

SA 035

Employment Impacts of Infrastructure Development for Hydrogen and Fuel Cell Technologies

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Overview

Timeline

Start date: FY13

End date: Ongoing project

Budget

FY14 DOE Funds: \$150k

FY15 Planned DOE Funds: \$200k

Including partners

Barriers

Future Market Behavior (A)

Stove-piped/Siloed Analytical Capability (B)

Inconsistent Data, Assumptions and Guidelines (C)

Insufficient Suite of Models and Tools (D)

Funded partners/collaborators

Argonne National Laboratory

RCF Economic & Financial Consulting

Northwestern University

Relevance

Model development

- Develop **consistent framework** to estimate impact of hydrogen (H₂) infrastructure investments by FCTO and others
- Develop tool to **address barriers/gaps** in FCTO analysis/modeling portfolio

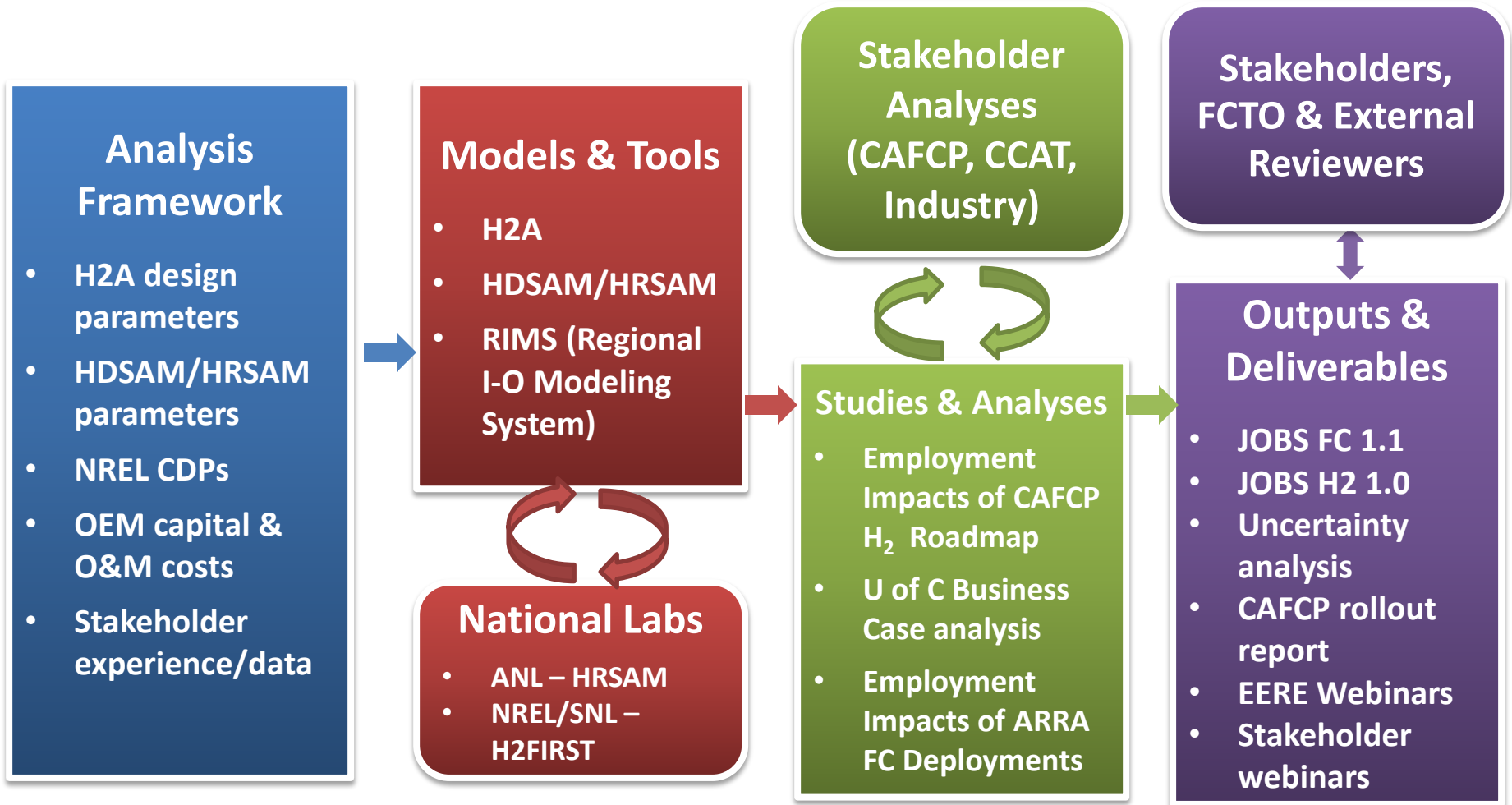
Analysis

- Evaluate impacts of alternative H₂ and fuel cell (FC) infrastructure deployment scenarios
- Provide input for evaluating R&D and deployment targets of FCTO program

Stakeholder support

- Work with stakeholders to develop robust, user-friendly tools with appropriate functionality
- Report analytical results to demonstrate benefits of FCTO program

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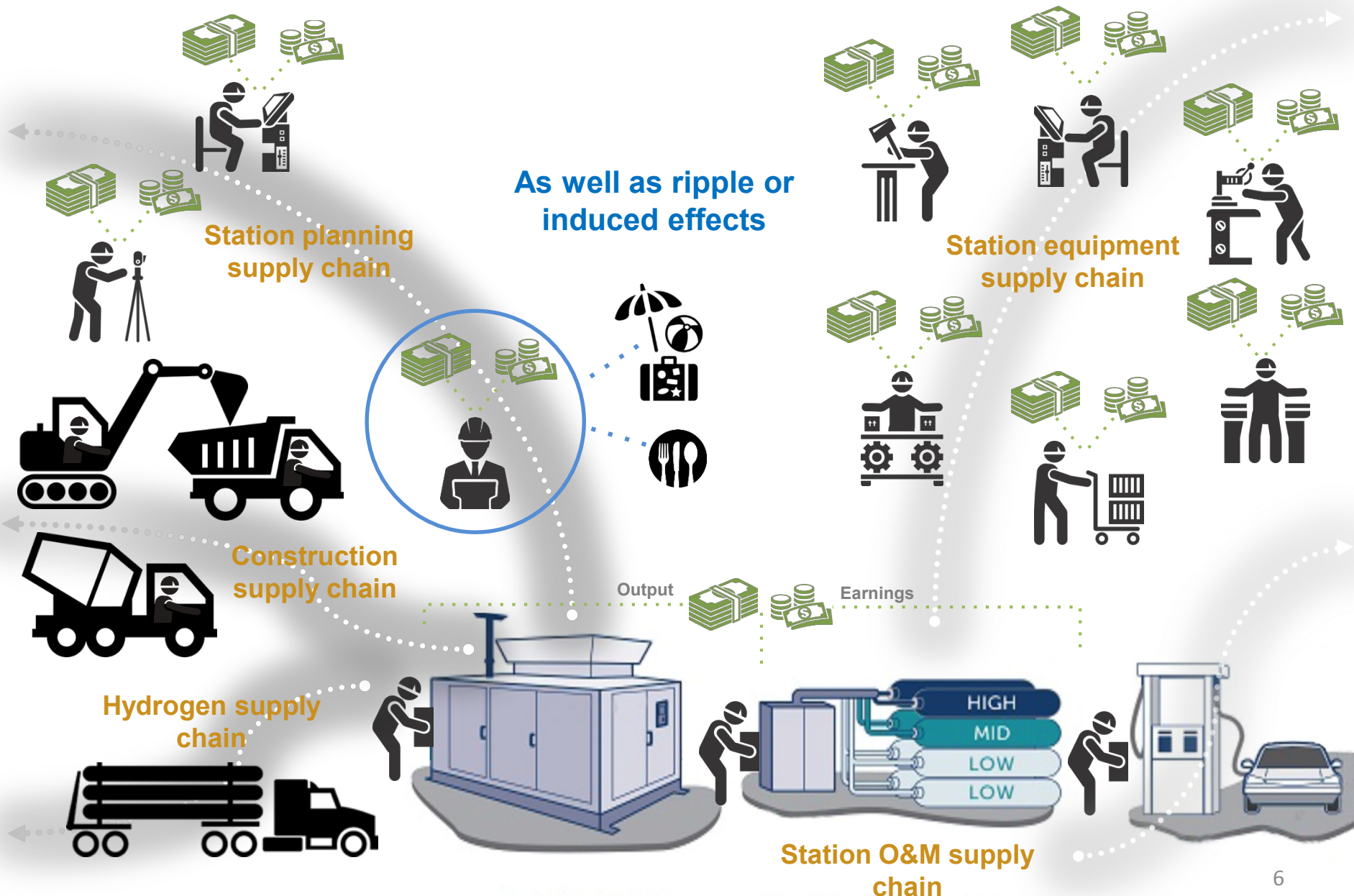


JOBS H₂ uses input-output approach

- Input-output methodology converts dollars spent into economic impacts using relationships from USDOC/BEA Regional Input-output Modeling System (RIMS)
- Default or user-input expenditure estimates
 - Reported values
 - Vendor quotes
 - Stakeholder inputs
- User-defined scenarios (e.g., planned rollouts)
- Capture supply chains & induced effects

JOBS H2 models impacts from equipment production/installation, station construction and fuel supply chains (direct + indirect jobs) as well as from ripple effects (induced jobs).

JOBS H₂ models expenditures for many supply chains



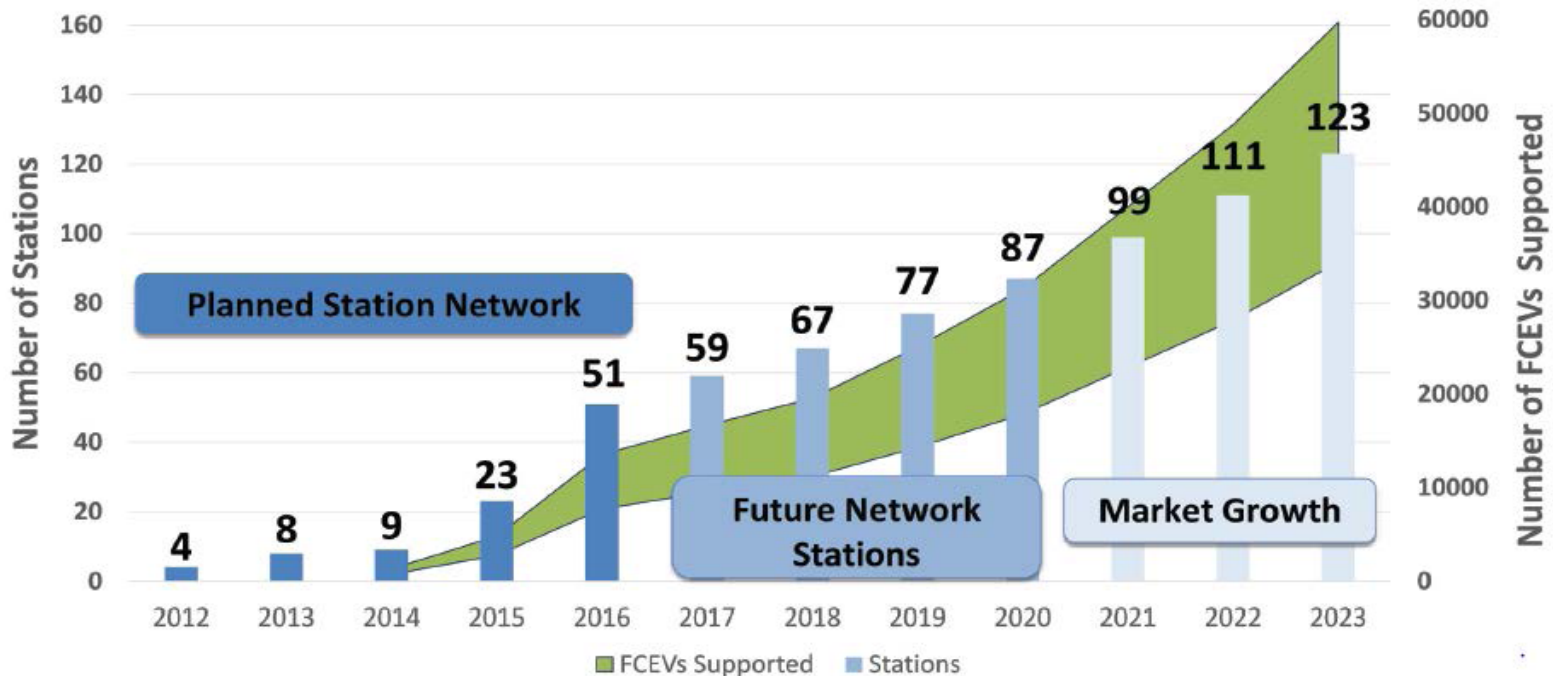
FY 2015 milestones

Milestone	Status
Analysis: CAFCP roadmap scenario	✓
Modeling: Uncertainty analysis*	✓
Modeling: JOBS H2 1.1	9/30/15
Analysis: Alternative rollout scenario	9/30/15

*JOBS H2

JOBS H₂ estimated impact of CAFCP's station roadmap

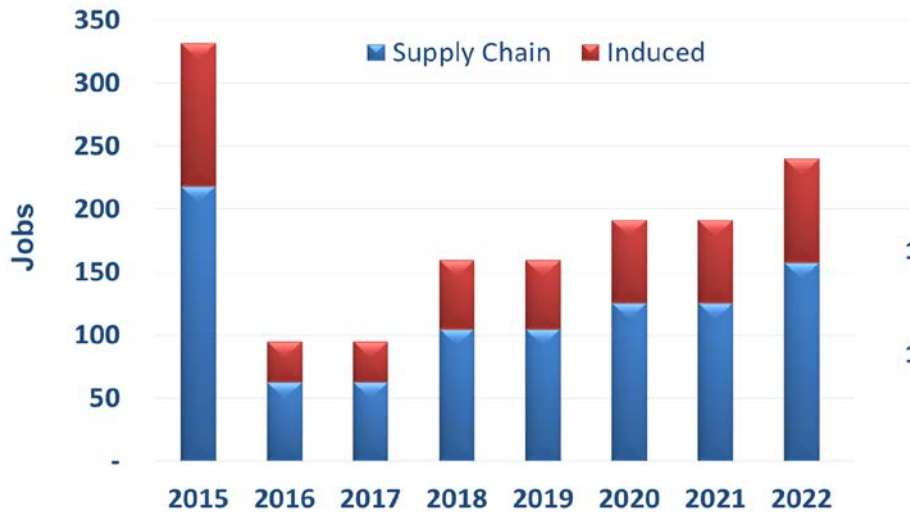
- Modeled development of 100 H₂ stations for a specific launch trajectory
- Varied size and utilization of new stations over time
- Modeled operations of new stations over time
- Included operations (but not development) of existing stations



Accomplishments

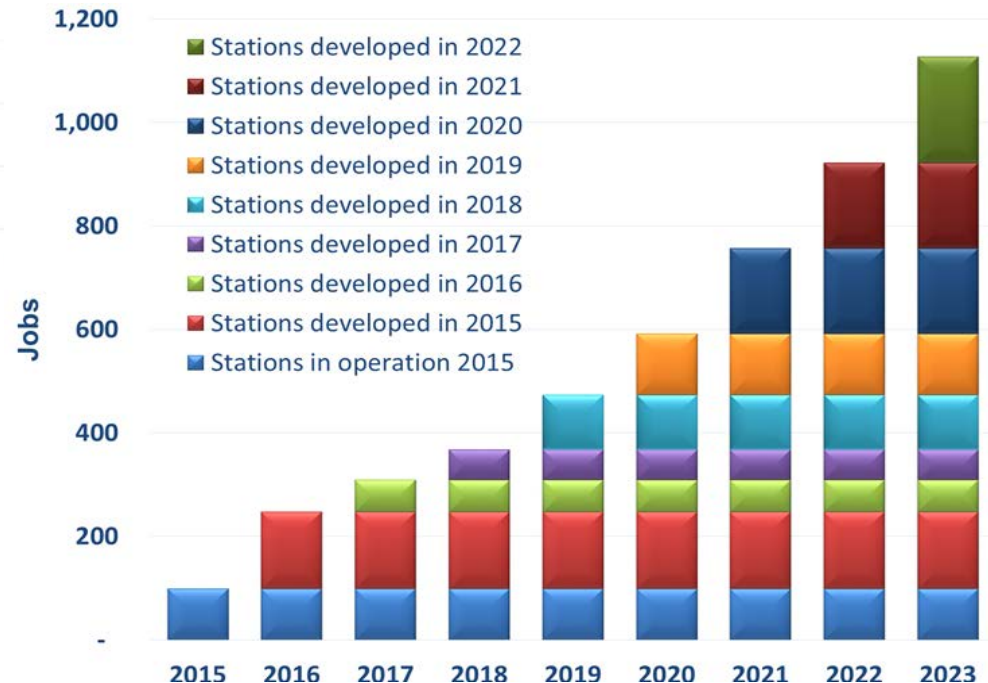
In CA roadmap analysis station development jobs start almost immediately. Operations jobs grow over time

Station Development



Station development is associated with 100–330 jobs/year in CA through 2022

Station Operations

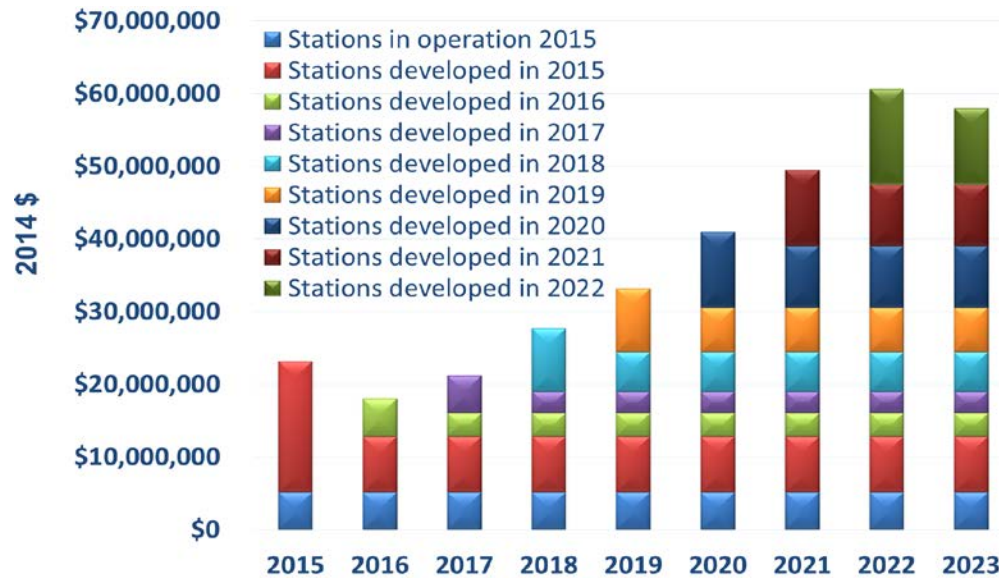


Station operation is associated with >1,100 CA jobs at full operation

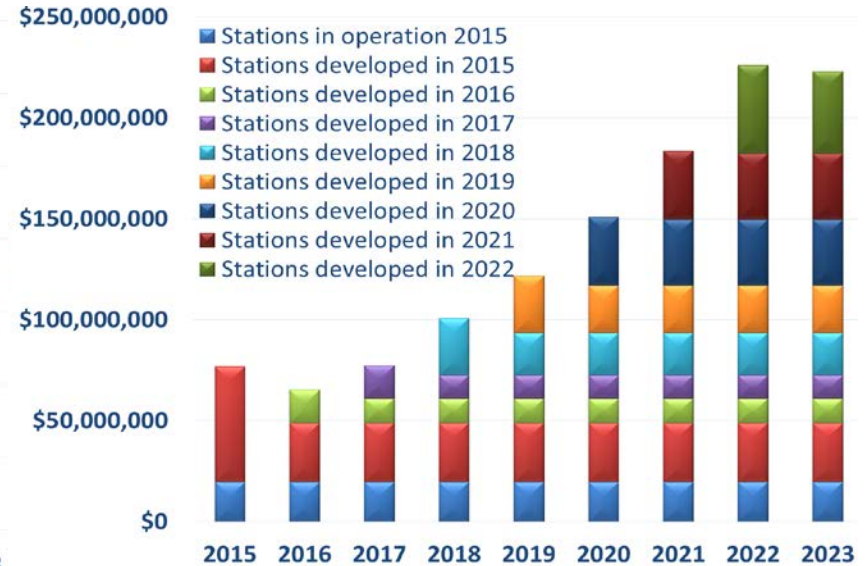
Timing & magnitude of impacts on CA earnings and economic output are similar to employment impact

- Total earnings and output modulate peaks in station development
- Earnings peak at \$60 million in 2022 then level off
- Economic output peaks at \$230 million in 2022 then levels off
- Stations have greatest impact in launch year as development expenses translate into earnings and output, then drop to steady operational level.

Total Earnings



Total Economic Output



Stochastic simulation feature added to JOBS H₂

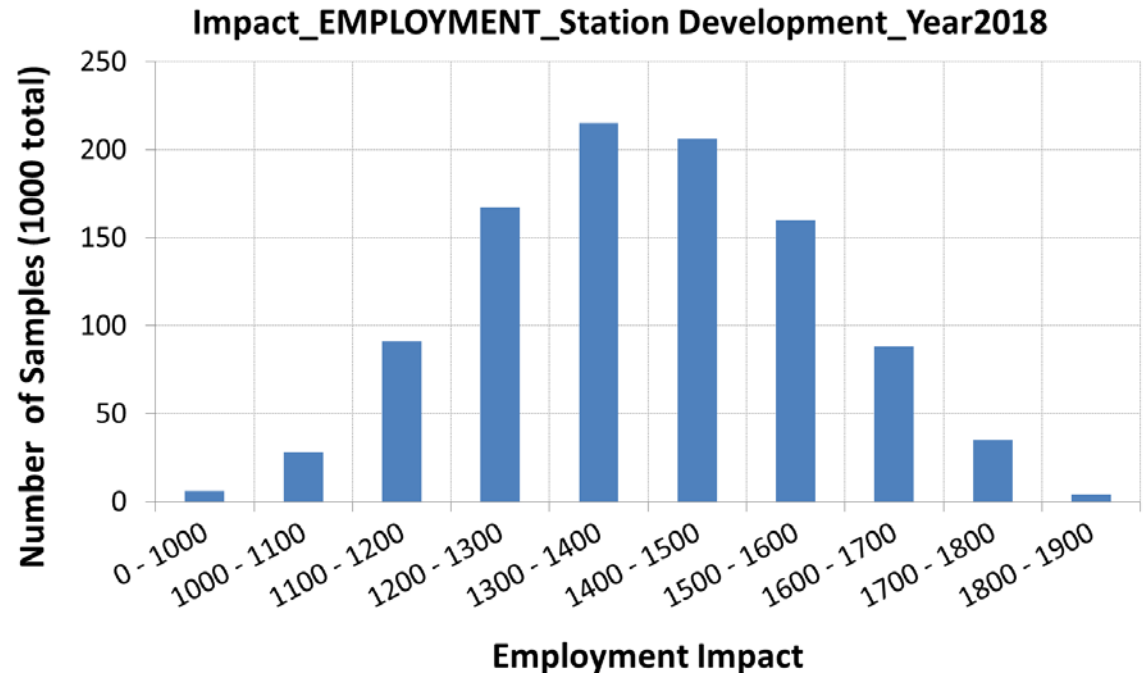
Variables simulated:

- Development expenses
- Equipment expenses
- Operational expenses

Probability distribution functions specified

Most probable value assumed to be default value (or user input)

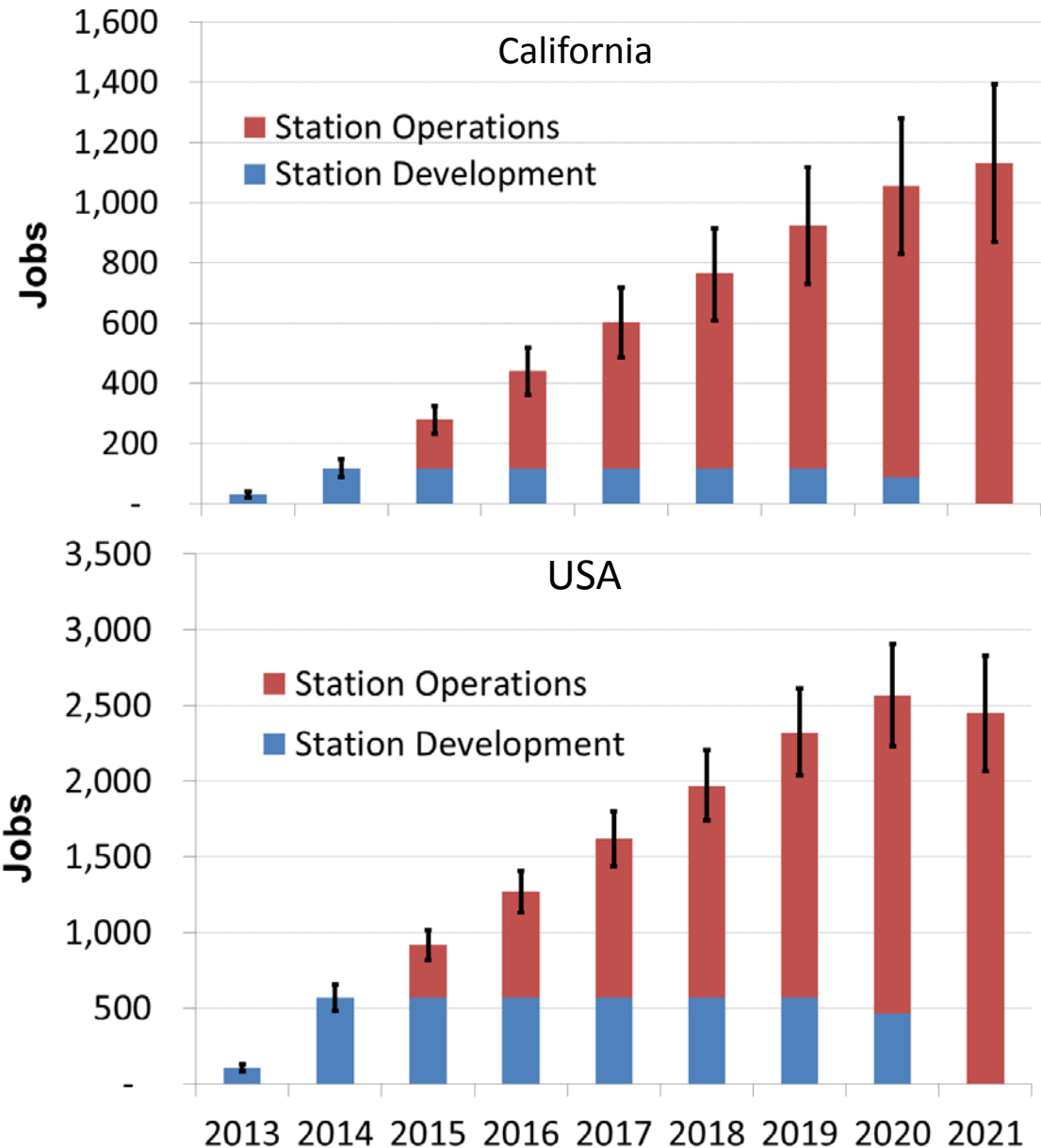
Distribution ranges based on engineering estimates



Two cases demonstrate capabilities and impacts of stochastic module

- Cases based on (not identical to) CAFCP H₂ Roadmap
 - Similar number of new stations (98 vs. 100) deployed
 - Same hydrogen throughput (~36,700 kg/day)
 - Uniform capacity rather than variable capacity stations
 - Constant launch rate (14 stations/year) rather than variable rate
 - Defaults for development and operating costs and local shares rather than Roadmap proposals
- Cases illustrative, not a comprehensive analysis
 - CA case uses CA multipliers & default local shares (i.e., benefits in CA)
 - USA case uses US multipliers & default shares (i.e., benefits in USA)
 - Much higher local shares in US case
- Results differ from CAFCP Roadmap results shown earlier

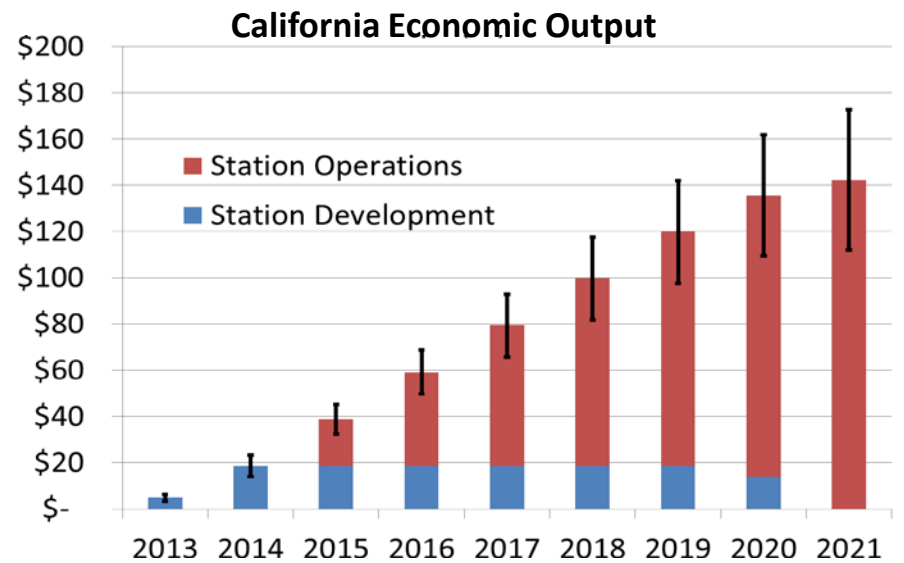
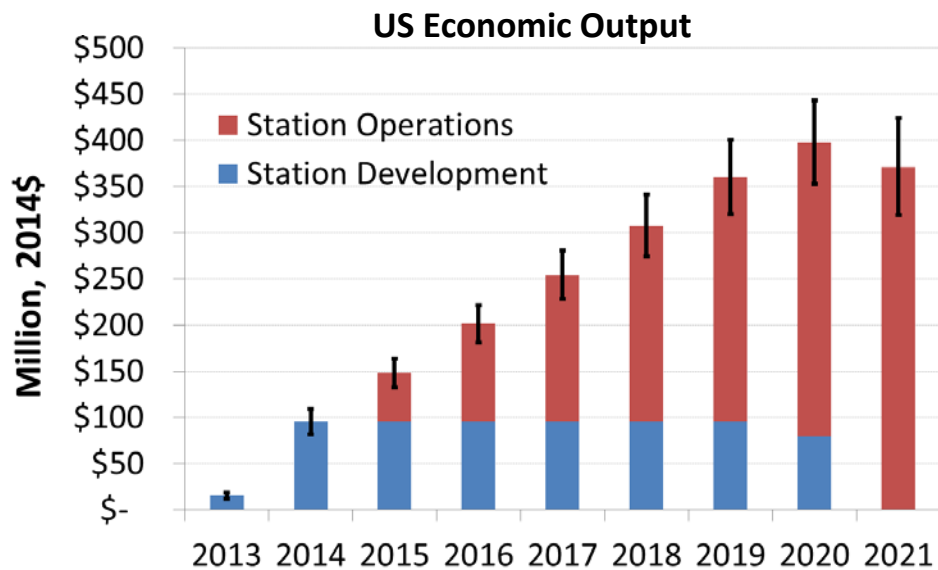
USA case has ~2x employment impact of CA case



- Total benefits in both cases accrue throughout period.
- Development benefits begin in year 1 and continue through construction of last stations.
- Operations benefits begin 2 years after initial development and continue through period.
- P10 and P90 results spread relatively evenly around most probable. Most parameter distributions assumed symmetric within range.

Impact on economic output has similar pattern

- Impacts decline in final year in US case because operations jobs added are less than development jobs lost
- Impacts do not decline in final year in CA case because fewer development jobs are in state



QR cards & websites direct users to JOBS models

JOBS Quick Response (QR) Card

US DOE/Clean Cities' Alternative Fuels Data Center tools/calculators page (<http://www.afdc.energy.gov/tools>)



Calculators

Vehicle Cost Calculator
Compare cost of ownership and emissions for most vehicle models.
mobile

Petroleum Reduction Planning Tool
Create a plan for your fleet to reduce petroleum consumption and emissions.

CNG VICE Model 2.0
Evaluate ROI and payback period for natural gas vehicles and infrastructure.

AFLEET Tool
Calculate a fleet's petroleum use, cost of ownership, and air pollutant and GHG emissions.

JOBS Model
Estimate economic impacts of natural gas, hydrogen, or fuel cell infrastructure.

REET Fleet Footprint Calculator
Calculate your fleet's petroleum use and greenhouse gas emissions footprint.

PEV Readiness Scorecard
Assess your community's readiness for the arrival of plug-in electric vehicles.

Interactive Maps

Alternative Fueling Station Locator
Locate alternative fueling stations and get maps and driving directions.
mobile

TransAtlas
Analyze vehicle densities and locations of fueling stations and production facilities.

BioFuels Atlas
Compare feedstocks and analyze biofuel production by location.

Truck Stop Electrification Sites
Locate truck stops with electrification sites to reduce the need for idling.
mobile

Coalition Locations
Find Clean Cities coalitions and contact information for coordinators.

Data Searches

Light-Duty Vehicle Search
Compare light-duty alternative fuel vehicles, electric vehicles, and hybrids.

Heavy-Duty Vehicle and Engine Search
Find medium- and heavy-duty alternative fuel vehicles, engines, and hybrid systems.

Fuel Properties Comparison
Compare alternative fuel properties and characteristics.

Laws and Incentives Search
Search for laws and incentives related to alternative fuels and advanced vehicles.

Find a Car
Compare fuel efficiency, costs, carbon footprints, and emissions.
mobile

State Information
Find state information about alternative fuels and advanced vehicles.

Collaborators provide key advice/expertise

JOBS H₂ Advisory Group

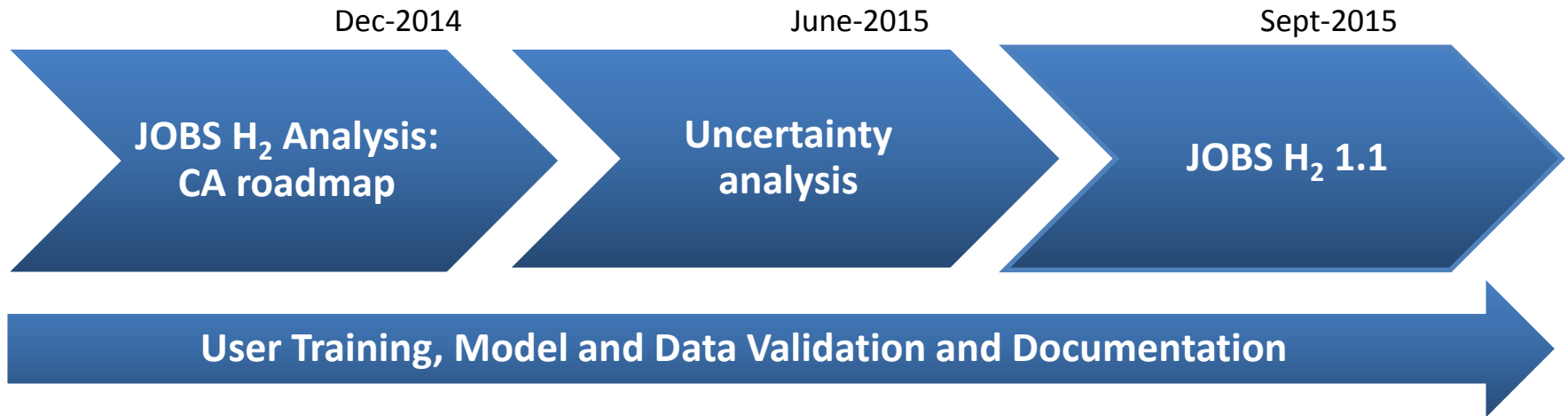
- California Air Resources Board (CARB)
- California Fuel Cell Partnership (CAFCP)
- Connecticut Center for Advanced Technology (CCAT)
- Fuel and vehicle suppliers
- Researchers

Assistance/role

- Defaults (data/analyses)
- Functionality/granularity
- Future directions/needs
- Beta testing
- Validation

Collaborator	FY 2015 Role
Argonne	Management and coordination; engineering data collection and analysis; quality assurance; outreach; stochastic modeling; documentation
RCF	Economic data collection and analysis; quality assurance; code development and application; documentation
Northwestern U.	Application and upgrading source code; stochastic modeling, quality assurance
Advisory group	Data/resource acquisition; document review; beta testing

Select enhancements & analyses planned in FY15-16

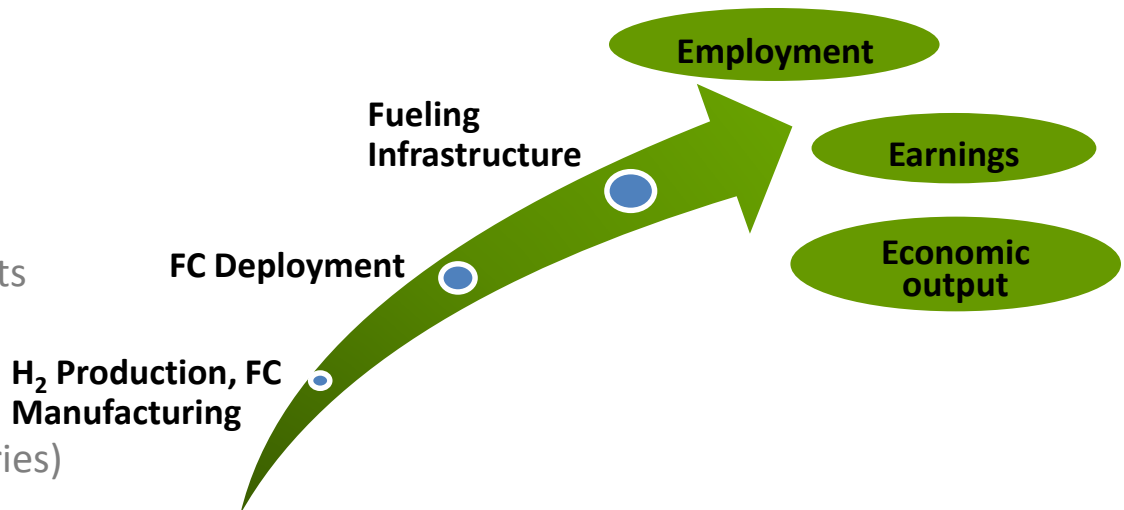


Planned model expansions/analyses:

- **LH₂, 400+ kg/d**
- **JOBS FC uncertainty analysis**
- **Alternative rollout scenarios**

Future possibilities (not funded)

- Annual impacts of FC deployments
- Mobile fuelers
- Distributed H₂ production
- Employment detail (skills, industries)
- FC applications in vehicles



Summary

- **Relevance:** Consistent platform to analyze employment and other economic impacts of H₂ and FC investments. Fill gap/barrier in analysis portfolio. Assist DOE and stakeholders with analyses of economic effects of deploying H₂ infrastructure in early markets.
- **Approach:** Input-output modeling in context of user-friendly tools to calculate supply chain and induced employment, earnings and economic output.
- **Collaborations:** Active partnership between ANL & RCF with FY15 assistance from Northwestern University. Extensive stakeholder interaction.
- **Accomplishments and progress:**
 - JOBS H₂ 1.0 launched June 2014 in conjunction with EERE webinar
 - Evaluated impact of CAFCP's proposed H₂ station rollout
 - Added stochastic module to permit uncertainty analysis in JOBS H₂
 - Tech transfer via AFDC and QR cards (<http://JOBSmodels.es.anl.gov>)
- **Future work:**
 - Expand JOBS H₂ to include LH₂ and larger stations
 - Add stochastic module to JOBS FC
 - Analyze additional station rollout scenarios and alternative station options
 - Continue validating and refining defaults and improving model functionality