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March 20, 2018

TO: California Energy Commission
FROM: NORESCO
RE: 2019 Title 24, Part 6 CASE Measures

2019 CASE MEASURES ECONOMIC IMPACT

Dear Energy Commission,

This technical memorandum summarizes the approach and preliminary findings from a review of 2019 Title 24, Part 6 CASE reports, staff supplemental reports and other third party reports. For this deliverable, the NORESCO team has produced estimates for the number of:

- Jobs that would be created and/or eliminated by the proposed 2019 Standards.
- Businesses that would be impacted by the proposed 2019 Standards.
- Business that would be created and/or eliminated by the proposed 2019 Standards.

These three estimates correspond with the Form 399 Fiscal and Economic Impact Statement sections A3, A4 and A6, respectively. This memorandum describes the measures included or excluded in the final estimates, the process and methodologies used for estimates, the preliminary results of economic impact, and recommendations as applicable.

General Process of Evaluation

- Gather information, including CASE measures and CEC supplement reports.
- Review each CASE measure and sub-measure for economic impact data.
- Extract available economic impact results and assumptions for each CASE measure.
- Utilize third-party publications to validate existing methodologies and assumptions.
- Identify gaps in the estimates of businesses and jobs impact.
- Develop estimates for businesses and jobs impact where gaps exist.
- Pro-rate businesses and jobs impact estimates based on the adoption or omission of CASE measures as announced by the Energy Commission for 2019 Title 24, part 6.
- Tabulate businesses and jobs impact estimates by individual CASE measure
- Aggregate businesses and jobs impact estimates by CASE measure category
- Provide total businesses and jobs impact estimates

CASE Measures by Category

NO RESCO has identified the following CASE measures as comprising of some level of economic impact either specified in the CASE reports or developed by the NO RESCO team:

1. NONRESIDENTIAL LIGHTING
 - a. [NR Indoor Lighting Sources](#)
 - b. [NR Outdoor Light Sources](#)
 - c. [NR Indoor Lighting Controls](#)
 - d. [NR Outdoor Lighting Controls](#)
 - e. [NR Lighting Alterations](#)
2. RESIDENTIAL AND NONRESIDENTIAL HVAC
 - a. [NR Proposals Based on ASHRAE 90.1-2016](#)
 - b. [NR Cooling Tower Minimum Efficiency](#)
 - c. [NR Economizer Fault Detection Diagnostics \(FDD\) Requirements](#)
 - d. [Res Quality HVAC](#)
3. RESIDENTIAL AND NONRESIDENTIAL ENVELOPE
 - a. [Res High Performance Walls](#)
 - b. [Res High Performance Attics](#)
 - c. [Res Improved Fenestration Products](#)
 - d. [Res Quality Insulation Installation \(QII\)](#)
 - e. [Loading Dock Seals in Warehouses](#)
4. PROCESS
 - a. [Variable Exhaust Flow Control](#)
 - b. [High Efficiency Fume Hoods](#)

Of the proposed CASE measures, some are not expected for Title 24 Standards adoption, while others are not expected to result in measurable economic impact. Based on the review, NO RESCO has determined that the following measures shall be excluded from the estimates of economic impact.

5. NONRESIDENTIAL LIGHTING
 - a. [NR Advanced Daylighting Design](#)
6. PROCESS
 - a. [Adiabatic Condensers](#)
7. RESIDENTIAL AND NONRESIDENTIAL INDOOR AIR QUALITY AND VENTILATION
 - a. [Res Indoor Air Quality \(IAQ\)](#)
 - b. [NR Indoor Air Quality \(IAQ\)](#)
8. RESIDENTIAL AND NONRESIDENTIAL DEMAND RESPONSE
 - a. [Demand Response Language Clean-Up](#)
9. RESIDENTIAL WATER HEATING
 - a. [Res Compact Hot Water Distribution Design](#)
 - b. [Res Drain Water Heat Recovery](#)

Methodologies

Given the urgency of this task, NORESKO has reviewed a combination of existing CASE reports, supporting documentations and third-party publications to validate and develop the necessary economic impact estimates. Based on review of the CASE measures, most of the economic impact analysis offers information and/or numerical estimates for jobs impact, whereas very minimal or no estimates are available for businesses impact. As such, NORESKO has validated and compiled the jobs impact from all applicable CASE measures to provide a total estimate of jobs created and/or eliminated by the proposed 2019 Standards. To address the lack of information on businesses impact, NORESKO has employed third-party statistics on energy efficiency jobs and businesses in California and reasonable assumptions to develop traceable estimates for economic impact on businesses.

I. Jobs that would be created and/or eliminated by the proposed 2019 Standards:

To estimate impact on jobs, it is important to first define the types of employment that can be counted towards the job estimates. All of the CASE reports refer to the Wei, Patadia, and Kammen (2010) publication on Clean Energy Jobs, which defines employment as follows:

- **Direct Employment** includes those jobs created in the design, manufacturing, delivery, construction/installation, project management and operation and maintenance of the different components of the technology, or power plant, under consideration. This data can be collected directly from existing facilities and manufacturers in the respective phases of operation.
- **Indirect Employment** refers to the “supplier effect” of upstream and downstream suppliers. For example, the task of installing wind turbines is a direct job, whereas manufacturing the steel that is used to build the wind turbine is an indirect job.
- **Induced Employment** accounts for the expenditure-induced effects in the general economy due to the economic activity and spending of direct and indirect employees, e.g. non-industry jobs created such as teachers, grocery store clerks, and postal workers.

Based on these definitions, it becomes clear that Direct Employment and Induced Employment can be extracted from a combination of direct jobs impact estimated for the CASE measure, and the annual energy savings projected for the CASE measure. On the other hand, the Indirect Employment factor presents key challenges because the “upstream and downstream supplier effect” may be difficult to estimate without more in-depth evaluation of the extended impact of a particular CASE measure. Furthermore, the majority of suppliers may be located outside of California, adding complexity to the estimate of Indirect Employment. For the purpose of this economic impact estimation, NORESKO has defined the jobs estimate as follows:

$$Total\ Jobs\ Created\ or\ Eliminated = Direct\ Employment + Induced\ Employment$$

Some of the CASE measures explicitly provide an estimate of Direct Employment for any proposed measure that could result in direct need of additional professionals, such as the need for additional HERS Raters. Other CASE measures do not include direct estimates of jobs, but instead refer to the basis of Induced Employment based on total annualized energy savings in GWh. Their estimates of Induced Employment can be traced to the Wei, Patadia, and Kammen (2010) study which developed a model for calculating energy employment. The Wei study normalized data from 15 job studies for average employment per unit energy for specific energy technology sector, including energy efficiency. Their calculation methodology consists of

- Average of “one-time” employment factors such as construction and installation (“job-years per peak MW”) over plant lifetime, plus ongoing employment factors such as operations and maintenance
- Estimate of induced employment per unit of energy (“job-years per GWh”) or per unit of average-MW of power output (“job-years per average MW”) to compare between technologies with different capacity factors.

The Wei, Patadia, and Kammen (2010) model applies to a timespan of 2009 to 2030, making it relevant to the 2019 Title 24 code cycle. The Wei study suggested a range of Induced Employment multipliers for energy efficiency measures as follow.

Multiplier for Induced Employment	Low	Average	High
Job-years/GWh of First-year Energy Savings from Measures	0.17 ¹	0.38	0.59 ²

The average multiplier of 0.38 job-years/GWh of energy savings has been widely adopted in the CASE reports. For the purpose of this economic impact review, NORESKO has adopted the low, medium and high range of multipliers to calculate Induced Employment based on first-year energy savings identified for each applicable CASE measure. Therefore, the final estimate of jobs created and/or eliminated by the proposed 2019 Standards will be presented in a range of low, medium and high potential, combining any estimates of Direct Employment called out by CASE Authors and the total Induced Employment as calculated by the employment multipliers suggested in the Wei, Patadia, and Kammen (2010) study.

Finally, for any CASE measures that were not fully adopted in the final Title 24, Part 6 rulemaking, NORESKO has pro-rated the employment impact accordingly to avoid over-estimation.

¹ John A. “Skip” Laitner and Vanessa McKinney—American Council for an Energy Efficient Economy Positive Returns: State Energy Efficiency Analyses Can Inform US Energy Policy Assessments <http://aceee.org/research-report/e084>

² Jose Goldemberg—State of Sao~ Paulo, Brazil Personal communication on Energy efficiency and jobs data. 13 February 2009.

II. Businesses that would be impacted by the proposed 2019 Standards:

The number of businesses directly impacted by the 2019 Title 24 Standards is derived from the estimate of businesses in the “Advanced Energy Employment” sector in California. A statewide survey (BW 2016) estimated that there are 43,000 businesses statewide in this sector, which comprises of grid technologies, advanced transportation, generation, and energy efficiency. Additionally, businesses and homeowners throughout the state may experience some impact from the Standards, due to reduced energy costs.

According to the Advanced Energy Jobs in California survey performed by BW Research Partnership in 2016, the following statistics were identified:

- Surveyed 831 companies doing business in California
- Total 43,000 advanced energy businesses in California that span the entire value chain
- Energy Efficiency has estimated 321,177 workers, representing 63% of energy employment by segment in 2015, as depicted in Figure 1. Energy Efficiency employment grew 6% over 2014, adding 18,060 new jobs.

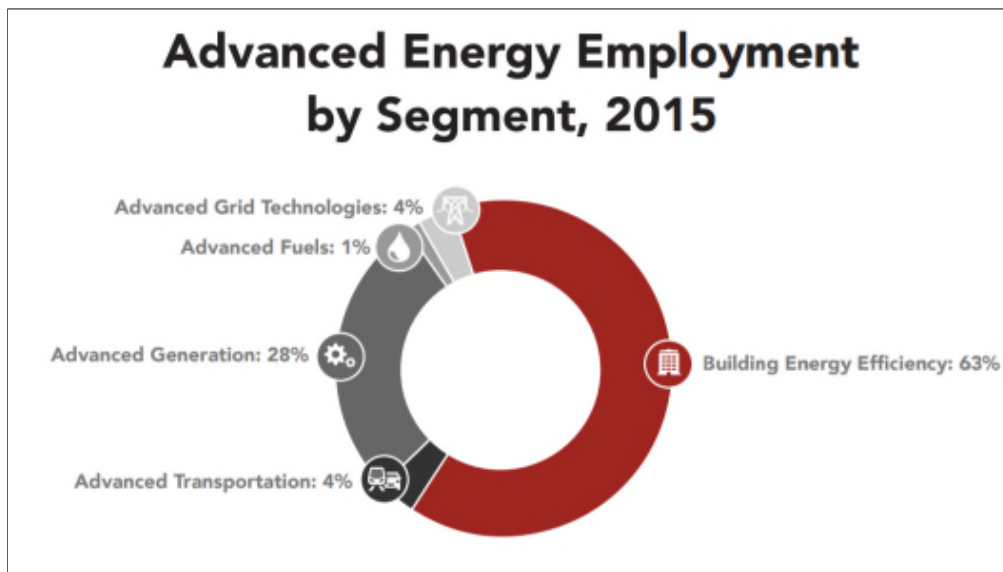


Figure 1 – Advanced Energy Employment by Segment, 2015 (BW Research 2016)

- Energy Efficiency employment can be attributed to main technology categories as illustrated in Figure 2.

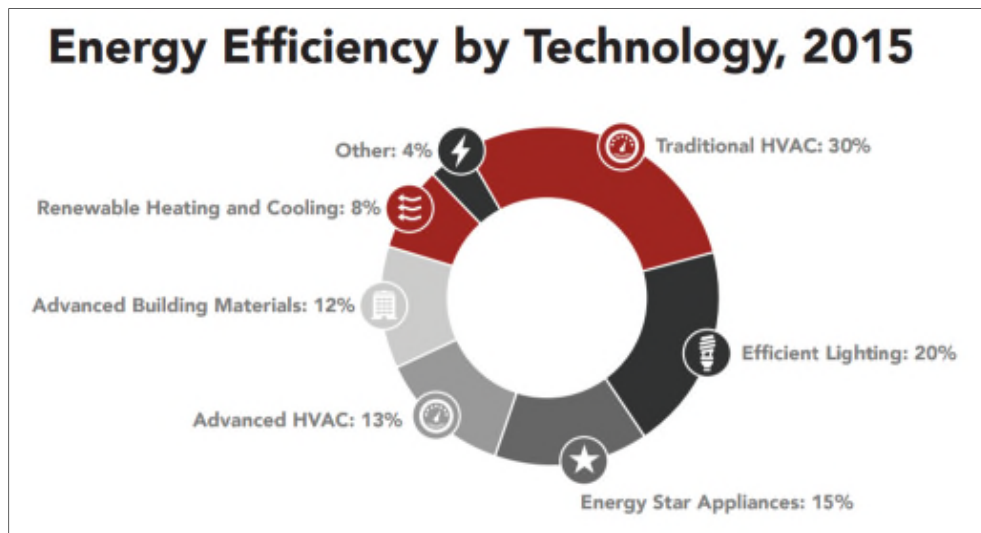


Figure 2 – Energy Efficiency by Technology, 2015 (BW Research 2016)

- Advanced energy businesses range from small to large by number of employees, with size distribution illustrated in Figure 3.

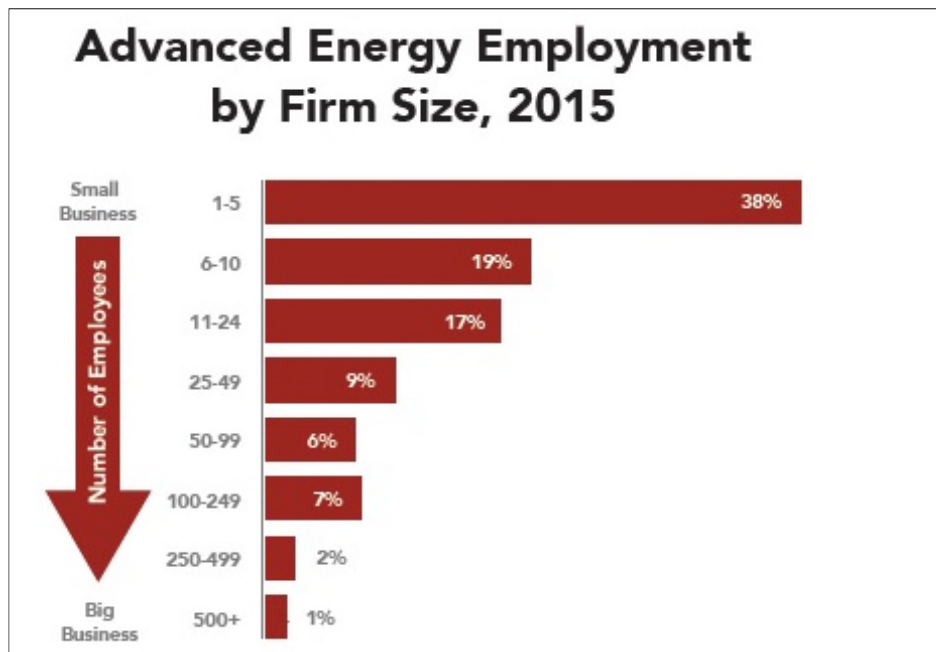


Figure 3 – Advanced Energy Employment by Firm Size, 2015 (BW Research 2016)

For the purpose of this economic impact review, NORESO has assumed that the employment breakdown by sector may be equivalent to the percentages of businesses by sector. The assumption enables the development of three scenarios to estimate the number of businesses directly impacted:

- **High Scenario:** Assume that all businesses in the Advanced Energy sector will be impacted by the proposed 2019 Standards in some way, resulting in roughly 43,000 businesses impacted according to BW Research 2016.
- **Medium Scenario:** Assume that only the Energy Efficiency businesses, which is estimated to be 63% of the Advanced Energy sector, will be impacted by 2019 Standards in some way, resulting in $63\% \times 43,000 = 27,090$ businesses impacted.
- **Low Scenario:** Assume that within the Energy Efficiency sector, which is estimated to have 27,090 businesses, only the following technology areas will be impacted by 2019 Standards in some way, resulting in 20,318 businesses impacted as calculated in Table 1.

Table 1 – Estimate of Businesses in Specific Energy Efficiency Technology Areas Impacted by Proposed 2019 Standards

Low Scenario	Percent of Businesses within Energy Efficiency Sector	Number of Businesses Impacted
Traditional HVAC	30%	8,127
Advanced HVAC	13%	3,522
Efficient Lighting	20%	5,418
Advanced Building Materials	12%	3,251
Total		20,318

III. Businesses that would be created and/or eliminated by the proposed 2019 Standards:

The 2019 Title 24 Standards will also spur the creation of new businesses to meet the growing needs of the energy efficiency sector. The number of businesses created is a function of the number of jobs created in the state. However, some new jobs can be allocated towards growth of existing businesses, and some fraction of job growth will directly result in the creation of new businesses. There is little available data on how job growth correlates to business creation. However, a review of the distribution of advanced energy employment firm size (**Figure 3**) reveals that the majority of businesses in the sector are very small, with 25 or fewer employees. An assumption is that for small businesses will be created at a much higher rate per job added than large businesses. From the BW report (2016), the survey indicated that 74% of jobs pertained to businesses with 25 employees or fewer. It is assumed that 50% of jobs in small business will result in business creation, and none of the jobs in larger businesses will result in job creation. This provides a reasonable estimate for the number of businesses created. Thus, the fraction of jobs serving new businesses in the equation below is 74% x 50% = 37%.

Among the small business market sector that is likely to grow in business size, the weighted average firm size for businesses with less than 25 employees, from **Figure 3**, is **11**.

While not explicitly identified in the jobs estimate, the exhaust flow process controls measure indicates a potential new need for specialized companies that can perform advanced wind flow analysis to support the specification of anemometer-based flow controls for exhaust fans. While this could result in a very small number of businesses added to the state, this is a specialized area that is difficult to forecast.

Larger businesses can grow their workforce through either organic growth (direct hiring) or inorganic growth (mergers and acquisitions). This estimate of business growth assumes that any reduction in the number of businesses in the advanced energy sector in California due to mergers and acquisitions is not dependent on the Title 24 Standards but rather on natural market maturation. Also, the adoption of the Title 24 Standards should not provide any cause for existing California businesses to leave the state.

Despite the available estimates of jobs created, there is a high level of uncertainty of whether new jobs would result in existing business expansion or new business creation. To account for this uncertainty, NORESKO has made the following reasonable assumptions to derive the businesses created and/or eliminated by the proposed 2019 Standards.

$$\begin{aligned}
 & \text{Businesses Created or Eliminated} \\
 & = \text{Jobs Created or Eliminated} \times \text{JobFraction as NewBusiness} \times \frac{\text{Business}}{\text{Jobs}}
 \end{aligned}$$

To correspond with the three scenarios of jobs created/eliminated, NORESKO has also developed three scenarios for businesses created/eliminated.

- **High Scenario:** Assume that 37% of the 878 new jobs can be traced to small companies. That results in 325 jobs x 1 business / 11 jobs = 30 businesses created. Assume the other jobs are developed by large companies that will expand instead of create new businesses.
- **Medium Scenario:** Assume that 37% of the 738 new jobs can be traced to small companies. That results in 273 jobs x 1 business / 11 jobs = 25 businesses created. Assume the other jobs are large companies that will expand instead of create new businesses.
- **Low Scenario:** Assume that 37% of the 599 new jobs can be traced to small companies. That results in 222 jobs x 1 business / 11 jobs = 20 businesses created. Assume the other jobs are large companies that will expand instead of create new businesses.

Conclusion

Using methodologies described above, NO RESCO has extracted and/or developed estimates for the three categories of economic impact:

- Jobs created and/or eliminated by the proposed 2019 Standards.
- Businesses impacted by the proposed 2019 Standards.
- Business created and/or eliminated by the proposed 2019 Standards.

Total aggregated estimates are summarized in the tables below. These estimates include all CASE measures expected to result in some level of economic impact, as described in the CASE Measures by Category section above.

Total	Low	Medium	High
Jobs Created:	599	738	878
Jobs Eliminated	0	0	0
Businesses Impacted:	20,318	27,090	43,000
Businesses Created:	20	25	30
Businesses Eliminated:*	0	0	0

** Does not include any reduction as a result of mergers and acquisitions.*

Attachment A includes supporting calculations and assumptions that NO RESCO applied to derive measure-by-measure impact on jobs and aggregated impact on businesses. Overall, the proposed 2019 Title 24 Standards are deemed to have positive impact on jobs and businesses in California.

Reference

- California Energy Codes & Standards. “2019 Title 24, Part 6 CASE Topics.” March 2018. <http://title24stakeholders.com/2019casetopics/>
- California Energy Commission. 2019 Energy Code Staff Supplements. <http://www.energy.ca.gov/title24/2019standards/rulemaking/documents/code-staff-supplements/index.php>
- California Energy Commission. Docket Log. <https://efiling.energy.ca.gov/Lists/DocketLog.aspx?docketnumber=17-BSTD-02>
- Max Wei, Shana Patadia and Daniel Kammen, “Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the US?” Elsevier, Energy Policy 38 (2010) 919-931. 2010.
- BW Research Partnership, “Advanced Energy Jobs in California, Results of the 2016 California Advanced Energy Employment Survey.” AEE Institute, 2016.