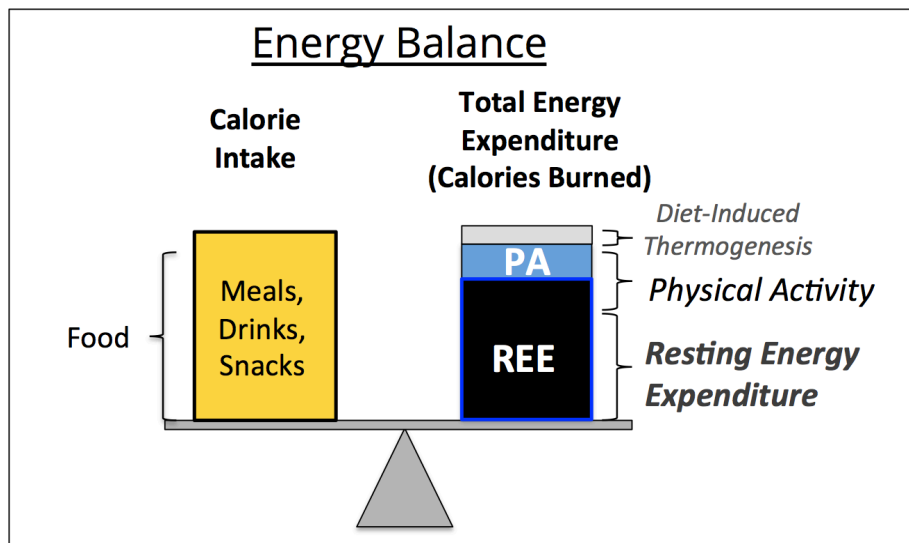


## Energy Balance: Importance of Resting Metabolism

Physiologically, the key to weight management lies in energy balance, commonly referred to as “calories in = calories out”.

Understanding energy balance can enable individuals to better manage changes in weight, by monitoring the energy difference (calorie gap) between calorie intake (“calories in”) and energy expenditure (“calories out”). To accurately monitor this energy difference, knowing both calorie intake and Total Energy Expenditure (TEE) is important (**Fig. 1**).



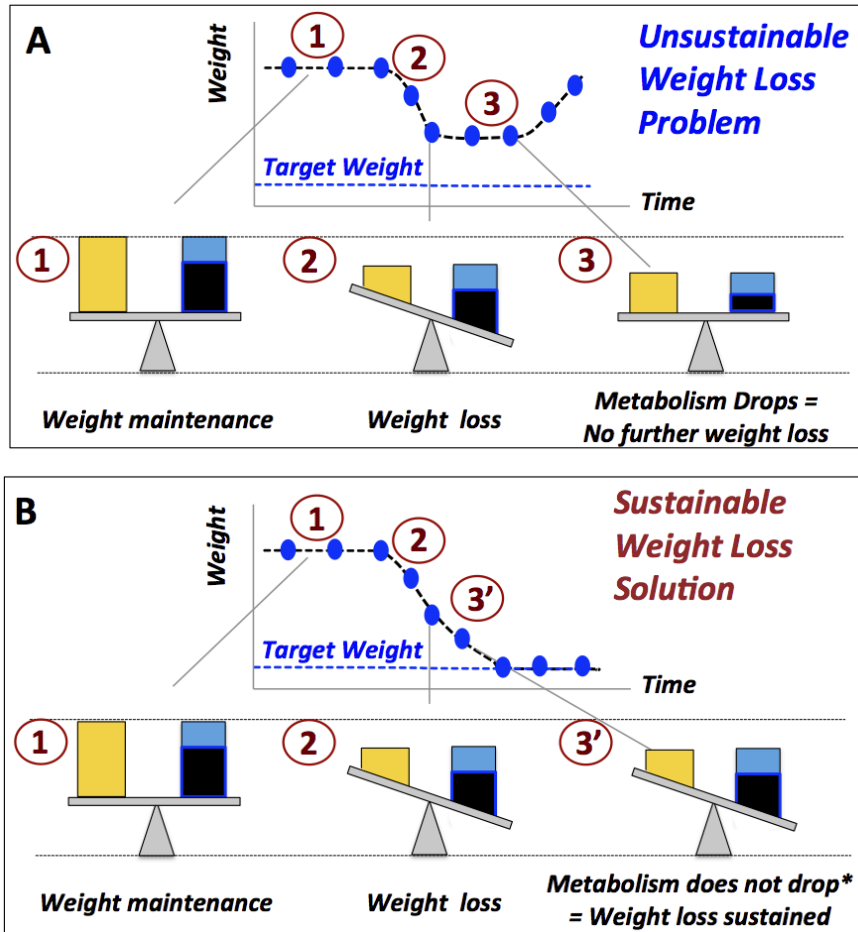
**Figure 1.** Energy is balanced when calorie intake equals total energy expenditure (TEE). TEE includes Resting Energy Expenditure (REE), Physical Activity Energy Expenditure (PA), and Diet-induced Thermogenesis (DIT). REE, PA, and DIT respectively constitute between 60 to 85 %, 15 to 30%, and ~10% of TEE, depending on the activity level of the individual (e.g., highly active vs. sedentary).

TEE comprises of resting energy expenditure (resting metabolic rate), diet-induced thermogenesis, and physical activity. Resting Energy Expenditure (REE) is the energy needed to maintain basic body functions, such as breathing, cellular repair and growth, blood circulation, and brain activity. REE values are determined by an individual’s metabolism, and can account for as much as 85% of total calories burned (see more details in Application Note No. 103). Knowing REE is therefore essential to monitoring energy balance for weight management.

While indirect calorimetry is the gold standard method of measuring REE, the traditional measurement process has been viewed as costly, time-consuming, and cumbersome. For that reason, REE is commonly estimated from standard equations such as the Harris-Benedict Equation to provide calorie intake recommendations. However, these calculated REE values can be significantly higher or lower than measured REE values. **Fig. 2** highlights the difference between calculated REE estimates and measured REE values for a male sample of the population [1, 2].



In **Fig. 3B**, weight loss is sustained due to a higher REE, as the calorie difference between calorie intake and TEE is maintained.



**Figure 3.** (A) Unsustainable weight loss: Reduction of calorie intake (yellow bar) may induce a drop in REE (black bar), which often results in weight plateau and weight re-gain. (B) Sustainable weight loss: monitoring and \*raising/maintaining REE (e.g. by increasing muscle mass).

Until now, lack of access to metabolic testing equipment has been a barrier to accurate REE measurement and tracking. Breezing™ Metabolism Tracker is the only indirect calorimeter that pairs with a mobile app to easily measure and track metabolism (REE), and provides accurate information for diet, activity, and weight planning based on the energy balance equation.

*Note: Breezing Tracker's advisory plan uses recommendations by the Academy of Nutritionists and Dietetics [3] for weight management.*

**References**

[1] J. A. Harris and F. G. Benedict, "A biometric study of human basal metabolism," *Proceedings of the National Academy of Sciences of the United States of America*, vol. 4, pp. 370–373, 1918.  
 [2] L. Criscione and M. Durr-Gross, "Eating healthy and dying obese," *Vitasanas GmbH*, [www.vitasanas.ch](http://www.vitasanas.ch), ISBN: 978-3-0033-02225-6, 2010.

- 
- [3] H. Seagle, G. W. Strain, A. Makris, and R. S. Reeves, "Position of the American Dietetic Association: Weight Management," *Journal of the American Dietetic Association*, vol. 109, pp. 330-346, 2009.
  - [4] L. Criscione, M. Durr-Gross, and K. Stebler, "Calogenetic Balance, an educational program for lifelong weight control on measured resting metabolic rate and intake of favorite foods, promotes adherence and success rate.," *European Congress on Obesity 2013, Liverpool, UK*, 2013.
  - [5] D. L. Elliot, L. Goldberg, K. S. Kuehl, and W. M. Bennett, "Sustained decrement in resting metabolic-rate following weight-loss," *Clinical Research*, vol. 35, pp. A365-A365, Apr 1987.
  - [6] D. L. Elliot, L. Goldberg, K. S. Kuehl, and W. M. Bennett, "Sustained depression of the resting metabolic-rate after massive weight-loss," *American Journal Of Clinical Nutrition*, vol. 49, pp. 93-96, Jan 1989.
  - [7] S. Heshka, M. U. Yang, J. Wang, P. Burt, and F. X. Pisunyer, "Weight-loss and change in resting metabolic-rate," *American Journal Of Clinical Nutrition*, vol. 52, pp. 981-986, Dec 1990.
  - [8] R. L. Leibel, M. Rosenbaum, and J. Hirsch, "Changes in energy-expenditure resulting from altered body-weight," *New England Journal of Medicine*, vol. 332, pp. 621-628, Mar 1995.