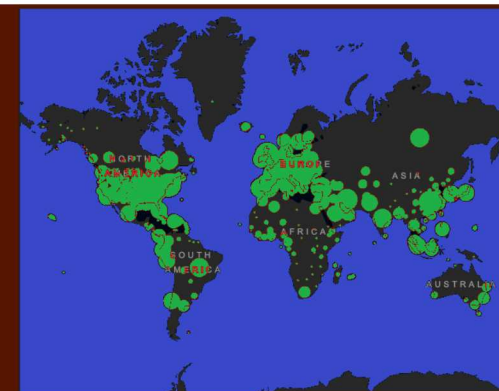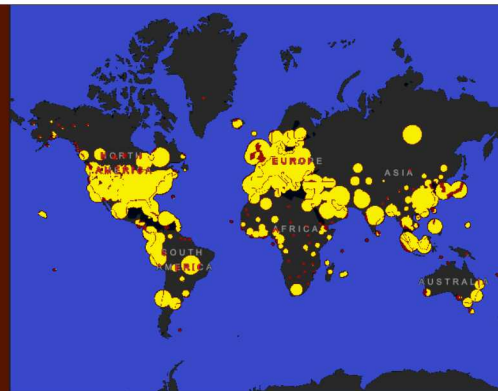
Epidemiological progression remains unknown but it will factor in and could change the response phases.

How the model is used:

1. Pre-loaded Regional Control "Baseline"

Model is the I/O, econometric, CGE representation of interactions
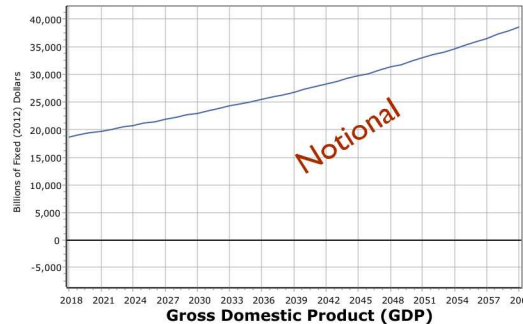
2. COVID-19 Shock ("New COVID Baseline")

Translation of physical event to dollars
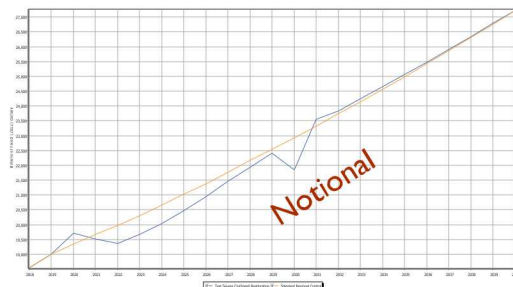
| 2018 | 2019 | 2020 | 2021 | 2022 | ...... |

3. COVID-19 Strategies

Reopening/recovery strategies

| 2018 | 2019 | 2020 | 2021 | 2022 | ...... |

Emergency Phase   Stabilization Phase   Recovery Phase
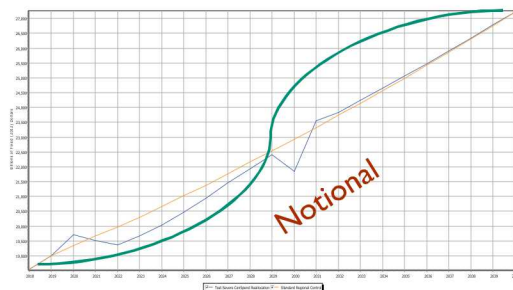
Temporal adjustments scale from weekly impact to annual Notional Timelines (Not to Scale)
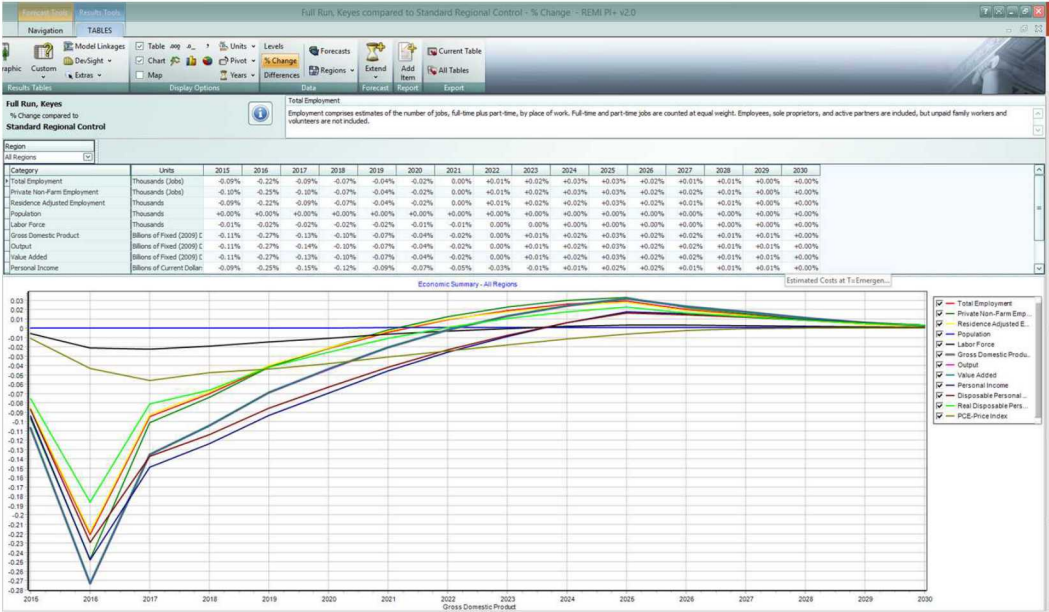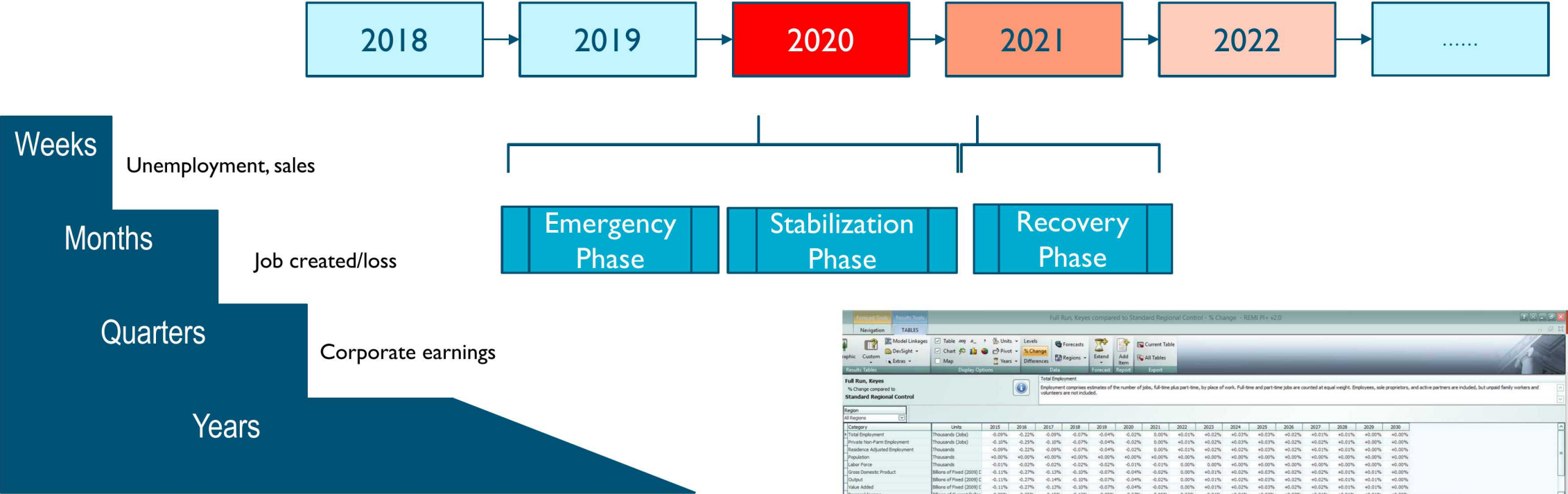
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How we are building the modeling input for parameter changes

Translation of physical, real-world observations, estimations, and hypotheticals into economic impact is accomplished in a layered approach

Layer 1

Supply and Demand Shocks

Layer 2

Changes in Spending Behavior
- Reallocation of consumption
- Reallocation of sales

Layer 3

Transfer Payments

A proportion of the population will be receiving a federal transfer payment

Layer 4

Productivity
- Reduced/Increased productivity for WFH
- Absenteeism

Layer 5

Healthcare Costs

Treatment costs

Layer 6

Morbidity and Mortality
- Survival rates

The combination of all layers provides a representation in the model of multiple types of shocks.

What is modeled in each phase depends upon a scenario
Development is iterative, model based, and/or reflective of real-world

Severe	Cautious	Exuberant

Severe

Emergency Phase
- No change

Stabilization Phase
- Mitigations, little to no effect
  - High savings rate; low demand continues into Q1 2021
  - Continued stay-at-home orders

Recovery Phase is still to be determined
- +/- 10 years

	Year 1 - Severe	
Category	Time Period 1	Time Period 2
Tourism	-100%	-75%
Non-essential	-100%	-75%
Essential	-75%	-50%
Medical Services	100%	75%

Cautious

Emergency Phase
- No change

Stabilization Phase
- Mitigations, have a mild effect
  - Savings rate slowly eases; no 2021 effect
  - Consumption approaches normal

Recovery Phase is still to be determined
- +/- 5 years

	Year 1 - Cautious	
Category	Time Period 1	Time Period 2
Tourism	-50%	-25%
Non-essential	-50%	-25%
Essential	-50%	-25%
Medical Services	50%	-25%

Exuberant

Emergency Phase
- No change

Stabilization Phase
- Mitigations, are fully effective
  - Consumption returns to normal for every income group
  - No 2021 effect

Recovery Phase is still to be determined
- +/- 2 years

	Year 1 - Exuberant	
Category	Time Period 1	Time Period 2
Tourism	-25%	-10%
Non-essential	-25%	-10%
Essential	-25%	-10%
Medical Services	25%	-10%

What is not considered? Full scale economic deterioration.

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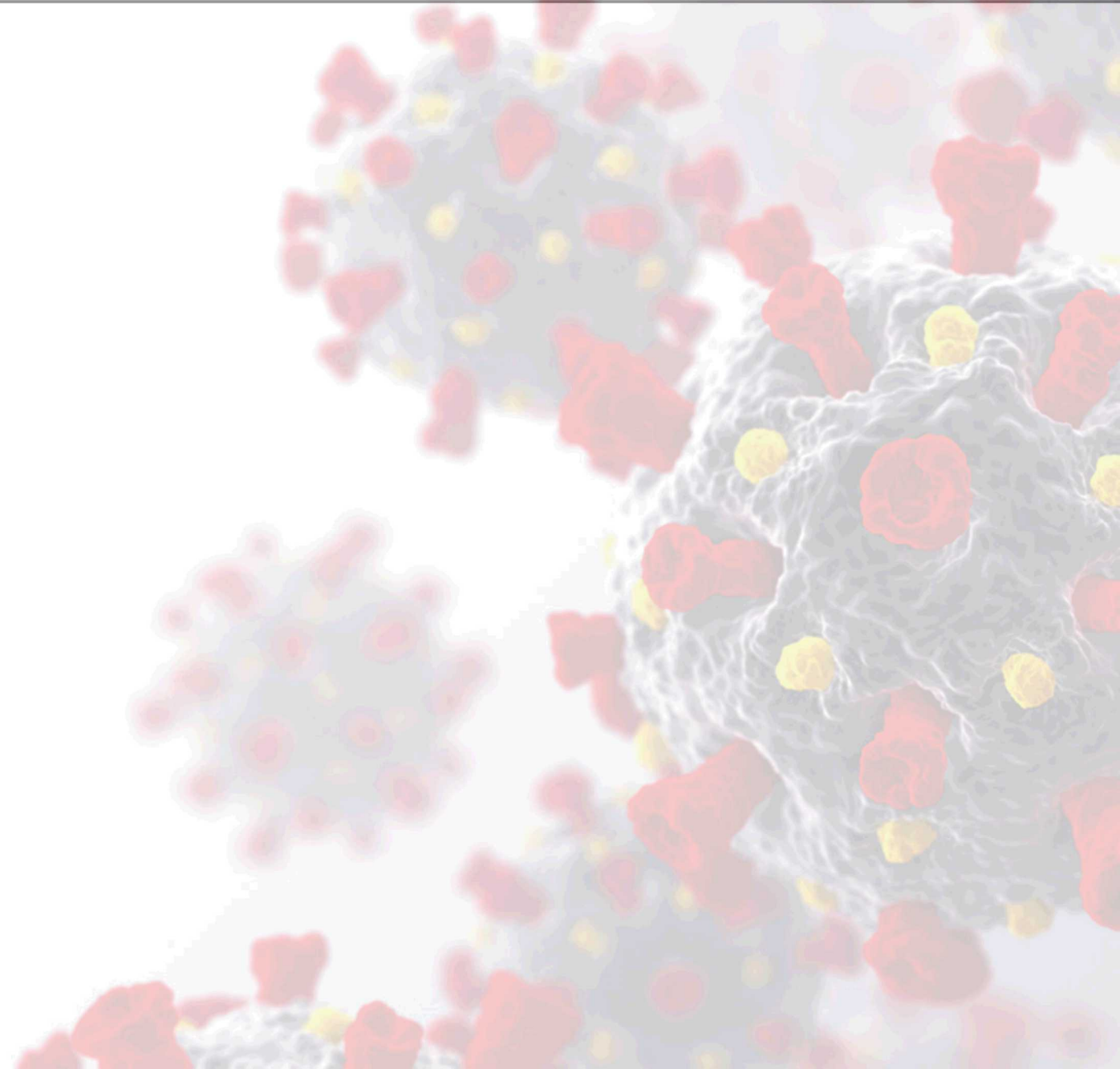
Layers and Scenarios

Creating a New Baseline

Current Status

We are collecting data and the process is challenging
Continuously updating and refining
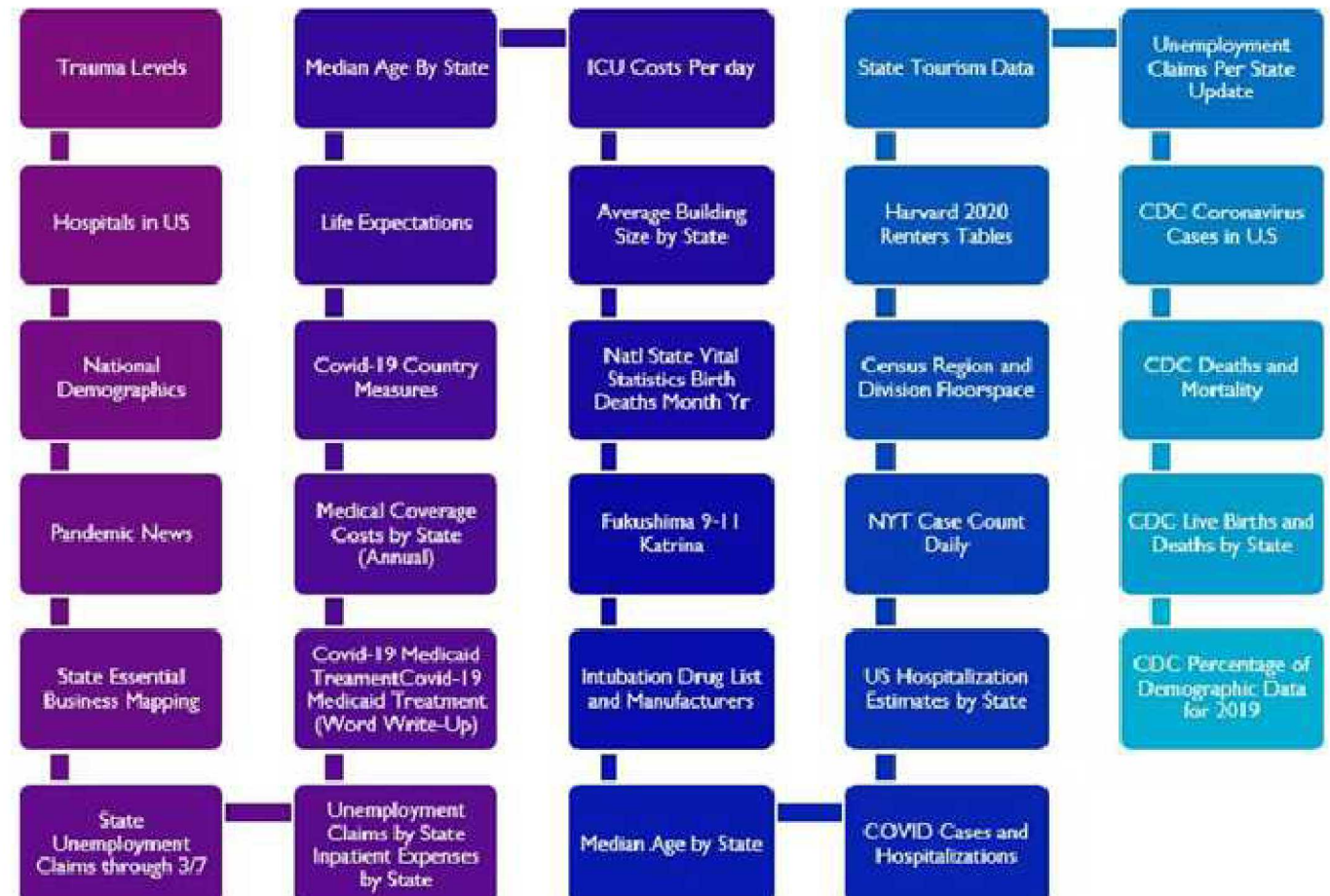
This is an ongoing, evolving event
- A team is pulling data around the clock to continually update the model

Sources
- Peer reviewed and non-peer reviewed
- State/local government
- Industry reports
- Network of peers
- Professional associations
- Lobbying groups

Challenges
- Unreliable data
- Economic data runs on a lag
- Differences in reporting
- "Ground truth" will be too late

Trauma Levels	Median Age By State	ICU Costs Per day	State Tourism Data	Unemployment Claims Per State Update
Hospitals in US	Life Expectations	Average Building Size by State	Harvard 2020 Renters Tables	CDC Coronavirus Cases in US
National Demographics	Covid-19 Country Measures	Natl State Vital Statistics Birth Deaths Month Yr	Census Region and Division Floorspace	CDC Deaths and Mortality
Pandemic News	Medical Coverage Costs by State (Annual)	Fukushima 9-11 Katrina	NYT Case Count Daily	CDC Live Births and Deaths by State
State Essential Business Mapping	Covid-19 Medicaid TreamentCovid-19 Medicaid Treatment (Word Write-Up)	Intubation Drug List and Manufacturers	US Hospitalization Estimates by State	CDC Percentage of Demographic Data for 2019
State Unemployment Claims through 3/7	Unemployment Claims by State Inpatient Expenses by State	Median Age by State	COVID Cases and Hospitalizations	

Demand-side: Building a new economic baseline

Capturing the demand-side effects

Informed by changing spending patterns

- Combine consumer spending data from the Bureau of Economic Analysis (BEA) and Census Bureau
- Spending on goods and services propagates upstream through the PCE-Bridge matrix
- Relates goods and services to retail and manufacturing sectors
- Changes in spending on goods and services change demand in retail and manufacturing sectors and impact inter-industry relationships

Consumer spending data is representation of new market equilibrium

- Changes in demand due to
  - Psycho-social effect
  - Income effect (job loss, furlough, savings under uncertainty)

Changes in supply due to forced and voluntary closures

Real-time data: Personal consumption expenditures have changed

Total personal consumption expenditures (PCE) down 7.5% in March 2020 from Feb 2020, larger impact expected for April

- Examples: Purchases of new autos (-26%), clothing (-51%), restaurants and bars (-27%), food from grocery stores (+29%)

Percent change in selected consumption categories, March 2020 vs Feb 2020 (BEA and Census)
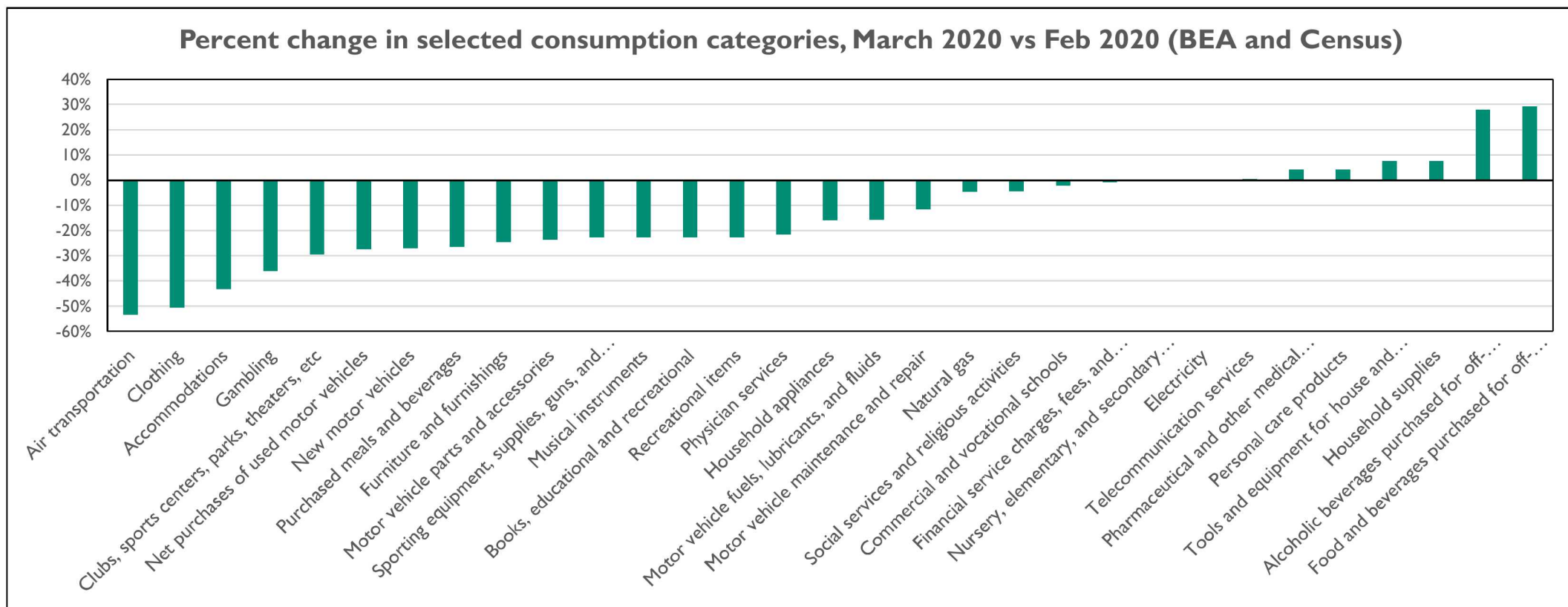
Supply-side: Building a new economic baseline

Capturing the supply-side effect

The effect of shuttered activity, example: manufacturing facilities (voluntary or by mandate)
- Affected through industry sales

Impacts to some industries are exogenous supply shocks
- Not a market response
- Reduced output due to facility closure

Impacts to some industries are indirect
- Changes in output due to exogenous changes in supply and demand
- These effects are outputs from simulations

Informed by reporting of permanent and temporary business closures subject to the Worker Adjustment and Retraining Notification Act of 1988 (WARN Act)

Informed by business Essential and Non-Essential designations at state level

Supply-side: The essential vs. non-essential business designation

States and local governments designated certain industries as being "essential" and "non-essential"

- Categories poorly defined (do not correspond to any classification system)
- Created list of common industries and worker categories designated as essential or explicitly non-essential
- Each industry assigned to NAICS and then REMI industries

Essential industries also face exogenous supply shocks

- Not all essential businesses are operating
- Difficulty operating under social distancing measures
- Uncertainty about future sales

Not all non-essential businesses cease operation

- Able to operate under social distancing measures (telecommuting, some retail, online sales)

Categorizing industries is not always straightforward
Essential and non-essential industries vs. supply and demand shocks

Essential	Essential	Non-Essential	Non-Essential	Non-Essential	Varies
Increased output due to high demand	Reduced output due to low demand	No output due to no supply	Reduced output due to lower supply *and* demand	Ambiguous change in output due to WFH; indirect changes in supply and demand	Direct and indirect changes in output due to exogenous changes in supply and demand

We use this notional binning system

A   Share of industry that is essential

B   Share of essential activity that shuts down

C   Share of non-essential activity that operates

D   Share of industry that operates during social distancing

$$D_i = A_i(1 - B_i) + C_i(1 - A_i)$$

Category	A	B	C	D	Example
E4	1.00	0	0	1.00	*Grocery stores*
E3	1.00	0.25	0	0.75	*Banks, construction*
E2	0.75	0	0.25	0.81	*Public transportation, ride sharing*
E1	0.75	0.50	0	0.38	*Air transportation*
E0	1.00	1.00	0	0	*N/A*
N4	0	0	1.00	1.00	*Office jobs*
N3	0	0	0.75	0.75	*Educational services (private)*
N2	0	0	0.50	0.50	*Retail*
N1	0	0	0.25	0.25	*Restaurants*
N0	0	0	0	0	*Personal care industries*

Binning system
- Each industry (99) is assigned to both Essential (E) and Non-essential (N) categories
- If industry is essential or not defined in a state order, receives E score; otherwise, receives N score
- For each state, output is reduced for each industry by $1 - D_i$ and scaled for a single quarter
- Example of values in binning system in table on the left

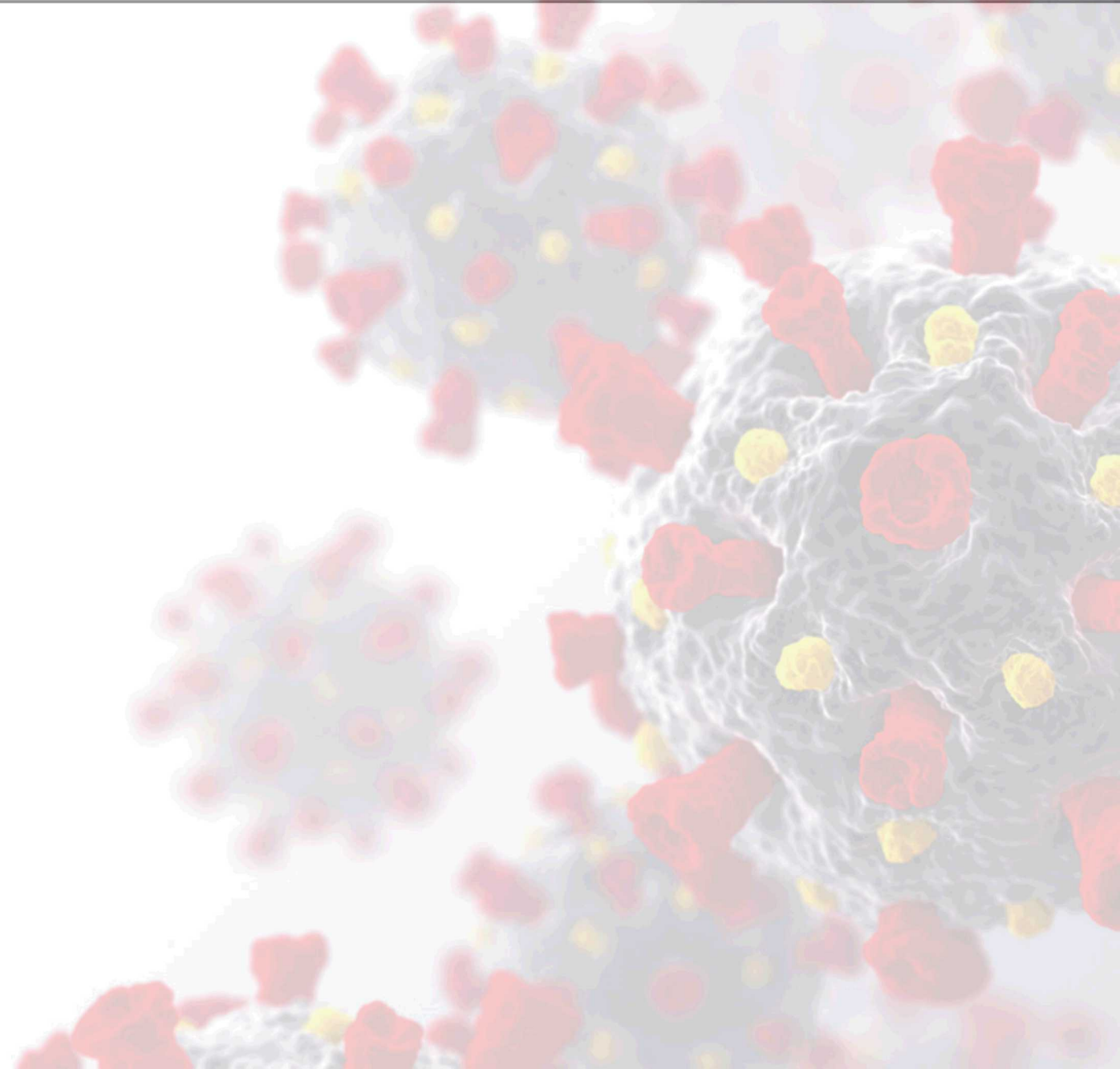# How this briefing will progress

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**Layers and Scenarios**

Creating a New Baseline

Current Status

# These key economic modeling assumptions are used in the analysis.

Type	Number	Duration	Region	Pedigree	Event/Scenario
Business Disruption: essential	See binning; supply/demand	Partial Q1 and Q2 w/decay Q3 and Q4	~6 states not fully participating	No	
Business Disruption: non-essential	See binning; supply/demand	Partial Q1 and Q2 w/decay Q3 and Q4	~6 states not fully participating	No	
Industry NAICS	3-digit and 4 digit	40 years	All 51 regions	Yes	Standard federal system
Perception: Tourism	-30% to -90%	Partial Q1 and Q2 w/decay Q3 and Q4	All 51 regions Every class of traveler	Yes	9/11, Hurricane Katrina, SARS, Fukushima
Perception: Worried-well	10%	Partial Q1 and Q2 w/decay Q3 and Q4	All population	Yes	SARS, Goionia, Fukushima
Remediation Services	~5%	1 year	All 51 regions	Yes	Anthrax, radiological accidents; 9/11
Healthcare: prompt illness	$ per doctor visit; hospital; ICU; COVID test	Partial Q1 and Q2	All 51 regions	Yes	9/11, SARS, RDD, pandemic scenarios
Healthcare: latent illness; not yet applied, not yet estimated	$ rehabilitation; nursing home; hospice; home healthcare; other med practitioners	Lifetime of individuals	All 51 regions	No	9/11, Fukushima, RDD scenarios
U.S. survival rate	Change in avg. survival by cohort	Study duration	All 51 regions	Yes	RDD scenarios; pandemic scenarios
Transfer payments	Avg $ State UIC; federal additional $600 UIC	Partial Q1 and Q2	All 51 regions	No	

This is the data situation as of April 24, 2020

STOP
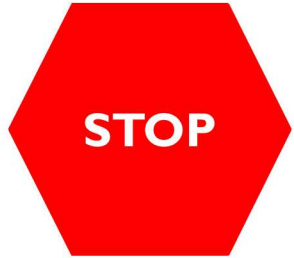
"Froze" data as of April 24 for current runs
- Economic data, newly released week ending 4/24
- Reporting of cases and deaths
- State level and National; quarterly
- Other relevant data

Yield
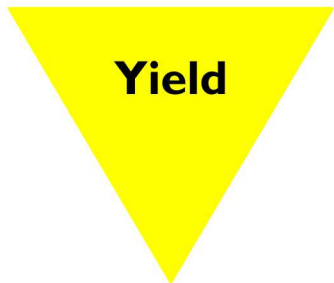
We are continuing to collect data for future runs
- All updated on rolling basis
- Additions to include Epidemiological and resource model outputs
- Expecting consumer spending data in April to be far lower than in March
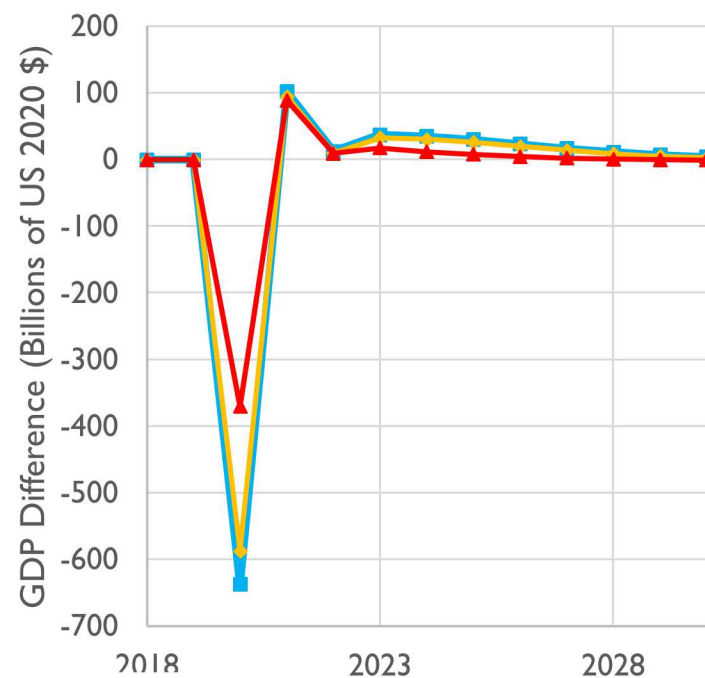
GO

We are moving forward
- **Past:** best informed assumptions and daily reporting; essential vs. non-essential binning
- **Current:** publicly available (govt. sourced), peer reviewed, non-peer reviewed
- **Next:** Epidemiological and resource data, newly launched federal data sources

Past: Annual results for a "Best Guess" Baseline
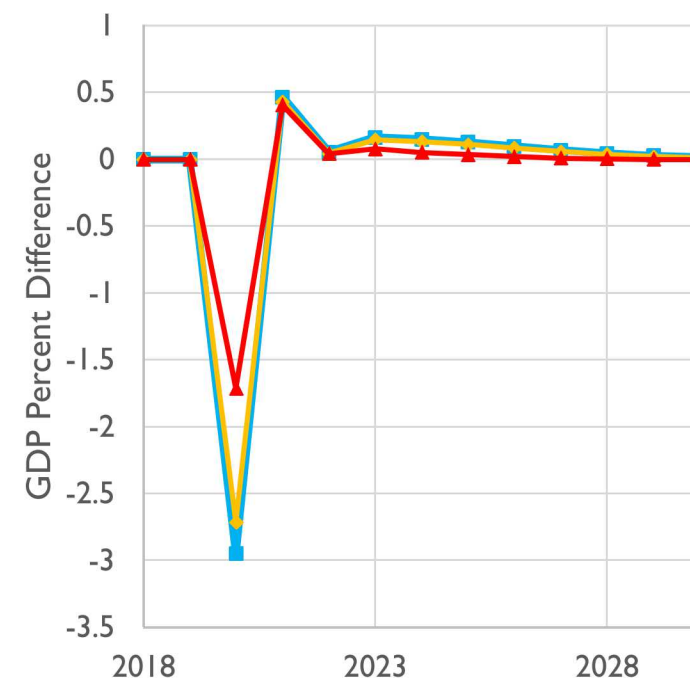## Q3 and Q4 adjustments only, all layers applied

U.S. GDP Levels
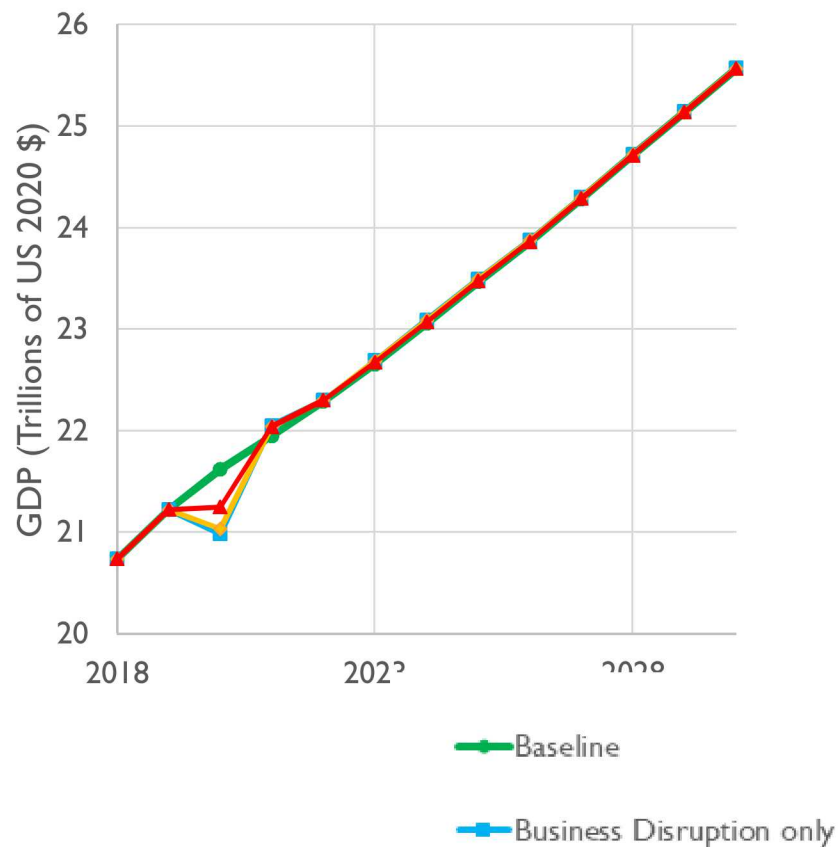
U.S. GDP Difference from Pre-COVID Baseline

U.S. GDP Percentage Difference from Pre-COVID Baseline

Legend:
- Baseline
- Business Disruption only
- Business Disruption and Consumption Switching (no transfer payments)
- Business Disruption, Consumption Switching, and Transfers

"Best Guess" Baseline: best informed assumptions and daily reporting; essential vs. non-essential binning.

Current: Going from "Best Guess" Baseline to "New COVID-19" Baseline

Changes to consumer spending only
- Uses PCE data from BEA and Census to inform changes in demand
- Plus additional layers

Changes to consumer spending and industry sales
- Uses PCE data as well as notional binning system
- Binning system used for industries with exogenous supply-side impact (mainly manufacturing)
- Plus additional layers

Changes to industry sales only
- Uses notional binning system without PCE data
- Binning system used for industries with exogenous supply-side impact (manufacturing and retail)
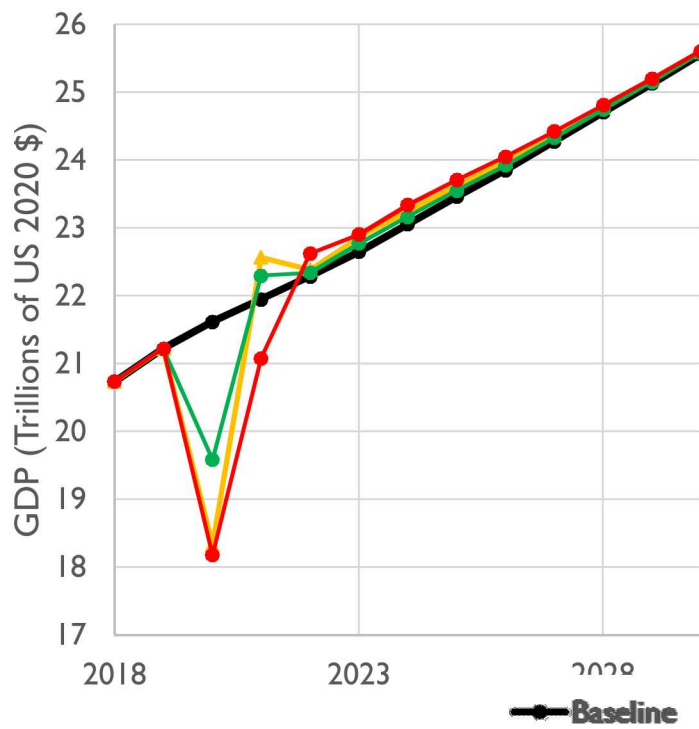- Plus additional layers

Additional layers (not modeled in baseline business disruption) include
- Tourism spending
- Remediation
- Transfer payments (from CARES Act)
- Healthcare spending

Current: Results for Economic Scenarios
All categories combined, full layering approach applied

| US GDP Levels | US GDP Difference from Baseline | US GDP Percentage Difference From Baseline |

Legend: Baseline | Cautious Full Layering | Exuberant Full Layering | Severe Full Layering

The pre-COVID baseline forecast is shown in red. "New COVID" baseline forecast is in purple. The interactions between supply and demand shocks, exogenous changes in economic transactions, and transfer payments are all captured in the purple result.
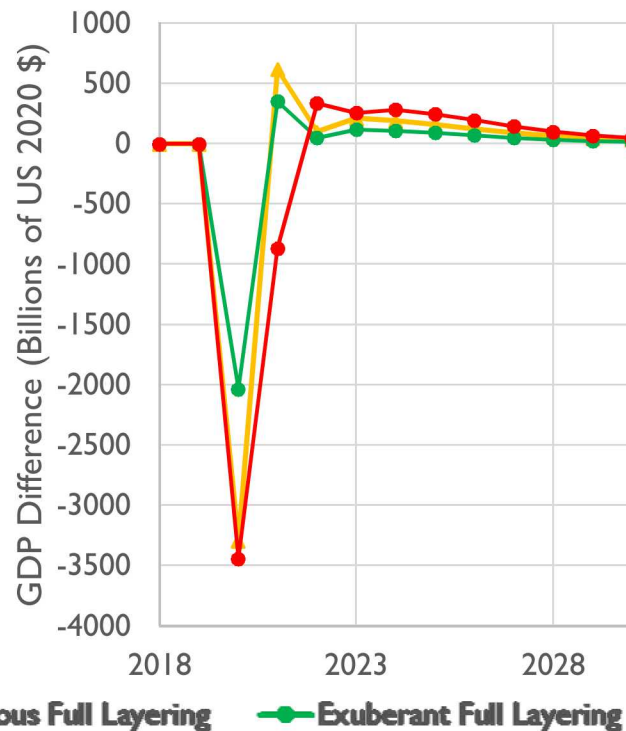
We are experiencing both demand and supply side shocks. It is the net of these effects that we are "experiencing" as economic losses. The economic situation will continue to evolve as either the event continues (i.e. healthcare spending) or mitigations (i.e. WFH; CARES Act) take a effect.
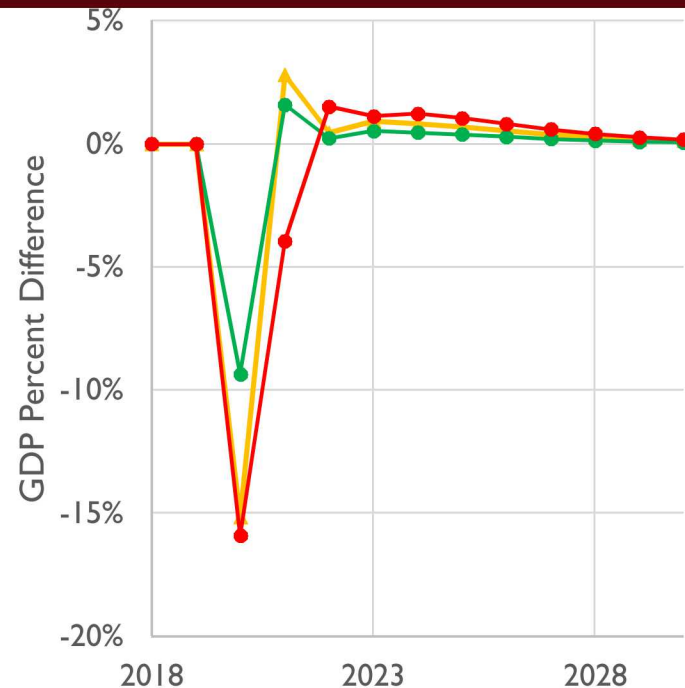
Depicted is the percent change from baseline. The shocks depress labor and commodity prices across the economy. Once the shock is gone it causes demand to more than bounce back in 2021. This expansion drives prices back up, creating a slow return to baseline in the years after 2021.

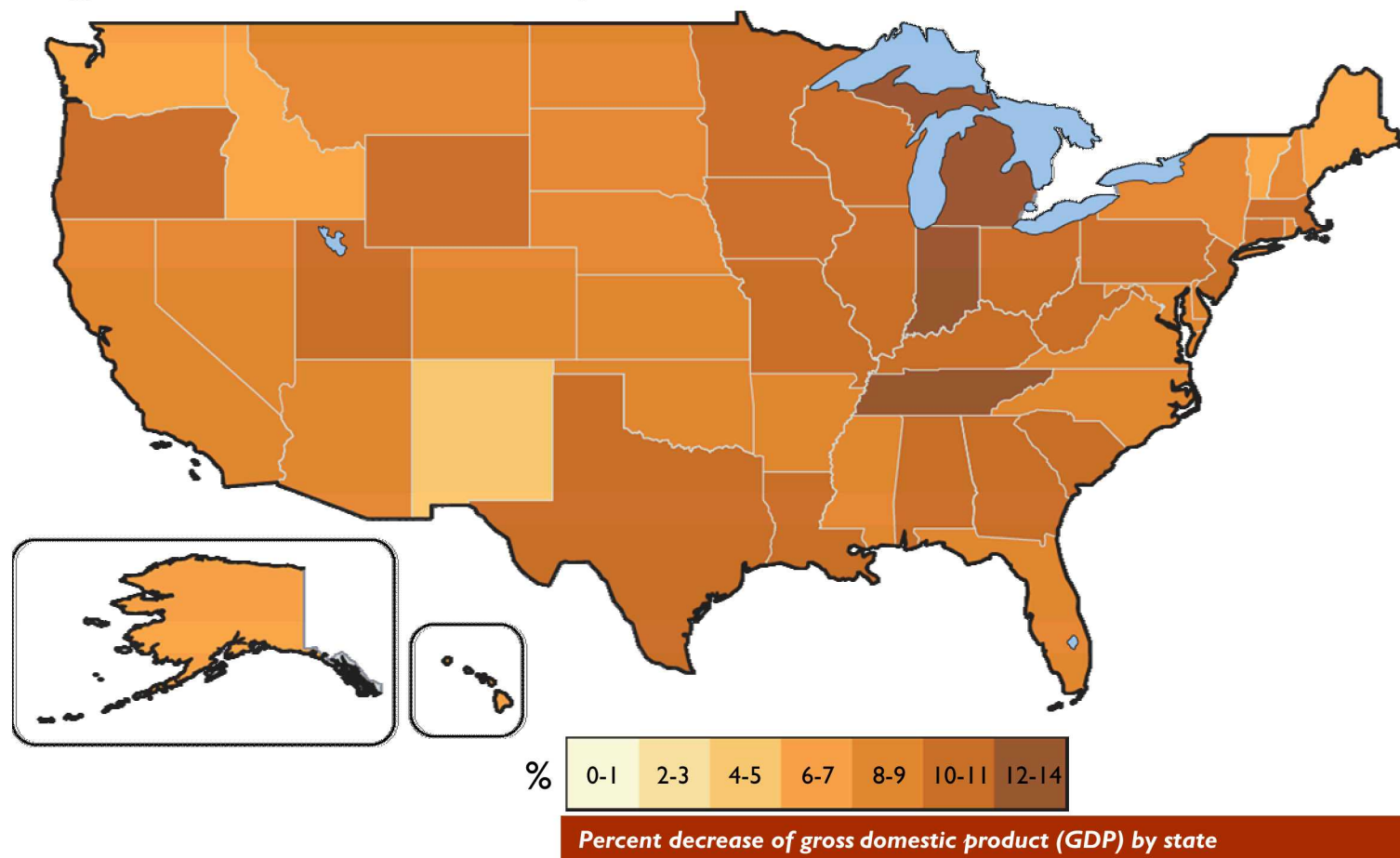The Cautious Scenario results in 15.2% reduction or $3.2 trillion loss in 2020 U.S. GDP from the pre-COVID baseline.

Current: Cautious Scenario, this is a national scale event with possibly long-term negative economic impacts

Unprecedented event
- Unlike previous "disaster" events this is not a regional event
- Every State is negatively affected
- The longer the "event" continues the larger the economic impact

State-by-state impacts
- Overall closures to retail, food and drinking places, and entertainment affect all States
- Manufacturing closures are concentrated in specific States
- The energy sectors in every State are negatively affected due to declining demand

%	0-1	2-3	4-5	6-7	8-9	10-11	12-14

Percent decrease of gross domestic product (GDP) by state

Every State is negatively affected.
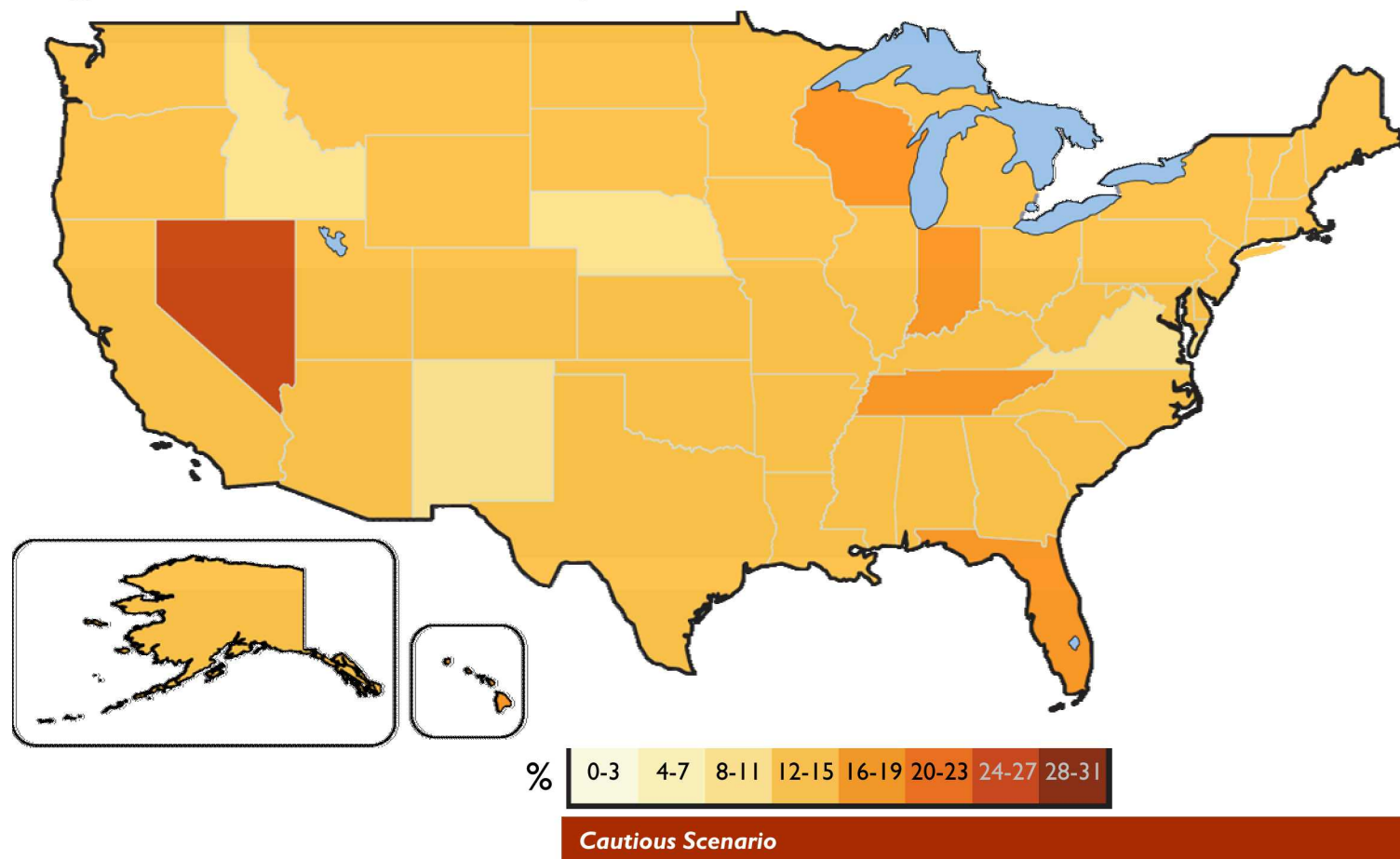States with diverse economies experience slightly less impacts.

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| % | 0-3 | 4-7 | 8-11 | 12-15 | 16-19 | 20-23 | 24-27 | 28-31 |

Cautious Scenario

Every State is negatively affected.
States with diverse economies experience slightly less impacts.

Current: Cautious Scenario, Impacts by State

Manufacturing
- Manufacturing is not a large industry in every state
- Makes up a significant portion of output in:
  - Michigan, Indiana, and Alabama
- Linked to automotive manufacturing sectors

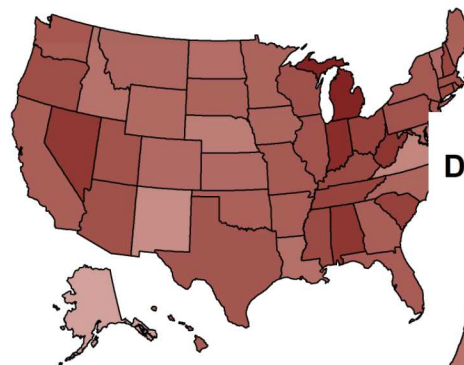Accommodation, Recreation, Dining, and Retail
- These industries are a large source of jobs and output in every state
- The effect is very similar across almost all States
- Nevada is more reliant on tourism relative to other States

Income
- Nevada's loss in income is expected given the large concentration of labor in tourism related industries
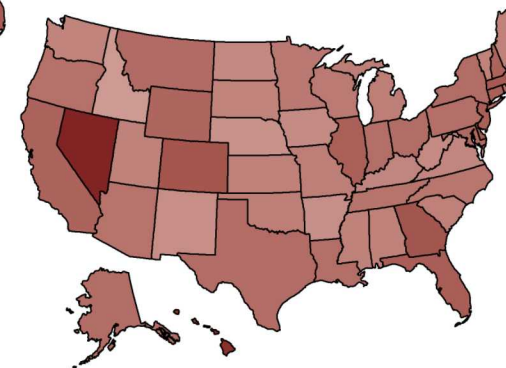- New Mexico historically experiences economic downturns on a lag; overall is a very small economy

Manufacturing Output by State
Year: 2020
Percent difference
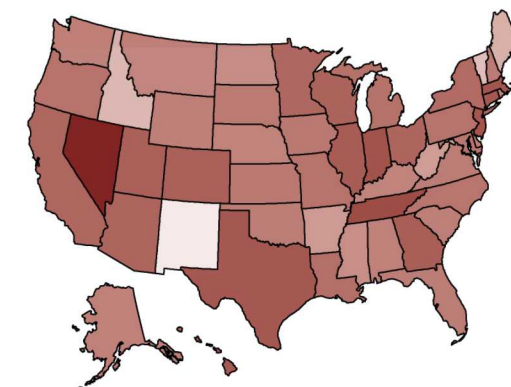-21 -18 -15 -12 -9

Accommodation, Recreation, Dining, and Retail Output by State
Year: 2020
Percent difference
-40 -35 -30 -25 -20

Income Per Capita by State
Year: 2020
Percent difference
-12.5 -10.0 -7.5 -5.0 -2.5

Current: Cautious Scenario, State and Industry Comparison

Drivers of economic losses
- NV: Accommodation and recreation
- HI: Broadly tourism related industries
- NM: Energy and film
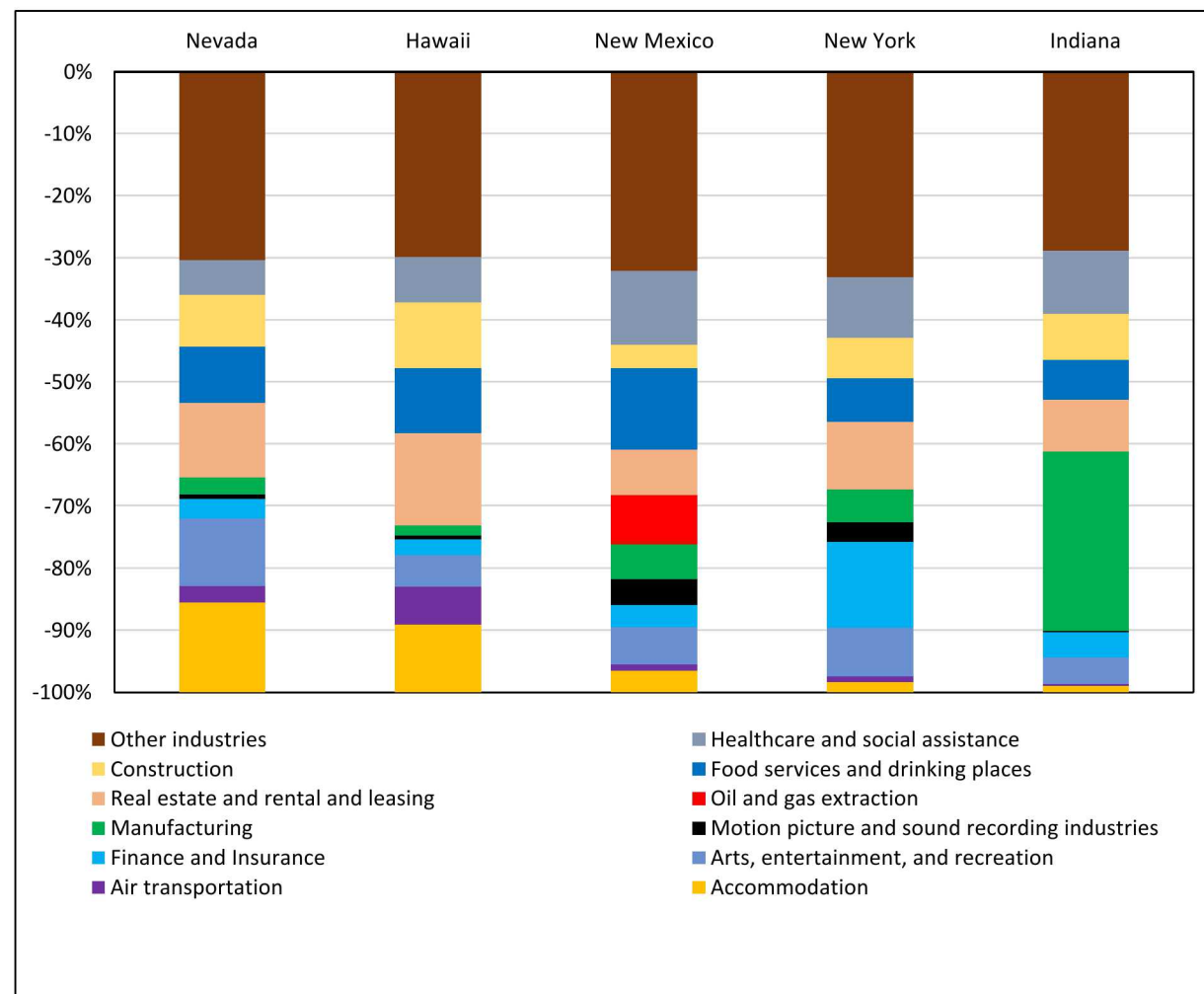- NY: Finance and insurance
- IN: Manufacturing

Food services and drinking places
- This re-emphasizes that the closures of these locations drive losses in every state
- Permanent losses in this industry could result in long-term negative consequences for every State

Real estate and rental & leasing
- Every State is negatively affected across the board
- As incomes decline demand for this industry category will also decline

Losses by industry and income lead to declines in sales tax and income tax revenue

Legend:
- Other industries
- Construction
- Real estate and rental and leasing
- Manufacturing
- Finance and Insurance
- Air transportation
- Healthcare and social assistance
- Food services and drinking places
- Oil and gas extraction
- Motion picture and sound recording industries
- Arts, entertainment, and recreation
- Accommodation

Shrinking local budgets could reduce public services.

Industry Reporting: Auto Manufacturing, Rental & Leasing, and Food

Automotive Manufacturing

Manufacturing is at a near stop and sales have dropped

- According to the Center for Automotive Research(CAR) resuming operations will be complex
  - Capital is costly to restart
  - Global supply chains
  - Potentially no demand for new supply

U.S. assembly plants as reported by CAR

- April 30, 2020
  - Daimler restarted production in Vance, AL

- Week of May 3-9, 2020
  - 17 plants restarted
  - BMW, FCA, Honda, Hyundai Kia, Toyota, Volkswagen

- Week of May 10-16, 2020
  - 2 plants restarted
  - Subaru and Volvo

Residential rental and mortgage

Future payments remain uncertain

- According to the National Housing Council (NMHC) Rent Payment Tracker survey of 11.4 million units of rent payment made
  - April 2020: 78%
  - May 2020: 80.2%
  - For comparison with 2019:
    - April 82.9%; May 81.7% of rent was paid

- The data represent a wide variety of market-rate rental properties across the U.S., which can vary by size, type, and average rental price.

Mortgages

- The CARES Act provides for affected borrowers to defer their mortgage payments for up to 180 days; can apply for an extension of another 180 days.

Agriculture and Food/Bev Supply

In 2020 Farm Income was forecast to increase; after years of decline

- Agriculture, food processing, and distribution was benefitting from low energy prices

Realignment is occurring

- Lost their main source of demand, restaurants
  - Short-term likely increase consumer prices

- Global recession, declining exports
  - Long-term likely decrease in consumer prices

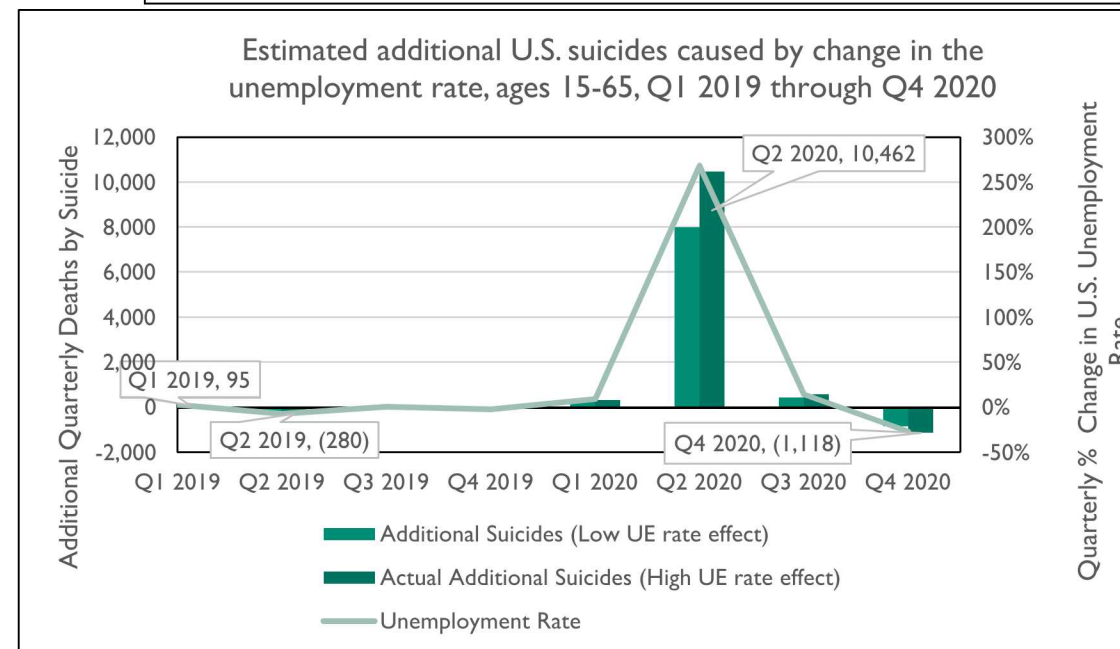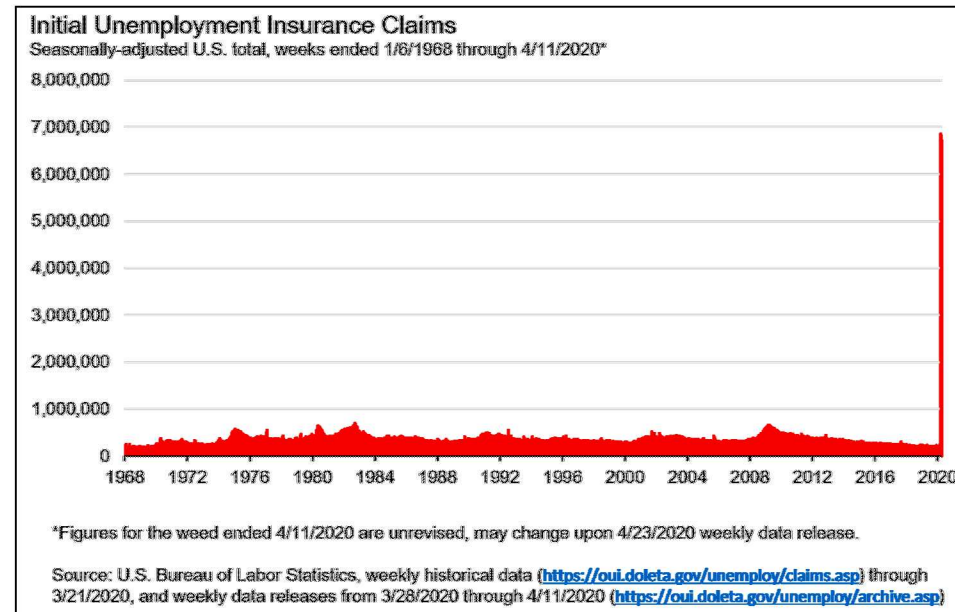# What is not currently covered in our analyses?

Unintended consequences of "shut-down"
- Increase in risky behaviors
- Post 2008 financial crash uptick in suicides
- Decreased life-years due to lack of access to medical care
- Increased life-years from lack of exposure to pollution
- The oil surplus (decrease in demand is captured)

Long-term structural changes to the economy
- Restructuring of labor market?
- Fast-tracking of automated and AI economy?
- Large permanent shifts in consumption?

Future increases to CARES Act

Initial Unemployment Insurance Claims
Seasonally-adjusted U.S. total, weeks ended 1/6/1968 through 4/11/2020*

*Figures for the weed ended 4/11/2020 are unrevised, may change upon 4/23/2020 weekly data release.

Source: U.S. Bureau of Labor Statistics, weekly historical data (https://oui.doleta.gov/unemploy/claims.asp) through 3/21/2020, and weekly data releases from 3/28/2020 through 4/11/2020 (https://oui.doleta.gov/unemploy/archive.asp)

Estimated additional U.S. suicides caused by change in the unemployment rate, ages 15-65, Q1 2019 through Q4 2020

What we will do next

Layer in epidemiological and resource model output

Continue collecting data
- This activity will continue until the period of performance is complete

Define reopening strategies for scenario analysis and additional modeling runs
- Agreement from epidemiological and resources teams

Examine permanent shifts to new behaviors or regional shifts
- This can drive how "shocks" decay out over time
- Permanent loss of brick-n-mortar locations
- Regional shifts in manufacturing
- Increased onshoring or co-located manufacturing (shifts from China to North America)

Perform sensitivity analysis and uncertainty quantification
- Right now the focus is on finishing the modeling runs
- Will occur in Phase 2 of this effort, if funded