C3ETP Economic Assessment Dry-Run

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October 21, 2008
Reliability and Economic Assessment
Determination of Alternatives

14 Alternatives

Studies:
• Power flow
• Post-transient voltage stability
• Transient stability

Purpose:
• Define project alternatives
• Check if satisfy reliability criteria
• Provide reliability justifications

More alternatives?

Reliability Assessment

11 Alternatives

Studies:
• Production cost simulation
• LCR
• Cost-benefit analysis

Purpose:
• Quantify benefits for each alternative
• Determine the most cost-effective one
• Provide economic justifications

More alternatives?

Economic Assessment

The Preferred Alternative

C3ETP Economic Assessment – Dry-Run
Data Needed by the Economic Assessment
Study Assumptions

1. Alternatives that meet reliability criteria
   To be finalized by Reliability Assessment

2. Projected increase of transfer capability for Path 15 and Path 26
   To be provided by Reliability Assessment

3. High-medium-low cost estimates in 2008 dollars
   To be provided by project sponsors

The following three slides elaborate on the three items
Alternatives That Meet Reliability Criteria
Will to Be Studied by the Economic Assessment

**Independent Solutions**

<table>
<thead>
<tr>
<th>PGE1</th>
<th>Fresno 230 kV Reconductoring</th>
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</thead>
<tbody>
<tr>
<td>PGE2</td>
<td>Midway – E2 500 kV DCTL</td>
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<tr>
<td>PGE2d</td>
<td>Midway – Gregg 500 kV DCTL</td>
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<td>PGE5</td>
<td>Midway – E2 230 kV DCTL</td>
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<td>PGE7</td>
<td>Midway – McCall – E2 230 kV DCTL</td>
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<td>PGE8</td>
<td>Gates – Gregg 230 kV DCTL</td>
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<tr>
<td>PGE9</td>
<td>Raisin 230 kV Switching Station</td>
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<tr>
<td>PGE10</td>
<td>New Generation 1000 MW in Fresno</td>
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<table>
<thead>
<tr>
<th>SCE1</th>
<th>Magunden – Rector 230 kV DCTL</th>
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<tbody>
<tr>
<td>SCE2</td>
<td>Whirlwind – S1 500 kV DCTL</td>
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</table>

The Economic Assessment will compute these alternatives separately. For combination of PG&E and SCE alternatives, total benefits are the sums of two individual benefits.

**Interconnected Solutions**

<table>
<thead>
<tr>
<th>INT2a</th>
<th>Midway – E2 500 kV DCTL with S2 Loop-In</th>
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</thead>
<tbody>
<tr>
<td>INT2b</td>
<td>Midway – E2 500 kV DCTL with S2-S3 Loop-In, Whirlwind – S3 500 kV Line</td>
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<tr>
<td>INT2c</td>
<td>Midway – E2 500 kV DCTL with One Line Looped into S2, Midway – Whirlwind Upgrade</td>
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<tr>
<td>INT2e</td>
<td>Midway – Gregg 500 kV DCTL with One Line Looped into S2</td>
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<tr>
<td>INT3</td>
<td>Midway – S2 – E2 500 kV SCTL</td>
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<tr>
<td>INT4</td>
<td>Whirlwind – E2 500 kV DCTL with One Line Looped into S2</td>
</tr>
<tr>
<td>INT6</td>
<td>Fresno – Big Creek 230 kV Inter-Tie</td>
</tr>
</tbody>
</table>

Alternatives will be finalized by Reliability Assessment
### Projected Path Transfer Capability Increase (MW)

<table>
<thead>
<tr>
<th>C3ETP Alternatives</th>
<th>Path 15 S2N</th>
<th>Path 26 N2S</th>
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<tbody>
<tr>
<td>PGE2 Midway-E2 500 kV DCTL</td>
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<tr>
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<td>PGE7 Midway-McCall-E2 230 kV DCTL</td>
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<td>INT4 Whirlwind-E2 500 kV DCTL with S2 Loop-In</td>
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Projected path transfer capability increase will be provided by Reliability Assessment
## Project Cost Estimates

To Be Compared with Benefits in the Economic Assessment

Costs Estimates (in $M of Year 2008 Value)

<table>
<thead>
<tr>
<th>C3ETP Alternatives</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
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</thead>
<tbody>
<tr>
<td>PGE2       Midway-E2 500 kV DCTL</td>
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<td>PGE2d      Midway-Gregg 500 kV DCTL</td>
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<td>INT2a      Midway-E2 500 kV DCTL with S2 Loop-In</td>
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</tr>
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<td>INT2c      Midway-E2 500 kV DCTL with S2 Loop-In, Midway-Whirlwind Line Upgrade</td>
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<td>?</td>
</tr>
<tr>
<td>INT2e      Midway-Gregg 500 kV DCTL with One Line Looped into S1</td>
<td>?</td>
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</tr>
<tr>
<td>INT3       Midway-E2 500 kV SCTL with S2 Loop-In</td>
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<td>INT4       Whirlwind-E2 500 kV DCTL with S2 Loop-In</td>
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<tr>
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</table>

Cost estimates will be provided by project sponsors
Dry-Run vs. Preliminary Results

We dry-run the pre-project cases and gain insights into the production cost database.

As some study assumptions are being determined, preliminary results are not available.

1. Alternatives that meet reliability criteria
   To be finalized by Reliability Assessment.

2. Projected increase of transfer capability for Path 15 and Path 26
   To be provided by Reliability Assessment.

3. High-medium-low cost estimates in 2008 dollars
   To be provided by project sponsors.
Central California Clean Energy Transmission Project (C3ETP)
Economic Assessment

Status of the C3ETP Study

Dry-Run Information

Going Forward
Economic Assessment

Models Developed

- Alt. 2: Midway-E2 500 kV, Magunden-Rector 230 kV DCTL
- Alt. 2a: Midway-E2 500 kV with S2 Loop-In
- Alt. 2b: Midway-E2 500 kV with S2-S3 Loop-In
- Alt. 2c: Midway-E2 500 kV with S2 Loop-In, Midway-Whirlwind Line
- Alt. 2d: Midway-Gregg 500 kV, Magunden-Rector 230 kV DCTL
- Alt. 3: Midway-S2-E2 500 kV SCTL
- Alt. 4: Whirlwind-E2 500 kV with S2 Loop-In
- Alt. 6: Fresno – Big Creek 230 kV Inter-Tie
- Alt. 7: Midway-E2-McCall 230 kV, Magunden-Rector 230 kV DCTL
- Alt.0: 2015 case
  - 2015 case
  - 2020 case

2017 case (2017 Wind Heavy, Version 21-Aug-08)
In on-going work, the CAP RPS is being aligned to 26.5% in 2015 and 33% in 2020.
Path Flows After Fix of Northwest Load
Load in PNW and Some Other Northern Areas Were Too Low

Path 66, Path 15 and Path 26 Flows (MW)
Before and After Pacific Northwest Load Was Rectified

Year 2020

- On 24-Sep-08 Northwest load data was fixed in the TEPPC 2017 base case (version 21-Aug-08)
- After the fix of Northwest load data, the north-to-south flows were reduced

Cases: C2020_v06 vs. C2020_v07
Path 15 Flow North-to-South
Simulated Versus Historical Data

With the TEPPC database, the simulated north-to-south flow is still heavier than historical data.
Path 15 and Path 26
Flow (MW) in Year 2020

Path 15 Flow (MW) in Year 2020

Path 26 Flow (MW) in Year 2020
Central California Clean Energy Transmission Project (C3ETP) Economic Assessment

- Status of the C3ETP Study
- Dry-Run Information
- Going Forward
Base Analysis:
• Refine RPS scenario and discuss with stakeholders
• Refine OTC modeling of Path 15 and Path 26
• Implement updates of the TEPPC base case
• Perform LCR study to calculate additional benefits

Sensitivity Analysis:
• Develop an alternative RPS scenario
• Acquire wet- and dry-year hydro data if available from TEPPC
• Run sensitivity cases once the preferred alternative is determined
Analytical Approach of Economic Assessment

“There Steps to Evaluate Onions”

**Step 1: “Find the Best Onion”**
For all studied alternatives:
- Compare costs and benefits for the CAISO ratepayers
- Determine the alternative that offers maximum net benefit

**Step 2: “Peel the Onion”**
For the preferred alternative:
- Analyze the benefit from different perspectives
- Measure benefits for relevant project objectives

**Step 3: “Test the Onion”**
For the preferred alternative:
- Address uncertainties by multi-scenario sensitivity analysis
- Evaluate expected benefits under uncertainties
## Step 1: “Find the Best Onion”
Cost-Benefit Analysis (CBA)

### C3ETP Costs and Benefits (in $M of Year 2008 Value)

<table>
<thead>
<tr>
<th>C3ETP Alternatives</th>
<th>CAISO Costs</th>
<th>CAISO Benefits</th>
<th>Net Benefits</th>
</tr>
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<tbody>
<tr>
<td>2 Midway-E2 500 kV DCTL</td>
<td>Magunden-Rector 230 kV DCTL</td>
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<tr>
<td>2a Midway-E2 500 kV DCTL with S2 Loop-In</td>
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The Criteria
Step 2: “Peel the Onion”
Insights into the Benefits Relevant to the Stated Objectives

Project objectives relevant to Economic Assessment

- Maximize CAISO ratepayers benefits
- Relieve transmission congestion
- Increase the value of California renewable resources
- Maximize utilization of pumped storage resources
- Provide opportunity for future expansion of the bulk transmission system

Quantified measures will be provided for each of the above-mentioned objectives.
Step 3: “Test the Onion”
Account for Uncertainties

-5% to +5%

Cost
Benefit

-50% to +50%

Wet year
Dry year

+500 MW

Cost
Benefit

Natural gas price
Generation retirement
Load forecast
New generation
Hydro
Natural gas price
Generation retirement
Alternative mix in RPS
Without PVD2

For Illustration Only

For Illustration Only

$$$

C3ETP Economic Assessment – Dry-Run
Your comments and questions are welcome

For written comments, please send to:
RegionalTransmission@caiso.com

Please send written comments in two weeks by COB on 4-Nov-2008