

Picking a Standard: Implications of Differing TRC Requirements

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ABSTRACT

As more states have adopted portfolio standards for energy efficiency, the majority have selected the Total Resource Cost Test (TRC) as the cost-effectiveness threshold utilities must meet. On the surface, it would appear these states are using the same standard. Upon closer review, significant differences occur between jurisdictions regarding how the TRC is calculated and applied. For example, while the majority of states use a weighted average cost of capital discount rate, Massachusetts uses a societal discount rate. Inclusion of externality benefits in the TRC also varies from state to state, as does the TRC's application. Where Pennsylvania ACT 129 requirements specify a portfolio must pass the TRC, New York Energy Efficiency Portfolio Standard (EEPS) requires each individual measure must pass the TRC. This diversity can create significant differences in the depth of savings, breadth of offerings, and long-term projections for a portfolio. While programs should continue to meet high evaluation standards, regulatory requirements related to cost-effectiveness should also be revisited to improve the planning process for meeting higher portfolio objectives. This paper analyzes the impacts that differences in calculating and applying the TRC have on program delivery and effectiveness.

Overview

The California Standard Practice Manual (California Manual) is the general standard of cost-effectiveness analysis in the United States (CPUC 2001). It details five tests, including the TRC and the societal cost test (SCT). The TRC is defined as the program's ratio of lifetime benefits to the program's lifetime costs over its duration. TRC benefits include avoided supply and capacity costs. Present values (PV) of costs and benefits are calculated by discounting annual values to the present year using a utility discount rate. In the TRC's simplest form, a program is considered cost-effective when:

$$\frac{\text{PV Total Resource Benefits}}{\text{PV Total Resource Cost}} \geq 1$$

Where:

$$\text{Total Resource Benefits} = \text{PV} \left(\sum_{\text{year}=1}^{\text{measure life}} \left(\sum_i^{i=8760} (\text{impact}_i \times \text{avoided cost}_i) \right) \right)$$

And:

$$\text{Total Resource Cost} = \text{PV} \left(\text{Incremental Measure Costs} + \text{Utility Administrative Costs} \right)$$

As described in the California Manual, the SCT is similar to the TRC, but it expands to society’s perspective rather than just the service territory. Two distinctions between these tests include use of a societal discount rate and inclusion of externality costs, also known as “adders.” Adders include avoided pollutants and non-energy benefits, such as water or detergent savings.

Although the California Manual creates a standardized method for calculating cost-effectiveness, application of these tests varies significantly by state for evaluating energy-efficiency programs. For example, some states, such as Iowa, require utilities to report four of the five tests outlined in the California Manual; others, such as Pennsylvania, only require the TRC test. Moreover, beyond diversity in perspectives considered by state commissions, variation exists in the calculation of individual tests and levels at which tests are applied. Inclusion of non-energy benefits and discount rates each have significant impacts on TRC ratios, yet the two are not consistent across states. Some states require cost-effectiveness solely at a portfolio or plan level, while others require each individual program or, in some cases, each measure to be cost-effective on a stand-alone basis.

While program offerings differ based on market potential and the length of time a utility has been implementing energy-efficiency programs, the TRC can impact program offerings. This paper focuses on different applications and variations of the TRC and SCT tests, and the impacts these differences have on the depth and breadth of energy-efficiency programs, measures, and savings.¹ The impacts of these variations become clear when examining TRC/SCT test guidelines for eight states: Colorado, Iowa, Maine, Massachusetts, New York, Oregon, Pennsylvania, and Washington.

Variations of the TRC

Frequently, variations between states’ TRC calculations arise from two sources: discount rates and non-energy benefits. The TRC, as formulated in the California Manual, excludes non-energy benefits, and does not specify the discount rate, which can lead to inconsistencies between utilities within states and across states, depending on which discount rate has been chosen and, in the case of Weighted Average Cost of Capital (WACC), when the rate was last determined. The SCT, on the other hand, includes all quantifiable benefits, and uses a societal discount rate: generally an average of Treasury Bill rates. States commonly prescribe a TRC or “modified TRC” test as a fusion of the two.² Washington and Colorado, for example, use a modified TRC test, which includes a 10% adder to account for non-energy benefits, and a WACC discount rate. New York EEPS requires utilities to use a 5.5% real discount rate (similar to WACC) for the TRC, and requires reporting of the “TRC + C”—which includes a \$15/ton carbon benefit (New York PSC 2008). Massachusetts uses a societal discount rate, but excludes environmental benefits. An additional variation between states exists in New York and Massachusetts, where shareholder incentives are treated as a TRC cost. Table 1 outlines these differences.

Table 1. TRC Calculation Requirements

State	Discount Rate	Discount Rate from Most Recent Plan	Non-Energy Benefits	Other
Colorado	WACC	7.88% (nominal ³) (Xcel Energy 2009)	10% adder (Colorado PUC 2008)	

¹ The TRC and SCT are the only tests reviewed, as they are almost universally applied for energy-efficiency programs.

² For simplicity, “TRC” from this point forward refers to the TRC test, modified TRC tests, and the societal test.

³ A real discount rate (RDR) reflects the time value of money; a nominal discount rate (NDR) also reflects the impact of inflation.

State	Discount Rate	Discount Rate from Most Recent Plan	Non-Energy Benefits	Other
Iowa	Societal	4.81% (nominal) (IP&L 2008)	10% adder for electric 7.5% adder for gas (The Iowa Legislature 1999)	
Maine	Societal	2.22% (real) (Efficiency Maine 2010)	All quantifiable non-energy benefits, including deferred replacement costs (Maine PUC 2009)	
Massachusetts	Societal	3.66% (nominal) (NSTAR et al. 2009)	All costs of complying with foreseeable environmental regulations (Massachusetts DPU 2009)	Utilities must treat shareholder incentives as a TRC cost (Massachusetts DPU 2009)
New York	5.5% Real	5.5% (real)	None ⁴	Utilities must treat shareholder incentives as a TRC cost (New York PSC 2008)
Oregon	5.2% Real	5.2% (real) ⁵	Carbon (\$15/ton) Non-energy benefits 10% adder (ETO 2008)	
Pennsylvania	WACC	Varies by Utility	None	O&M and salvage benefits are specifically allowed, consistent with the California Manual (Pennsylvania PUC 2009)
Washington	WACC	Varies by Utility	10% adder (Schwartz 2008)	

In addition to variations in TRC calculations, the level at which it is applied significantly differs from state to state, as shown in Table 2.

Table 2. Level of Evaluation for TRC Results

State	Level	Notes
Colorado	Program	Low-income and education programs are only subject to cost-effectiveness tests at the portfolio level. (Colorado PUC 2008)
Iowa	Portfolio	Used in conjunction with the Utility, Participant, and Ratepayer Impact Tests. Low-income and education programs are not required to be cost-effective, and do not need to be taken into account when determining cost-effectiveness of the plan. (The Iowa Legislature 1999)
Maine	Program	Allows programs not passing the TRC if the entire portfolio is substantially cost-effective. (Maine PUC 2009)
Massachusetts	Program	Programs are not required to be cost-effective each year, but they must be cost-effective over the planning horizon (of three years). Programs with benefits difficult to assess are evaluated as part of the sector-portfolio. (Massachusetts DPU 2009)
New York	Measure	For implementation, project screening must include a prorated portion of overall program administration costs. Utilities must assume 0.90 net-to-gross ratio in planning assumptions. (New York PSC 2009)
Oregon	Measure	
Pennsylvania	Plan/Portfolio	Requires reporting of program TRC, but only the plan is required to be cost-effective. (Pennsylvania PUC 2009) Additionally, net-to-gross adjustments are not included in cost-effectiveness calculations.

⁴ The PSC requires results for the TRC and the “TRC + C”; these include carbon benefits. It is not clear, however, the PSC will allow utilities to offer measures passing the TRC + C but not the TRC.

⁵ This is the discount rate used by the Energy Trust of Oregon.

State	Level	Notes
Washington	Measure	(Schwartz 2008). Net-to-gross adjustments are excluded from cost-effectiveness calculations (Initiative 937 2006).

Breadth of Offerings

While program offerings differ based on market potential and the length of time a utility has implemented energy-efficiency programs, the TRC can also impact program offerings. Market sectors requiring higher levels of outreach and having more complex market barriers, or typically utilizing lower-saving measures, may be excluded if each program or individual measure is required to pass the TRC.

Targeted Markets

In the residential market, program offerings universally address customers in single-family homes, while multifamily programs are less common.⁶ This is partly driven by the markets served by those utilities: utilities serving a larger portion of multifamily customers are more likely to offer multifamily programs. In Iowa, MidAmerican Energy Company offers a multifamily program, and provides electric service to the state's four most populous cities, all of which have a higher percentage of multifamily customers than the statewide average (U.S. Census Bureau 2008). Interstate Power and Light, also in Iowa, does not offer a multifamily program, most likely because it provides service in only one of the state's four most populous cities (IP&L 2006).

Multifamily segment market barriers also drive program offerings. Split-incentive structures increase the difficulty of convincing landlords to upgrade when they do not benefit from billing savings, making it harder to offer a comprehensive program. TRC rules can create an additional barrier when higher costs associated with addressing this market segment make it marginally (or not) cost-effective. Of states examined in this study, five of the eight specifically address the multifamily market. Colorado, which uses the WACC as a discount rate and requires each program to pass the TRC, does not have multifamily programs (Xcel Energy 2009), while states with more lenient TRC rules, such as Massachusetts and Iowa, offer programs to the multifamily sector (NSTAR et al. 2009).

Low-income programs, which typically do not pass the TRC while including measures to improve health and safety as well as energy efficiency, are offered by all states examined in this study. For states requiring cost-effectiveness at the program level, exceptions often are allowed for programs targeting low-income customers, due to additional participation barriers these customers face, including the split-incentives noted and the difficulty in overcoming first-cost hurdles. For example, Colorado assesses low-income programs at the portfolio level, as opposed to the program level (Colorado PUC 2008). New York provides an interesting exception, where individual measures installed must be cost-effective. This requirement means only a select set of measures can be offered, or only a subset of the low-income market can be served through their programs. For example, NYSERDA's EmPower New York program offers weatherization measures, but it prioritizes refrigerators and lighting measures through the program (NYSERDA 2010). This stands in stark contrast with PPL Electric's weatherization program in Pennsylvania, which, in 2006, installed electric water heaters in 44% of participating homes,

⁶ All programs targeting multifamily buildings were included in the multifamily analysis, regardless of whether the program was part of the residential or commercial sectors.

and frequently paid for plumbing repairs (PPL 2008). In Washington, between 2001 and 2005, PacifiCorp's low-income weatherization program paid incentives toward a larger percentage of insulation and infiltration measures than for replacement refrigerators (Pacific Power 2007).

In the commercial and industrial sector, some segments, particularly small commercial customers, have been more difficult to address. Small business owners generally do not have the time or experience necessary to understand standard program offerings, or the capital necessary to purchase more efficient equipment. Smaller customers also generally do not have access to account representatives the way larger commercial customers do, making outreach to this sector challenging. Further, available savings on a per-customer basis are less than for larger commercial customers, making smaller customers less desirable when factoring in costs to target customers. All these barriers raise program delivery costs associated with this market segment, and lower the TRC. Direct-install programs offer a path to achieve savings and educate customers about program offerings. Beyond installing measures during audits or surveys, these programs universally offer additional rebates for measures recommended through the audit. Those offerings, however, can be limited by sector, depending on cost-effectiveness rules.

While some measures, such as CFLs and showerheads, easily pass the TRC for all sectors and building types, other measures are more sensitive to building-specific variables, such as capacity requirements and cooling load hours; therefore, they are excluded from entire market sectors or segments. For example, Table 3 outlines TRC results for central air conditioning in eight different commercial building types.

Table 3. Central AC Savings by Commercial Building Type

Building Type	Tons⁷	Gross Savings (kWh)⁸	Incremental Equipment Cost⁹	TRC¹⁰
Big Box Retail	15	2,851	\$683	2.18
Assembly	15	1,491	\$683	1.14
Primary School	20	1,170	\$911	0.67
Small Retail	5	339	\$533	0.33
Full-Service Restaurant	10	395	\$697	0.30
Small Office	5	315	\$566	0.29
Fast Food Restaurant	5	248	\$533	0.24
Light Industrial	25	1,101	\$2,696	0.21

This analysis demonstrates, when each measure is required to pass an unadjusted TRC, only a fraction of the target market may qualify for incentives. Such diversity of TRC results could result in minimal offerings for a particular building type, or potentially result in eliminating a broad range of measures to achieve consistency across sector offerings.

Depth of Savings

TRC requirements also affect depth of savings in simple ways. If, for example, programs must pass the TRC, lighting programs will be favored over weatherization programs. This effect is amplified

⁷ Estimate relies on engineering judgment.

⁸ New York Standard Approach for Estimating Energy Savings from Energy Efficiency Measures in Commercial and Industrial Programs (New York Technical Manual).

⁹ Database of Energy Efficient Resources (DEER).

¹⁰ Assumes a 15-year measure life from DEER, a \$0.06/kWh avoided cost, and a 7.7% discount rate.

when all measures must pass the TRC on a stand-alone basis. The following section discusses depth of savings by sector.

Single-Family Market

Certain single-family market measures rarely pass the TRC, but they offer substantial savings at a program level because of their common presence in homes, popularity with contractors and customers, or non-energy benefits. For example, tankless water heater rebates are popular in many states, despite not being cost-effective on a stand-alone basis. For example, Piedmont Natural Gas issued over 500 rebates for tankless water heaters in 2009, compared to 49 for storage water heaters (Piedmont Natural Gas Company 2010). Despite the potential savings associated with offering this measure, rebates for tankless water heaters were excluded from New York’s “Fast Track” programs as they were not considered cost-effective at the measure level (New York PSC 2009).

Though clothes washers are present in nearly 80% of residential households, only 11% of those are ENERGY STAR® qualified (D&R International, Ltd. 2008). Because of potential savings associated with clothes washers, it is unsurprising prescriptive rebates are available for clothes washers in single-family homes for all states examined. In New York, however, that rebate is only available through the American Recovery and Reinvestment Act of 2009 program. Under New York EEPS guidelines, utilities cannot offer prescriptive rebates for clothes washers because of cost-effectiveness requirements. If New York standards were altered to require utilities to meet cost-effectiveness at a program/portfolio level, or if water benefits were included in measure-level cost-effectiveness, nearly 814 GWh of savings could be claimed toward EEPS targets in the single-family market alone.

Table 4 through Table 6 illustrate the impacts of discount rates and non-energy benefits on the cost-effectiveness of clothes washers and LED light bulbs.

Table 4. Measure Savings Assumptions

	Energy Star® Clothes Washer		LED Light Bulb	
Gross Savings (kWh)	224	Energy Star®	33	
				Engineering Calculation Database for Energy Efficient Resources (DEER)
Measure Life	11		24	
Incremental Cost	\$258		\$25	Online pricing
Annual Water Savings (\$)	\$30			
Avoided Cost (\$/kWh)	\$0.06		Annual Energy Outlook	
WACC	7.7%		New York EEPS Nominal Discount Rate	
Societal Discount Rate	4.81%		Iowa Societal Discount Rate (2008)	

Table 5. Benefit-Cost Ratios for Clothes Washers

Variable	Included	Included	Included	Included	Included	Included
WACC Discount Rate	Yes	Yes		Yes	Yes	
Societal Discount Rate			Yes			Yes
Water Savings				Yes	Yes	Yes
10% Benefit Adder		Yes			Yes	Yes
Benefit-Cost Ratio	0.38	0.42	0.44	1.21	1.33	1.54

Table 6. Benefit-Cost Ratios for Residential LED Light Bulbs

Variable	Included	Included	Included	Included	Included
WACC Discount Rate	Yes	Yes		Yes	
Societal Discount Rate			Yes		Yes
10% Benefit Adder		Yes			Yes
Benefit-Cost Ratio	0.87	0.96	1.14	0.96	1.25

For clothes washers, non-energy benefits—namely water savings—have dramatic impacts on cost-effectiveness. While the discount rate has little impact, water benefits nearly triple the TRC ratio. The combination of a societal discount rate, water benefits, and an adder¹¹ make this an attractive measure from a TRC perspective.

While LED light bulbs are an emerging technology and unlikely to have a strong presence in residential homes, utilities in two states have suggested including LED lights in future programs as the technology improves. With CFL lighting savings decreasing due to standards established by the Energy Independence Security Act (EISA), utilities will need to achieve savings by targeting other end uses or incentivizing emerging lighting technologies. Relaxing TRC standards for emerging technologies at the program/portfolio level, similarly to low-income programs, could encourage utilities to incent LED light bulbs and accelerate adoption of higher lighting standards.

Multifamily Market

The multifamily market, as discussed, can be difficult to penetrate because landlords in rent-controlled markets face significant capital constraints for upgrades. Therefore, maximizing savings during an initial contact is essential. As shown in Table 7, nearly all multifamily offerings incorporate a direct-install approach. Unfortunately, measures applying to multifamily buildings are not always available through these targeted programs. Clothes washers—prevalent in multifamily buildings and, as shown above, generally not cost-effective—are only incented on a prescriptive basis in two states (most noticeably in states allowing inclusion of water benefits). This demonstrates how restricting cost-effectiveness to the program or measure level rather than the portfolio level can further decrease offerings to the multifamily sector. Iowa’s portfolio approach allowed some flexibility in offerings: MidAmerican Energy Company reduced the TRC threshold for measures in the multifamily program to 0.75, including a broader range of measures in the program, while meeting portfolio cost-effectiveness requirements (MidAmerican 2008).

¹¹ Clothes washers have non-energy benefits beyond water in detergent savings, avoided waste, and avoided emissions. Template used with permission by IEPEC.

Table 7. Multifamily Program Offerings

State	TRC Level	Discount Rate	Non-Energy Benefits	Multifamily Directly Targeted	Prescriptive Rebates for Clothes Washers	Direct-Install / Audit	On –bill financing or Energy Grants
Colorado	Program	WACC	Yes	No	N/A	N/A	N/A
Iowa	Portfolio	Societal	Yes	Yes	No	Yes	Yes
Maine	Program	Societal	Yes	No	N/A	N/A	N/A
Massachusetts	Program	Societal	No	Yes	No	Yes	Yes
New York	Measure	5.5% Real	No	Yes	No	Yes	No
Oregon	Measure	5.2% Real	Yes	Yes	Yes	No	No
Pennsylvania	Plan/Portfolio	WACC	Yes	No	N/A	N/A	No
Washington	Measure	WACC	10% Adder	Yes	Yes	Yes	Yes

Small Commercial and Industrial Market

On-bill financing and direct-install programs effectively maximize savings in small commercial buildings. Of utilities specifically targeting small businesses, only Xcel Energy in Colorado does not offer direct-install measures. Xcel Energy also is the only utility not providing on-bill or another form of low-interest financing, and using the WACC as a discount rate (Xcel Energy 2009).

Government and nonprofits face additional challenges in funding. Massachusetts and Maine offer cost-effective programs to government and nonprofits by including them in the standardized commercial and industrial programs (Efficiency Maine 2009b). Additionally, Massachusetts offers a broad range of measures to the government/nonprofit sector, including renewable energy incentives, as these can incorporate other, more cost-effective measures into the program (NSTAR et al. 2009).

All states in this study target small commercial and government/nonprofit sectors. In Pennsylvania and Maine, these sectors have specific savings goals. Energy grants or on-bill financing are available to small commercial customers in Massachusetts and Washington, while Iowa, Massachusetts, and New York offer direct-install programs. These direct-install programs provide businesses with an energy audit and installation of low-cost measures, such as CFLs and faucet aerators. In reviewing offerings summarized in Table 8, it becomes clear Massachusetts, Iowa, and Washington offer the most targeted and innovative programs for this difficult-to-reach customer group. All these states have more favorable TRC rules.

Table 8. Small Commercial and Industrial Offerings

State	TRC Level	Discount Rate	Non-Energy Benefits	On-bill Financing or Energy Grants	Direct-Install	Small Business Directly Targeted	Government/ Nonprofits Direct Targeted
Colorado	Program	WACC	Yes	No	No	Yes	No
Iowa	Portfolio	Societal	Yes	Yes	Yes	Yes	No
Maine	Program	Societal	Yes	Yes	No	Yes	Yes
Massachusetts	Program	Societal	No	Yes	Yes	Yes	Yes
New York	Measure	5.5% Real	No	No ¹²	Yes ¹³		Yes
Oregon	Measure	5.2% Real	Yes	No	No	No	Yes
Pennsylvania	Plan/Portfolio	WACC	Yes	No	No	Yes	Yes

¹² Department of Energy grants for government entities are administered by NYSERDA.

¹³ Small business is directly targeted through the Small Business Direct-Install “Fast Track” programs.

State	TRC Level	Discount Rate	Non-Energy Benefits	On-bill Financing or Energy Grants	Direct-Install	Small Business Directly Targeted	Government/Nonprofits Direct Targeted
Washington	Measure	WACC	10% Adder	Yes	No	Yes	Yes

General Awareness

Education and outreach programs pose a unique challenge when conducting cost-benefit analyses. Behavior-based program benefits are typically difficult to quantify. Of states researched, all offer education programs, and four attempt to estimate benefits. Despite differing variations of TRC applications, many jurisdictions have created exceptions for education programs. Such exceptions range from completely exempting cost-effectiveness analysis to assessments only at the portfolio level. This allows utilities to offer extensive programs; however, those including costs at the portfolio level may have to compensate with more cost-effective, measure-based programs.

Table 9. General Awareness Offerings

State	TRC Level	Discount Rate	Education Programs Offered	Savings Estimated	TRC Requirements
Colorado	Program	WACC	Yes	No	Exempt from TRC test (Colorado PUC 2008)
Iowa	Portfolio	Societal	Yes	Yes	Cost are included the portfolio (The Iowa Legislature 1999)
Maine	Program	Societal	Yes	No	Programs with hard-to-calculate savings are included if the portfolio passes (Maine PUC 2009)
Massachusetts	Program	Societal	Yes	No	Programs with hard-to-calculate savings are evaluated at the sector level (Massachusetts DPU 2009)
New York	Measure	5.5% Real	Yes	Yes	
Oregon	Measure	5.2% Real	Yes	No	While individual programs must be cost-effective, educational programs are exempt from that guideline (Energy Trust of Oregon, 2005)
Pennsylvania	Plan/Portfolio	WACC	Yes	Yes	
Washington	Measure	WACC	Yes	Yes	Utilities are allowed to spend 10% of the total portfolio on education and awareness programs

Conclusion

Though typically based on standard TRC and SCT definitions in the California Manual, many states have chosen to adopt variations of these two tests when evaluating cost-effectiveness. Variations in the discount rate and inclusion of non-energy benefits have proven to be a driving force behind the types of measures included in programs as well as program offerings for specific market sectors. The level at which the TRC/SCT is applied also affects a utility's program offerings. If a utility must only include cost-effective measures, then emerging technologies, renewables, and measures with a broad reach and low per-unit savings will be excluded. When the TRC/SCT is applied at the program level, pilot programs with high upfront costs, education programs with unquantifiable benefits, and programs geared to hard-to-reach markets may be excluded from the portfolio. As states seek to gain broader and

deeper savings by targeting all market sectors and employing innovative technologies, examining the TRC/SCT rules will prove to be as important—if not more so—than evaluating program design.

After examining the impact of discount rates, non-energy benefits, and the level at which the TRC/SCT test is applied, we advocate using a societal approach for screening demand-side management programs. Specifically, we recommend the following guidelines:

- ***Apply the TRC at the portfolio level.*** This will allow inclusion of beneficial measures that are not cost-effective on a stand-alone basis, programs targeted at hard-to-reach markets, and innovative programs.
- ***Include a benefits adder.*** An additional benefit of 10% of avoided costs can account for externalities, while avoiding the controversy associated with valuation of environmental benefits. Potential carbon impacts, however, should be included directly in the avoided costs.
- ***Exempt select portfolio components from cost-effectiveness requirements.*** While cost-effectiveness should be evaluated at the portfolio level, we recommend excluding certain costs from this evaluation. Excluded costs should include pilot programs, research and development costs, low-income programs, codes and standards efforts, and public purpose programs and education. This exemption will allow for innovation and greater societal benefits.
- ***Use a societal discount rate.*** Using the 10-year Treasury bill rate, rather than utility-weighted average cost of capital, as a discount rate for the TRC test recognizes benefits accrue at societal level in addition to the utility and participants. Use of a societal discount rate is also consistent with including non-energy benefits in the form of an adder. This will also create consistency within and across jurisdictions, while avoiding undervaluing the interests of future generations.

Adopting these recommendations will: provide for greater consistency in the application of the TRC between states and utilities; increase the breadth of program offerings; and increase the magnitude of cost-effective energy efficiency savings achieved.

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