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CALIFORNIA ENERGY COMMISSION

RESEARCH & DEVELOPMENT DIVISION

# Scoping Workshop:
# 2018-2020 EPIC Investment Plan
# March 14, 2017

# Housekeeping

- In case of emergency
- Facilities
- Public comment protocol
- Today's presentation will be posted at:

http://www.energy.ca.gov/research/epic/17-EPIC-01/documents/

# Opening Comments

Chair Robert Weisenmiller
California Energy Commission

Commissioner Martha Guzman Aceves
California Public Utilities Commission

# Agenda

| Item | Time |
|---|---|
| Welcome and Housekeeping – Anthony Ng | 5 minutes |
| Opening Comments – Chair Weisenmiller, Commissioner Aceves | 5 minutes |
| Introduction and Agenda Review - Laurie ten Hope | 15 minutes |
| CPUC Overview – Maria Sotero | 5 minutes |
| Investor Owned Utilities' EPIC Portfolio – Aaron Renfro | 10 minutes |
| Energy Commission Overview of *2018-2020 EPIC Investment Plan* Draft Initiatives – Energy Commission Staff | 2 hours 40 minutes |
| Lunch | 1 hour |
| End-User Panel – Laurie ten Hope, Moderator | 1 hour 10 minutes |
| Public Comment – Anthony Ng, Moderator | Remaining Time |

# Purpose of Workshop

- Discuss the schedule and framework for developing the 2018 – 2020 EPIC Triennial Investment Plan.
- Provide guidance on how stakeholders can participate in the development of the 2018 – 2020 EPIC Triennial Investment Plan.
- Catalyze a conversation to maximize the value of the research portfolio.
  - Engage researchers to expand what's possible.
  - Partner with customers to identify needs, encourage adoption, and share the benefits of clean energy more broadly.
  - Drive clean energy innovation in California's low-income and disadvantaged communities.
  - Expand our research to create a vibrant, impactful innovation ecosystem.

# Overview of EPIC Program

- The Electric Program Investment Charge (EPIC) program is California's R&D investment in the 21st century electric power system.

- All EPIC research initiatives must:
  - Address the state's pioneering energy priorities.
  - Accelerate technology innovations and tools.
  - Provide benefits to California ratepayers.

- Transforming our state's electric power system is a significant undertaking that requires multi-dimensional solutions.

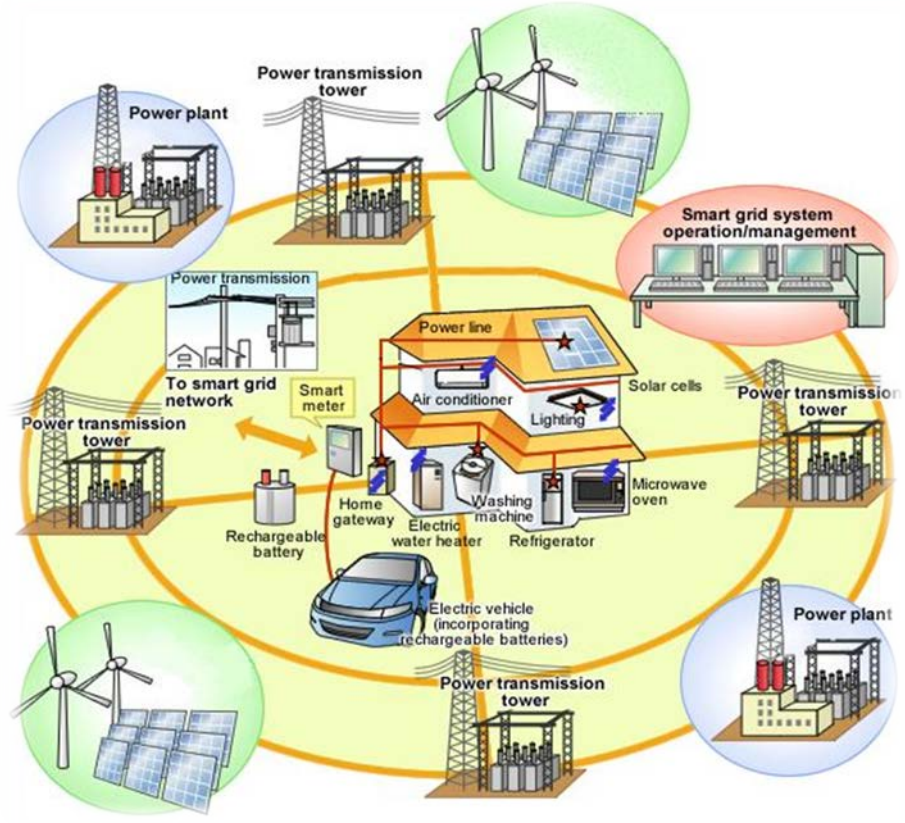
# CEC Administered EPIC Funding


## Funding Areas

- Energy Efficiency
- Clean Generation
- Smart Grid
- Cost Share for Federal Awards
- Renewables
- Demand Response
- Integration of EV, DR, DER, Renewables, and Smart Grid
- Entrepreneurial support and assistance
- Innovative local strategies
- Streamlined customer adoption

# Policy Drives Innovation

- Increase RPS to 50% by 2030
- Reduce GHG to 40% below 1990 by 2030
- 1.3 GW of storage by 2020




- Double energy efficiency savings by 50%
- 1.5 million ZEV's by 2025
- Increase access to clean energy in disadvantaged communities

# Policy Guidance

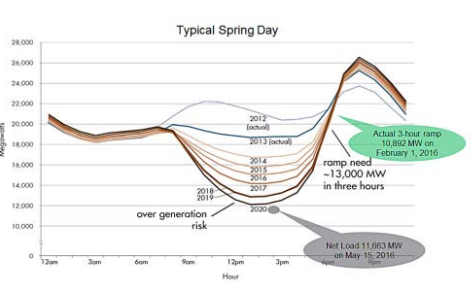
SB 96 provides additional direction to the Energy Commission in its administration of EPIC

EPIC should award, "funds to projects that may lead to technological advancement and breakthroughs to overcome barriers that prevent the achievement of the state's statutory energy goals and that may result in a portfolio of projects that is strategically focused and sufficiently narrow to make advancement on the most significant technological challenges."

The Energy Commission shall, "use a sealed competitive bid as the preferred method to solicit project applications and award funds pursuant to the EPIC program."

# EPIC Innovation: Providing Solutions

| Controlling Vampire Loads with Technologies and Infrastructure | Moving from Energy Storage Research Investments to Procurement | Testing Demand Response Strategies Across Multiple Sectors | Launching an Energy Innovation Ecosystem |
|---|---|---|---|


# EPIC Innovation: Providing Solutions

Addressing California's Susceptibility to Drought

Innovative Solutions to Address Tree Mortality

Adapting to Climate Risks to the Electricity System

# EPIC Innovation: Engaging Customers

Increasing Energy Savings for Multi-Family Dwellings

Creating Zero or Near Zero Net Energy Buildings

Building the Advanced Energy Community of the Future

# EPIC Innovation: Engaging Customers

| Building Commercial Opportunities Through Successful Military Partnerships | Targeting Reliability and Resiliency | Establishing Commercial Opportunities for Microgrids |
|---|---|---|
|  |  |  |

# Tentative Schedule for Developing 2018-2020 EPIC Investment Plan

| Activity | Time Frame |
|---|---|
| Energy Commission Post Draft Funding Initiatives | March 10, 2017 |
| Energy Commission Hosted Workshop on Draft Funding Initiatives; Sacramento, CA | March 14, 2017 |
| **Stakeholder Comments due on Draft Funding Initiatives:** https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=17-EPIC-01 | **March 20, 2017** |
| Energy Commission Post Draft Investment Plan | March 30, 2017 |
| Energy Commission Post Final Investment Plan | April 17, 2017 |
| Energy Commission Business Meeting to Approve Investment Plan | April 27, 2017 |
| Submit to CPUC | May 1, 2017 |

# Upcoming Workshops for Developing 2018-2020 EPIC Investment Plan

| Activity | Time Frame |
|---|---|
| Climate Change Research; Sacramento, CA | March 16, 2017 |
| Community Focused Equity in Research Funding; Clovis, CA | March 20, 2017 |
| Community Focused Equity in Research Funding; Lynwood, CA | March 27, 2017 |
| IOU EPIC Workshop; Westminster, CA | March 24, 2017 |

# 2018 – 2020 EPIC Investment Plan
# Draft Funding Initiatives

# Theme 1: Advance Technology Solutions for Deep Energy Savings in Buildings and Facilities

- SB 350 establishes an ambitious goal to double statewide energy efficiency savings by 2030
- There will be a need to make exponential energy efficiency gains based on growing energy demand, spacing cooling needs and further electrification of the energy sector
- This theme focuses on technology advancements to drive cost and performance improvements to energy efficiency components intended to accomplish the following:
  - Accelerate the adoption rate of energy efficiency upgrades in existing buildings and facilities
  - Increase cost-effective technology options for energy efficiency in future buildings
  - Electrify traditionally non-electric appliances and equipment
  - Improve the energy efficiency of the industrial sector

# Theme 1: Advance Technology Solutions for Deep Energy Savings in Buildings and Facilities

S1.1 Accelerate Product Development and Market Acceptance of Solid-state Lighting Technologies and Designs

S1.2 Develop Advanced Building Envelope Materials and Designs for Healthy, Comfortable and Highly Efficient Buildings

S1.3 Drive Technical- and Cost-Performance Improvements in High-Efficiency Heating, Ventilation and Air Conditioning Systems

S1.4 Enable Integration of Building and Equipment Controls and Automation

S1.5 Increase the Energy Efficiency of Plug Loads and Consumer Electronics Devices

S1.6 Accelerate the Transition to Direct Current Powered Buildings and Facilities

S1.7 Develop Technologies that can Assist in Decarbonizing Key California Industries

# S1.1 Accelerate Product Development and Market Acceptance of Solid-State Lighting Technologies and Designs

**S1.1.1** Pilot and Test New Solid-State Lighting Features and Applications that Add Functionality in Addition to Energy Savings

- Evaluate value added features to increase adoption of Solid-State Lighting technology, including cost, energy use of the added feature, and overall benefits

# S1.1 Accelerate Product Development and Market Acceptance of Solid-State Lighting Technologies and Designs

**S1.1.2** Test Novel Luminaire Systems Architecture and Form Factors That Leverage the Unique Properties of LEDS

- Develop, design and test new fixture geometries that can be installed in new construction or be easily retrofitted in facilities, such as hospitality, retail, healthcare, and outdoor lighting

# S1.1 Accelerate Product Development and Market Acceptance of Solid-State Lighting Technologies and Designs

**S1.1.3** $1 LED A-19 Lamp Prize

- Drive down SSL cost while maintaining product quality and feature richness (e.g., Energy Commission specifications for color rendering, durability and performance
- Same light output as a 100W incandescent bulb
- Demonstrate the lamp in a minimum number of buildings in disadvantaged communities
- Market the lamp at $1

# S1.2 Develop Advanced Building Envelope Materials and Designs for Healthy, Comfortable and Highly Efficient Buildings

**S1.2.1** Deploy Next Generation Window and Building Envelope Systems in Existing Residential and Commercial Buildings

- Large scale deployment of pre-commercial window and envelope measures in pre 1980's residential, commercial or multifamily buildings including disadvantaged communities
- Example technologies include building envelope materials, air and liquid sealing, dynamic windows/window films, or highly insulating roofs

# S1.2 Develop Advanced Building Envelope Materials and Designs for Healthy, Comfortable and Highly Efficient Buildings

**S1.2.2** Builder Competition for Best Residential Envelopes

- Contest for the most efficient residential building envelope by production home builders at a certain price point
- Selected builders will build a minimum number of homes
- Third party will assess  for air leakage, conduction losses, solar heat gain, etc

# S1.2 Develop Advanced Building Envelope Materials and Designs for Healthy, Comfortable and Highly Efficient Buildings

**S1.2.3** Multifamily Factory Built Homes Competition for Highly Efficient Building Envelopes

- Contest for the most efficient building envelope for multifamily factory built homes by manufactured home builders
- Selected manufacturers will build a number of factory built homes
- Third party will test for air leakage, conduction losses, solar heat gain, etc

# S1.3 Drive Technical- and Cost-Performance Improvements in High-Efficiency Heating, Ventilation and Air Conditioning Systems

**S1.3.1** Develop and Test Cold Climate Electric Heat Pump Space and Water Heaters

- Capable of operating a low ambient temperatures without impacting performance, energy efficiency or operating costs

# S1.3 Drive Technical- and Cost-Performance Improvements in High-Efficiency Heating, Ventilation and Air Conditioning Systems

**S1.3.2** Develop and Test Electrochemical Compression Systems

- Develop and test a working prototype of an electrochemical compressor in a light commercial application in CA to document savings and performance over a one year period

# S1.3 Drive Technical- and Cost-Performance Improvements in High-Efficiency Heating, Ventilation and Air Conditioning Systems

**S1.3.3** Manufacturing and Designing Improved Heat Exchangers

- Design competition
- Use of additive manufacturing technologies (e.g., 3D Printing) to design and develop heat exchangers with high efficiency
- Performance and durability to be installed into an electric heat pump
- Evaluated for a minimum of 12 months

# S1.4 Enable Integration of Building and Equipment Controls and Automation

**S1.4.1** Research and/or Demonstrate Open Source Platforms, Protocols, and Interoperability of Technologies

- Investigate open source platforms for affordable, flexible building automation for small and medium scale residential and commercial buildings

# S1.4 Enable Integration of Building and Equipment Controls and Automation

**S1.4.2** Human Centered Design Thinking for Next Generation Building Controls

- Develop, demonstrate, or deploy technologies that enable human centered design in building controls/automation allowing building designers to interact with representative occupants early in the design process to ensure their needs are met

# S1.4 Enable Integration of Building and Equipment Controls and Automation

**S1.4.3** Demonstrate Innovative Security and Cyber Security Methods

- Evaluate existing or novel approaches to securing technologies that facilitate the interactions between users, buildings and the grid
- Can include demonstrations of building transactive energy models, block chain security or digital privacy and security standards

# S1.5 Increase the Energy Efficiency of Plug Loads and Consumer Electronics Devices

**S1.5.1** Develop and Test New Strategies for Low Power and Idle Mode Devices

- Address devices that are always on but have low power/idle mode or no power management capabilities
- Create a database to identify those with the highest potential for energy savings
- Develop and test devices that have zero to near zero idle modes
- Develop strategies to motivate manufacturers to include in design
- Develop test procedures for measuring

# S1.5 Increase the Energy Efficiency of Plug Loads and Consumer Electronics Devices

**S1.5.2** Develop and Test Energy Saving Opportunities for Electronic Medical Equipment with Potential to Reduce Standby or Idle Energy Use

- Examine medical equipment plug load operational modes to determine control technologies/strategies to power down devices when not in use while ensuring fast response and emergency readiness

# S1.5 Increase the Energy Efficiency of Plug Loads and Consumer Electronics Devices

**S1.5.3** Large-scale Demonstrations of Low Energy Consuming Plug-in Devices with the Greatest Potential of Market Adoption and Penetration

- Demonstrate new emerging plug load technologies with at least 10 percent lower energy consumption than devices currently on the market

# S1.6 Accelerate the Transition to Direct Current Powered Buildings and Facilities

**S1.6.1** DC Building Distribution Systems to Enable New ZNE Commercial Buildings by 2030

- Develop DC building test bed to test and demonstrate electrical components and configurations, voltages, communication protocols, installation procedures and safety practices needed to inform building standards for DC and hybrid (AC/DC) buildings
- Determine optimal combinations of AC and DC electrical systems by building type
- Compare benefits of DC and hybrid buildings
- Test DC systems and appliances
- Establish best practices for DC systems

# S1.6 Accelerate the Transition to Direct Current Powered Buildings and Facilities

**S1.6.2** Cost Competitive, Efficient DC Appliances

- Develop DC appliances focusing on optimizing key components, such as DC motors, variable frequency drives, solid state heating and cooling and other core components

# S1.7 Develop Technologies That Can Assist in Decarbonizing Key California Industries

**S1.7.1** Develop and Deploy Sensors and Software to Optimize Refrigeration Compressor Efficiency by Automatically Floating Compressor Head Pressure

- Improve refrigeration compressor control through use of sensors/software
- Deployed in minimum number of industries
- Prove the viability and the savings and benefits

# S1.7 Develop Technologies That Can Assist in Decarbonizing Key California Industries

**S1.7.2** Develop and Deploy Sensors and Software to Optimize Compressed Air and other Related Systems to Minimize Energy Losses and Maximize Efficiency

- Improve compressed air systems to compare current operations w/industry standards and determine leaks and potential energy/cost savings
- Large scale deployment of sensors and software
- Provide information to plant operators of potential areas of waste and potential energy and cost savings

# S1.7 Develop Technologies That Can Assist in Decarbonizing Key California Industries

**S1.7.3** Develop Strategies and Tools for Maximizing Cost Effective Energy Efficiency Strategies for Decarbonization of the Industrial Sector

- Identify cost-effective strategies with highest potential for major industries
- Potential for implementation in the near and mid term
- Determine cost effectiveness and potential savings and regulatory constraints

# S1.7 Develop Technologies That Can Assist in Decarbonizing Key California Industries

**S1.7.4** Large Scale Deployment of Pre-Commercial Technologies with Demonstrated Potential

- Large scale deployment of projects with the capability to reduce industrial energy use by at least 10% and be scalable and duplicated at multiple facilities

# Theme 2: Accelerate Widespread Customer Adoption of Distributed Energy Resources

- California's energy policies envision a future electricity system significantly more decentralized and decarbonized than the one that developed a century earlier. Driving this transition are distributed energy resources (DERs)
- The market for DER solutions, especially those that integrate multiple customer-side technologies, is still in its early-stages and limited information and experience exist among the various stakeholder groups needed for their widespread diffusion
- This theme describes funding initiatives that will demonstrate new DER technologies, as well as new strategies for deploying DER solutions, that seek to:
  - Identify optimal technology packages for specific uses and applications that can drive new business cases for DER
  - Accelerate the learning curve for deploying new DER solutions
  - Align planning, permitting, procurement and financing models to meet the needs of the DER market

# Theme 2: Accelerate Widespread Customer Adoption of Distributed Energy Resources

S2.1 Increase the Cost-effectiveness of Zero Net Energy Buildings and Communities

S2.2 Push Low-Carbon Microgrids Closer to Commercial Viability

S2.3 Improve the Business Proposition of Integrated Distributed Storage

S2.4 Incentivize DER Adoption through Innovative Strategies at the Local Level

# S2.1 Increase the Cost-Effectiveness of Zero Net Energy Buildings and Communities

**S2.1.1** Develop and Test Plans for Enhanced New Construction of Highly Efficient Communities that Include Distributed Energy Resources

- Develop several enhanced plans for community-scale developers
  - Implement during build out phase to include advanced energy efficiency beyond current requirements
  - Minimize energy use and electrical load
  - Use DERs to provide grid flexibility

- **Phase 1**: Plan Development

- **Phase 2**: Funding

# S2.1 Increase the Cost-Effectiveness of Zero Net Energy Buildings and Communities

**S2.1.2** Assess, Plan and Test Innovative Strategies to Employ Cost-Effective Combinations of Advanced Energy Efficiency Technologies, Distributed Generation and Electricity Storage to Provide Grid Benefits

- **Phase 1**: Applicants identify community
  - Assess community interest; develop community engagement and investment strategy, identify coalition of contractors, community leaders, local government and utility reps to support a pilot test

- **Phase 2**: 1st Phase winners compete to pilot test innovative approaches

# S2.2 Push Low-Carbon Microgrids Closer to Commercial Viability

**S2.2.1** Advance Microgrids to the Tipping Point of Broad Commercial Adoption

- Stakeholder Involvement
- Use the actions defined in the published *Roadmap for the Commercialization of Microgrids in California* and from public workshops
- Develop documents that provide clear directions

# S2.3 Improve the Business Proposition of Integrated Distributed Storage

**S2.3.1** Development of Customer's Business Proposition to Accelerate Integrated Distributed Storage Market

- Address ***key commercial business case actions*** defined in the State's Energy Storage Roadmap, *Advancing and Maximizing the Value of Energy Storage Technology, A California Roadmap*
- **Phase 1**: Establish key stakeholder working groups
- **Phase 2**: Develop funding initiatives

# S2.4 Incentivize DER Adoption through Innovative Strategies at the Local Level

## S2.4.1 EPIC Challenge II

- 2016 EPIC Challenge
- New Challenge
- Challenge project teams to develop innovative and replicable approaches

# Theme 3: Increase System Flexibility from Low-Carbon Resources

- SB 350 establishes a new 50 percent target for California's RPS and SB 96 requires GHG emission reductions of 40 percent below 1990 levels by 2030
- For California to meet both of these goals and continue to drive down the levelized cost of renewable generation, new innovations are needed that will increase the use of low-carbon resources for grid flexibility
- The funding initiatives described in this theme will further enable these strategies by advancing system-level science and technology innovations that:
  - Accelerate the development and adoption of communication-enabled devices and controls
  - Improve the performance and economics of hardware technologies used in grid-connected customer devices
  - Utilize big data to optimize planning and management of low-carbon energy resources
  - Inform innovative designs for rate and market structures for integrating DERs

# Theme 3: Increase System Flexibility from Low-Carbon Resources

S3.1 Accelerate Broad Adoption of Automated Demand Response Capabilities that Provide the Grid Flexible Response Services

S3.2 Enable Electric Vehicle-Based Grid Services

S3.3 Increase the Value of Distributed Energy Resources and Renewables to the Transmission and Distribution System

S3.4 Define and Demonstrate the Locational Benefits and Optimal Configurations of Grid-level Storage as the California Grid Transitions to More Distributed Energy Resources

# S3.1 Accelerate Broad Adoption of Automated Demand Response Capabilities that Provide the Grid Flexible Response Services

**S3.1.1** Market Design for the Next-Generation Demand Response Landscape

- Develop and pilot test new market designs and concepts
- Identify subsets of end-use loads to meet the variable flexible response needs of CA ISO and the Utilities
- Assess and demonstrate how demand response can provide rapid load reductions and load increases
- Assess load shapes and potential load control performance

# S3.2 Enable Electric Vehicle-Based Grid Services

**S3.2.1** Grid-Friendly Plug-in Electric Vehicle Mobility

- Demonstrate advanced vehicle grid integration functions to better characterize the business cases for emerging applications
  - Advance communication and control functionalities
  - Demonstrate the value of advancing technological platforms
  - Seek to reduce the marginal costs for bi-directional functionality for Plug-in Electric Vehicles and charging stations

# S3.2 Enable Electric Vehicle-Based Grid Services

## **S3.2.2** Battery Second Use

- Develop technologies or test methods
- Develop and demonstrate viable and beneficial technologies to optimize second-life Plug-in Electric Vehicle battery packs

# S3.3 Increase the Value of Distributed Energy Resources and Renewables to the Transmission and Distribution System

**S3.3.1** Optimize and Coordinate Smart Inverters Using Advanced Communication and Control Capabilities

- Improve the ability of solar PV to benefit the grid and ratepayers by optimizing the functionality of smart inverters
- Develop and demonstrate Distributed Energy Resource Management System algorithms

# S3.3 Increase the Value of Distributed Energy Resources and Renewables to the Transmission and Distribution System

**S3.3.2** Reduce the Cost and Time Needed for Interconnection to the Grid and Improve Interoperability

- Build on the outcomes of modeling planned under the second investment plan
  - Show optimal locations
  - Include smart inverters
  - Facilitate interconnection

# S3.3 Increase the Value of Distributed Energy Resources and Renewables to the Transmission and Distribution System

## S3.3.3 Advance Distribution Planning Tools

- Improve distribution-planning tools
  - Distributed Energy Resource Management Systems and
  - Improves and speeds up Integrated Capacity Analysis calculations

# S3.3 Increase the Value of Distributed Energy Resources and Renewables to the Transmission and Distribution System

**S3.3.4** Provide Visibility into DER Responses to Weather and Other Variables and into the Effects of DER on Gross Load

- Understand the effects of weather patterns and other events on rooftop solar production, electric vehicle charging, and other DER usage, as well as on the gross load

- Enable forecasters to better predict the net load that will need to be met through geothermal, natural gas, and other utility-scale generation

# S3.3 Increase the Value of Distributed Energy Resources and Renewables to the Transmission and Distribution System

**S3.3.5** Facilitate Adoption of the Communication and Protocols for the Electricity System

- Develop a standard framework to evaluate and compare competing communication standards and protocols currently being developed and proposed for grid-connected devices including:
  - Storage
  - Electric vehicles
  - Smart inverters

- Test the different communication standards against the criteria

# S3.4 Define and Demonstrate the Locational Benefits and Optimal Configurations of Grid-Level Storage as the California Grid Transitions to More Distributed Energy Resources

**S3.4.1** Assessment and Simulation Study of California Grid with Optimized Grid-Level Energy Storage

- This initiative will focus on analysis and detailed studies, including:
  - Baseline assessment
  - Comprehensive and complex simulation study

# Theme 4: Increase the Cost-Competiveness of Renewable Generation

- SB 350 expanded the RPS target from 33% by 2020 to 50% by 2030
- Renewable generation capacity tripled between 2001 and 2016
- Onshore utility-scale wind, utility-scale solar PV and rooftop solar PV has led this increase
- Continued growth of renewables will become difficult as resource locations become fewer, costs to integrate become higher, and the market for rooftop PV begins to saturate
- This theme focuses on technology advancements needed to open new market opportunities for renewables:
  - Increase the economic potential of renewables within in California
  - Enable renewables to compete in grid service markets
  - Develop technologies whose unique attributes can create new uses and markets for renewables

# Theme 4: Increase the Cost-Competiveness of Renewable Generation

S4.1 Advance Emerging Thin-Film PV Technologies for High Value Applications

S4.2 Develop Technologies that Enable Increased Wind Capacity in California

S4.3 Increase the Strategic Value of Flexible CSP and Geothermal to the Electricity System

S4.4 Improve the Value Proposition of Bioenergy

# S4.1 Advance Emerging Thin-Film PV Technologies for High Value Applications

**S4.1.1** Advance the Material Science, Manufacturing Process, and In-Situ Maintenance of Thin-Film PV Technologies

- Exploring advantages of changes in materials composition substituting toxic and/or rare elements with non-toxic and abundant alternatives
- Developing novel encapsulating materials and techniques to prevent module failures
- Using existing manufacturing equipment and processes to manufacture thin film PV
- Developing cost-effective in-situ refurbishment and upgrade processes to replace degraded materials with new materials

# S4.2 Develop Technologies that Enable Increased Wind Capacity in California

**S4.2.1** Advanced Manufacturing and Installation Approach for Utility-Scale Land-Based Wind Turbine Components

- Advanced manufacturing techniques of wind turbine components
- New composite materials for wind towers/blades

# S4.2 Develop Technologies that Enable Increased Wind Capacity in California

**S4.2.2** Reduce Costs and Technical Barriers to Facilitate Deployment of Offshore Wind

- Technology advances that lower the cost of offshore generation and transmission to shore
  - Examples: Floating platforms, rotors, drivetrains, generators
- Design of offshore wind components and logistics systems that can be accommodated at existing ports
  - May be coordinated with upgrades for port electrification and resilience to sea level rise

# S4.2 Develop Technologies that Enable Increased Wind Capacity in California

**S4.2.3** Real-Time Remote Monitoring System for Offshore and Land-Based Wind Technologies

- Development of cost-effective real time remote monitoring and control system for wind turbines

# S4.3 Increase the Strategic Value of Flexible CSP and Geothermal to the Electricity System

**S4.3.1** Making Flexible-Peaking Concentrating Solar Power (CSP) with Thermal Energy Storage (TES) Cost Competitive

- RD&D on system components and integration approaches needed to increase the efficiency of CSP-TES
- Demonstrate emerging low cost/alternative CSP
- Conduct system simulation, modeling and design studies that will confirm the system performance relative to other energy storage

# S4.3 Increase the Strategic Value of Flexible CSP and Geothermal to the Electricity System

**S4.3.2** Geothermal Energy Advancement for a Reliable Renewable Electricity System

- Develop materials, designs and operational techniques to mitigate corrosion issues and possibly integrate energy storage
- Explore the economic values of useful elements from buildup of condensates (such as solid sulfur for agriculture use or metals for industrial application)

# S4.4 Improve the Value Proposition of Bioenergy

**S4.4.1** Tackling Tar and Other Impurities: Addressing the Achilles Heel of Gasification

- Demonstrate methods to cost-effectively remove impurities such as tar

# S4.4 Improve the Value Proposition of Bioenergy

**S4.4.2** Demonstrating Modular Bioenergy Systems and Feedstock Densifying and Handling Strategies to Improve Conversion of Accessibility-Challenged Forest Biomass Resources

- Demonstrate modular gasification systems in forest/urban interface areas
- Demonstrate innovative systems, such as densification and torrefaction, that reduce biomass volume and improve energy density

# S4.4 Improve the Value Proposition of Bioenergy

**S4.4.3** Demonstrate Improved Performance and Reduced Air Pollution Emissions of Biogas or Low Quality Biogas Power Generation Technologies

- Develop and demonstrate low-cost emissions control technologies
- Demonstrate fuel-flexible and cost effective generation technologies that can use low quality biogas to produce electricity

# Theme 5: Create a Statewide Ecosystem for Incubating New Energy Innovations

- Transforming California's electricity sector will require innovation at unprecedented levels
- New energy technologies don't fit the risk, return or time profiles of traditional venture capital
- The funding initiatives described in this theme seek to leverage, align and expand California's existing assets to build a more efficient statewide energy innovation ecosystem that will:
  - Provide a more systematic approach to move new energy inventions through the "Technological Valley of Death"
  - Reduce non-value added activities from the development of energy technology breakthroughs
  - Overcome barriers to broader and more diverse clean energy entrepreneurship

# Theme 5: Create a Statewide Ecosystem for Incubating New Energy Innovations

S5.1 Shorten the Timeframe of New Energy Technologies from Idea to Investment

S5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

# S5.1 Shorten the Timeframe of New Energy Technologies from Idea to Investment

**S5.1.1** Continue CalSEED Initiative to Provide Early Stage Support for Clean Energy Technology Entrepreneurs

- The small-scale funding provided by the CalSEED Initiative gives entrepreneurs starting capital to develop their ideas into proof-of-concepts and early prototypes

- This level of funding fills a crucial niche in the financing landscape for clean energy entrepreneurs as Venture Capital firms have decreased their level of investment at this level over the past several years

# S5.1 Shorten the Timeframe of New Energy Technologies from Idea to Investment

**S5.1.2** Expand Entrepreneurial Services from Innovation Clusters

- This initiative will expand the entrepreneurial support provided by the Regional Energy Innovation Clusters funded under the first two EPIC Investment Plans by expanding the suite of commercialization assistance and services available for clean energy entrepreneurs and startups

- This expansion will include increased access to laboratory testing facilities, and increased mentorship on business development, commercialization, scale-up, and intellectual property considerations

- Together, these technical and non-technical resources create an ecosystem that fosters energy innovations at all Technology Readiness Levels

# S5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

**S5.2.1** Connect Clean Energy Entrepreneurs with Local California Manufacturing

- This initiative will leverage existing manufacturing infrastructure and provide clean energy entrepreneurs with access to high volume production technologies and expertise
- Connecting energy entrepreneurs with advance manufacturers early in the technology development process to help shorten the time and cost required for hardware scale-up and deployment
- Material selection, assembly processes, and other engineering and design considerations can have dramatic impacts on the performance, reliability, and safety of a technology
- Local manufacturers can inform these practical design considerations and help address them early in the technology development process before costly redesigns are needed later in the process

# S5.2 Accelerate the Most Promising Energy Technologies from Prototype to Market Entry

**S5.2.2** Bringing Rapid Innovation Development to Green Energy (BRIDGE)

- This initiative will establish a new funding mechanism to provide crucially needed follow-on funding for the most promising innovations that come out of EPIC and ARPA-e
- This support will allow researchers to continue their technology development without losing momentum or pausing to fund raise from private sources
- Even the most promising energy innovations typically require multiple rounds of funding to advance their technology to attract private sector interest and investment

# Theme 6: Maximize Synergies in the Water-Energy-Food Nexus

- Water and energy systems are interdependent meaning that each system is vulnerable to the problems of the other
- California's drought over the last several years threatened water supplies of communities and residents, affected agricultural production and wildlife habitats and reduced hydropower availability
- This theme focuses on technology advancements to drive down cost and development of strategies to reduce the energy intensity of water supply, use and treatment and to optimize management practices intended to accomplish the following:
  - Develop low energy intensity treatment processes for conventional and non-conventional water sources
  - Demonstrate cost-effective options for water and energy efficiency in agriculture and food processing to reduce carbon intensity
  - Develop tools and strategies for improved water management to improve energy resilience and reduce vulnerability

# Theme 6: Maximize Synergies in the Water-Energy-Food Nexus

S6.1 Reduce the Energy Intensity Required to Supply and Treat Water

S6.2 Increase the Energy and Water Efficiency of California's Food and Agricultural Sector

S6.3 Optimize Management Practices Associated with the Water-Energy Nexus

# S6.1 Reduce the Energy Intensity Required to Supply and Treat Water

**S6.1.1** Develop and Test Novel Energy Efficient Treatment Methods for Conventional and Non-conventional Sources of Water Supply

- Optimize disinfection technologies
- Optimize treatment plant and water distribution systems
- Reduce the energy intensity to convert non conventional water sources for community use
- Evaluate and test low energy intensity desalination for brackish water

# S6.1 Reduce the Energy Intensity Required to Supply and Treat Water

**S6.1.2** Develop and Demonstrate Tools and Strategies to Help Water and Wastewater Agencies Lower Energy Use, Increase Efficiency, and Reduce the Carbon Intensity of Operations

- Demonstrate strategies in water and wastewater treatment plants in California
- Could include use of advanced sensors, controls and monitoring equipment, and use of advanced energy efficiency technologies

# S6.1 Reduce the Energy Intensity Required to Supply and Treat Water

**S6.1.3** Develop and Demonstrate Advanced Energy Efficiency Improvements to Allow for On-site Wastewater Treatment for Industrial Facilities and Reuse for Water Intensive Industries

- Demonstrate advanced, low energy treatment processes to allow for direct on-site reuse of water
- Consider potential for retrofits to existing systems
- Consider capital and operating costs—goal is high water reclamation and be more efficient than current standard processes

# S6.2 Increase the Energy and Water Efficiency of California's Food and Agricultural Sector

**S6.2.1** Demonstrate Advanced Water and/or Energy Efficiency Technologies to Reduce Carbon Intensity of Agriculture

- Demonstrations of technologies to reduce energy and water use in varying regions and by crop type
- Independent monitoring of energy and water savings and impacts on crop yield over several seasons

# S6.2 Increase the Energy and Water Efficiency of California's Food and Agricultural Sector

**S6.2.2** Demonstrate Advanced Water and/or Energy Efficiency Technologies to Reduce Carbon Intensity of Food Processing Operations

- Demonstrations of technologies with potential for cost effectiveness that will not impact business operations or product quality
- Process efficiency improvements
- Advanced energy management controls
- Refrigeration systems
- Advanced on-site water/wastewater systems

# S6.3 Optimize Management Practices Associated with the Water-Energy Nexus

**S6.3.1** Conjunctive Management for Improved Energy Resilience

- Research to ensure reliable and clean water supply for multiple needs
  - Studies related to using pumped storage in combination with groundwater recharge; improving actual use of technologies and practices for groundwater and recycled water supply for electricity generation

# S6.3 Optimize Management Practices Associated with the Water-Energy Nexus

**S6.3.2** Develop Tools for Reducing Vulnerability to Hazards, Interconnected Infrastructure Risk, and Climate Impacts through Collaboration of Water and Energy Sectors

- Development of tools to prevent and respond to risks that are tailored to the assets and challenges of subregions within California
- Delineate and respond to barriers to effective communication and/or management between water and energy systems
- Decision support tools, models and innovative methodologies for engagement between water and energy systems

# Theme 7: Develop Tools and Analysis to Inform Energy Policy and Planning Decisions

The changing electricity system must be informed by studies that illuminate climate impacts and best management practices to maximize resources

# Theme 7: Develop Tools and Analysis to Inform Energy Policy and Planning Decisions

S7.1 Identify Pathways for Achieving California's Energy and Climate Goals

S7.2 Increase the Resiliency of the Electricity System to Climate Change and Extreme Weather Events

S7.3 Evaluate Strategies to Understand and Mitigate Impacts of the Electricity System on the Environment and Public Health and Safety

# S7.1 Identify Pathways for Achieving California's Energy and Climate Goals

**S7.1.1** Integrated Pathways for Energy Futures: Tools and Science-Based Research for Holistic Energy Decision Making

- Integrated analyses of urban areas and regional studies for more detailed consideration of factors, such as geographical distribution of demand and local resources

- Investigate equity issues, such as the potential costs and the benefits of electrification for disadvantaged and low income communities

# S7.1 Identify Pathways for Achieving California's Energy and Climate Goals

**S7.1.2** Applied Social Science Research to Inform Technology Development and Adoption for Deep Decarbonization of the Energy System

- Applied behavioral research to increase penetration of technically, environmentally, and economically sound demand response measures and energy efficiency programs
- Interdisciplinary teams to consider economics, social sciences and technology advancements together

# S7.2 Increase the Resiliency of the Electricity System to Climate Change and Extreme Weather Events

**S7.2.1** Assess Climate- and Weather-Related Risks to California's Electricity System and Develop Resilience Options to Inform Operations and Infrastructure-Related Decisions in California's Electricity Sector

- Build planned projections for parameters of interest (e.g., coastal fog, cloud cover) to California's electricity system
- Probabilistic forecasts for additional parameters (e.g., short-term precipitation forecasting) that could improve electricity sector operations (e.g., hydropower management)

# S7.2 Increase the Resiliency of the Electricity System to Climate Change and Extreme Weather Events

**S7.2.2** Clarify Interactions Between Renewable Electricity Systems and Climate Change to Ensure an Effective, Resilient Transition to Low-Carbon Energy in California

- Study how climate change might affect renewable energy systems and how to integrate impacts into design, deployment, and operations

# S7.2 Increase the Resiliency of the Electricity System to Climate Change and Extreme Weather Events

**S7.2.3** Advance Climate Readiness into Electricity System Operations and Ratepayer Readiness

- Provide tools that feed directly into management, strategies for overcoming barriers to adaptation actions, and a clear understanding of the electricity sector's interconnectedness with other critical systems

- Expand Cal-Adapt with operations-oriented tools

# S7.3 Evaluate Strategies to Understand and Mitigate Impacts of the Electricity System on the Environment and Public Health and Safety

**S7.3.1** Find Environmental and Land Use Solutions to Facilitate the Transition to a Decarbonized Electricity System

- Investigate risks to sensitive species and habitats from interactions with energy facilities, and discover the mechanisms involved so that effective solutions can be developed
- Marine environmental research to assist the development, planning, and permitting of offshore renewable generation
- Develop innovative avoidance, impact minimization, or compensatory mitigation tools or strategies

# S7.3 Evaluate Strategies to Understand and Mitigate Impacts of the Electricity System on the Environment and Public Health and Safety

**S7.3.2** Enhance human health and safety associated with the electricity sector

- Studies of human exposure to emerging energy-related health threats and finding solutions to reduce risks
- Quantify risks associated with emerging electricity sector technologies, emphasizing health risks in disadvantaged communities
- Develop training and equipment to reduce risks for workers to safely respond to incidents involving the emerging electricity system

# S7.3 Evaluate Strategies to Understand and Mitigate Impacts of the Electricity System on the Environment and Public Health and Safety

**S7.3.3** Improve overall environmental performance in the entire supply chain for the electricity system

- Find substitute materials or processes (e.g., extracting natural resources to make devices and final disposal methods) that have potential to reduce emissions or other environmental impacts of energy technologies
- Develop and test improved recycling or reuse methods
- Assess the life-cycle environmental impacts such as disposal and recycling options for PV panels and batteries

# Theme 8: Catalyze Clean Energy Investment in California's Disadvantaged Communities

- SB350 takes steps to ensure California's clean energy transformation benefits all Californian's, especially those in the most vulnerable communities
- The SB350 Barriers Study identifies several recommendations – including recommendations for RD&D – to ensure disadvantaged and underserved communities have access to clean and affordable energy services
- The initiatives described in this theme seek to increase investment, deployment, and adoption of clean energy innovations in low-income and disadvantaged communities by:
  - Reducing knowledge gaps among decision makers looking to advance technology deployment in these communities
  - Demonstrating energy innovations and technologies that lead to sustained investments for low-income and disadvantaged communities
  - Developing new financial and business models that can mobilize private-sector energy investments

# Theme 8: Catalyze Clean Energy Investment in California's Disadvantaged Communities

S8.1 Inform Policy Efforts to Bring Low-Carbon Energy Solutions and Their Benefits to Low-Income Customers and Disadvantaged Communities

S8.2 Demonstrate Emerging Clean Energy Technology Solutions in Disadvantaged Communities

S8.3 Develop Innovative Strategies to Increase Clean Energy Investment in Disadvantaged Communities

# S8.1 Inform Policy Efforts to Bring Low-Carbon Energy Solutions and Their Benefits to Low-Income Customers and Disadvantaged Communities

**S8.1.1** Advancing the Information Infrastructure for California's Low-income and Disadvantaged Communities

- There is a lack of information on energy-usage in low-income and disadvantaged communities
- This lack of information limits decision makers' understanding of how to advance technology development in these communities
- This initiative will support continued public data and information collection as well as increase the state's analytical capacity to determine the most pressing market gaps for clean energy in low-income and disadvantaged communities

# S8.2 Demonstrate Emerging Clean Energy Technology Solutions in Disadvantaged Communities

**S8.2.1** Scaling ZNE and Building California's Resilient Neighborhoods in Low-income and Disadvantaged Communities

- One of the largest hurdles for expanding clean energy in low-income and disadvantaged communities is the lack of examples of successful clean energy demonstrations to serve as models for would-be adopters
- Insufficient means to design, finance, and implement clean energy technologies, especially for retrofitting projects or community-scale projects, further impedes wide-spread customer adoption in these communities
- This initiative will demonstrate flexible and adaptive ZNE, or near ZNE, design packages in low-income and disadvantaged communities that include energy efficiency, renewable energy, demand response, and energy storage applications

# S8.3 Develop Innovative Strategies to Increase Clean Energy Investment in Disadvantaged Communities

**S8.3.1** The Inclusive Development through Equitable Adoption (IDEA) Challenge

- Driving California's clean energy economy will require innovative solutions to the financial barriers burdening low-income and disadvantaged communities
- The immature clean energy markets for low-income and disadvantaged communities raise a host of financing concerns that must be de-risked in order to bring in capital
- This initiative will launch a new Prize-based Competition that will challenge project teams to design innovative and inclusive financial models providing for more flexible, sustainable flows of capital to help overcome barriers to clean energy adoption and deployment in low-income and disadvantaged communities

# End-User Panel

- What suggestions do you have to ensure research is most impactful for your organization or sector?

- What critical electricity-related challenges does your organization or sector face that are not currently addressed by the draft funding initiatives?

# Public Comment

- Are there specific funding initiatives you think can be improved so they have a greater impact? If so, which initiative(s) and what specific suggestions would you make to improve the focus?

- Are there topics not included in the current set of funding initiatives where EPIC can add significant value? What are the topic(s) and what would be needed to have a measurable impact?

# Tentative Schedule for Developing 2018-2020 EPIC Investment Plan

| Activity | Time Frame |
|---|---|
| Energy Commission Post Draft Funding Initiatives | March 10, 2017 |
| Energy Commission Hosted Workshop on Draft Funding Initiatives; Sacramento, CA | March 14, 2017 |
| **Stakeholder Comments due on Draft Funding Initiatives:** https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=17-EPIC-01 | **March 20, 2017** |
| Energy Commission Post Draft Investment Plan | March 30, 2017 |
| Energy Commission Post Final Investment Plan | April 17, 2017 |
| Energy Commission Business Meeting to Approve Investment Plan | April 27, 2017 |
| Submit to CPUC | May 1, 2017 |

# Upcoming Workshops for Developing 2018-2020 EPIC Investment Plan

| Activity | Time Frame |
|---|---|
| Climate Change Research; Sacramento, CA | March 16, 2017 |
| Community Focused Equity in Research Funding; Clovis, CA | March 20, 2017 |
| Community Focused Equity in Research Funding; Lynwood, CA | March 27, 2017 |
| IOU EPIC Workshop; Westminster, CA | March 24, 2017 |

# Submitting Written Comments

Submit written comments via the e-Comment system for Docket 17-EPIC-01:
https://efiling.energy.ca.gov/Ecomment/Ecomment.aspx?docketnumber=17-EPIC-01

Draft Funding Initiatives and Today's Presentation can be found here:
http://www.energy.ca.gov/research/epic/17-EPIC-01/documents/

**Submit Comments by 5:00pm on March 20, 2017**