

The Davey Tree Benefits Engine, powered by i-Tree



API Description

i-Tree® is a collection of software tools built upon peer-reviewed USDA Forest Service science to provide urban and rural forestry analysis and benefits assessment. These i-Tree tools help strengthen forest management and advocacy efforts by quantifying the environmental benefits that trees provide. Many i-Tree tools allow users to estimate the benefits provided by individual trees to demonstrate their value to stakeholders and assist with priorities for more effective decision-making with regard to management and planting efforts.

For years, The Davey Tree Expert Company (Davey), a partner in the i-Tree Cooperative (i-Tree), has provided an ad-hoc set of web services for individual tree analyses. With changes in technology since those services were released, Davey has invested in a new, updated tree benefits API (application programming interface) to strengthen delivery of these services, unify i-Tree results across all tools for users, provide timely scientific updates to said tools, and to expand 3rd party use of i-Tree.

- The Davey Tree Benefits Engine API has a new URL that uses modified parameters for the service calls.
- Existing applications using the old services will need code changes.
- The old services will be shut down in the near future.
- Scientific updates to the calculations used by the new service **will** yield changes versus previous results.
- The API employs an expanded tree species list (mirroring what is available in the i-Tree Eco software – 6,000+)
- Davey will provide an API key, unique to each authorized user and this key will be used to track successful benefit requests for each tree.
- Davey will allow a testing phase. Once complete, Davey will begin billing for the API based on usage.
- This is not a free service – Davey charges for the service in order to maintain the service. A signed contract for said service is needed to use the API in production. The cost is \$0.02 per tree (US Dollars).
- Davey can assist with existing tree databases to accommodate mass updates at a reduced rate.
- API users must attribute and link to i-Tree on any display of tree benefits derived from the API. **Proper attribution includes an indication that the data or information is “Powered by i-Tree”, including a legible display of the i-Tree logo, and, where applicable, a link to the www.itreetools.org website.**

Growing in Ohio, USA, one red maple can:

- Remove 108 pounds of Carbon Dioxide from the atmosphere.
- Intercept 640 gallons of rainfall and avoid 82 gallons of runoff.
- Filter a third of a pound of gaseous Ozone, Nitrogen Dioxide, and Sulfur Dioxide from the air we breathe.



Please note that in the future, Davey intends to improve and extend these API calls. At this time:

- Davey may modify the input and output structure at any time (ex: standardizing on metric units of measurements) to improve the service as needed.
- Science changes will continue to occur.
- Information about future changes will be disseminated as they become available.

Visit <https://dtbe-api.daveyinstitute.com> to learn about gaining access to the API. Quarterly usage charges will apply to users based on the number of their successful API requests at a rate of \$0.02 per tree.

API users must attribute i-Tree on any display of all tree benefits derived from the API and link to the i-Tree website.

What has changed with the new API?

In general, the API more closely aligns with i-Tree Eco - the flagship (desktop) software that contains the latest scientific models to estimate the ecosystem service benefits of trees. Previous i-Tree web services relied more heavily on i-Tree Streets.

Below are key considerations. More information can be obtained from the i-Tree Support team at info@itreetools.org.

- Aesthetic Valuation is not available and there are currently no plans to include such.
- Energy and Pollution Removed estimates will no longer be based upon the older, i-Tree Streets-based look up tables.
- Carbon and Pollutant pricing have been adjusted to current monetary values.
- Growth caps are imposed for many species.
- A cap on carbon storage has been implemented.
- Different precipitation values are in use.
- Values relating to stormwater have changed and been added to.
- The tree species list has been expanded to the full US Forest Service i-Tree list (6,700+)
- Species names and codes may differ from others' lists.
- International use is limited to locations where i-Tree Eco and associated secondary processing has been fully funded. For other locations, US national averages will be used as base data to compute tree benefits; using these estimates should indicate such.
 - Please, use i-Tree MyTree (mytree.itreetools.org) to verify support of a location in i-Tree Engine.
- The new API is not free and requires a contract to be used in production.

To better understand i-Tree – beyond the mechanics of the API itself - please visit www.itreetools.org for information and reference material or contact info@itreetools.org.

Usage and Examples

Calling the API

API Endpoint Name: `getGrowoutTreeBenefit`

Description: Calculates various benefit estimates in the current, annual period and allows for tree growth estimates plus changes in benefit estimates associated with said growth.

- Base URL:
<https://dtbe-api.daveyinstitute.com/v2/getGrowoutTreeBenefit/>
 - After the first parameter, add parameters using the '&' symbol
- Example URL:
<https://dtbe-api.daveyinstitute.com/v2/getGrowoutTreeBenefit/?key=xxxxxxxx-xxxx-xxxx-xxxx-xxxx&ProjectYears=20&MortalityRate=0.0&ProjectDirection=1&Longitude=-81.12345&Latitude=41.12345&TreeAmount=1&Species=CADE&DBHCentimeter=0.635&TreeHeightMeter=-1&TreeCrownHeightMeter=-1&TreeCrownWidthMeter=-1&Condition=Excellent&CLE=5&EnergyOnly=0&HouseVintage=Post-1980&DirectionDegree=225&DistanceMeter=9&Heated=1&AirConditioned=1>

API XML Response

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  <Error/>
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  <DBVersion>11.2.4</DBVersion>
  <EngineVersion>1.0.0-beta</EngineVersion>
  <InputInformation>
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      <Latitude>40.685112</Latitude>
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      <CountyName>Huntington</CountyName>
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    <CityName>Warren</CityName>
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  <Tree>
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    <CrownHeightMeter/>
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  <TreeAmount>1</TreeAmount>
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```

... subsequent year outputs (could be quite lengthy!)

```

1711
1712
1713   </OutputInformation>
1714 </Result>
1715

```

General Technical Details

Inputs

The following are the required input parameters. **NOTE:** all inputs require a value, but some allow a negative one (-1) to signify an unknown or uncollected measurement. Except if nearby building information is not collected, then all those parameters can be excluded together (if one is given, then all are required).

1. **Key:** 32-character text string given for access. Unique key identifier that allows use of the API. Be aware that minute and day rate limits are enforced to help keep the server stable for i-Tree website users. Those may be relaxed or tightened as performance changes in the future.
 - i. Returns status 401 Unauthorized, 403 Forbidden, or 500 Server Error depending on circumstances when key is denied, or key is not given.
 - ii. Returns status 403 Permission Denied when rate limited. May change to 429 Too Many Requests in the future.
2. **ProjectYears:** The number of years up to 100 for which to generate benefit estimates.
 - i. Set from '1' to '100', whole years only.
3. **MortalityRate:** The rate at which submitted trees die off over time. Pairs well with TreeAmount planting groups.
 - i. Set from '0.00' to '1.00' (0% to 100%), to an accuracy of two decimal places (Ex: '0.01' is 1%).
4. The location (Longitude and Latitude) must be given as a point or a name {name DEPRECATED} (NorthHemisphere, NationFullName, StateAbbr, CountyName, CityName):
 1. **Longitude:** (x-axis, -180 thru 180) For precision, use at least five decimal points; use negative values for the western hemisphere.
 2. **Latitude:** (y-axis, -90 thru 90) For precision, use at least five decimal points; use negative values for the southern hemisphere.
 1. Submitted longitude and latitude coordinates are matched to a known location in our database to employ appropriate background data such as location-specific frost-free days. Name returned from coordinates is for our matched location.
 2. Matching done using a GIS overlay operation. If a match cannot be determined, the API falls back to employ US national averages in order to perform calculations. Ex: an average frost-free date for the entire US will be used. When it occurs, the fall back is conveyed in the response, in the location section, as the "US National Averages" name.
 3. Due to vagaries of GIS boundary datasets and also the coverage as provided even by officially supported countries, we may not be able to find a match in supported regions and will fall back to US national average rates.

{DEPRECATED – use Longitude & Latitude instead} NorthHemisphere – Specifies if location is within the northern hemisphere.

'1' : location is within the northern hemisphere.

'0' : location is within the southern hemisphere.

{DEPRECATED – use Longitude & Latitude instead} NationFullName – The name of target nation. Used to specify location Nation/Country.

US, United States, or USA can be used to enter 'United States of America'

Currently limited to Supported countries with i-Tree Eco and associated processing.

{DEPRECATED – use Longitude & Latitude instead} StateAbbr – Target location "state" level abbreviation code.

(Ohio = OH, Kentucky = KY, California = CA, etc.).

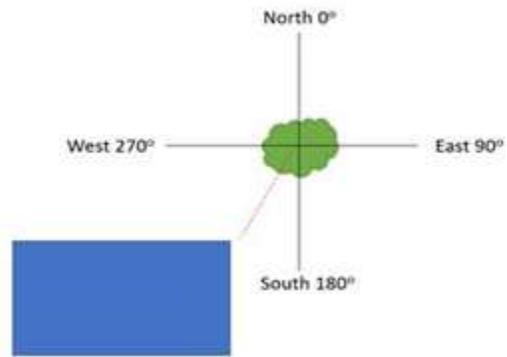
{DEPRECATED – use Longitude & Latitude instead} CountyName – The name of target "county" level.

{DEPRECATED – use Longitude & Latitude instead} CityName – The name of target city.

Submitting named locations is deprecated due to the difficulty of matching the i-Tree database to the variety of names used in location databases around the world. Ex: "St. Albans" in England can be listed as St. Albans, St. Albans City, Saint Albans, St./Saint Albans, or as Albans, St.

5. **TreeAmount**: scaling factor for planting groups.
 - i. '1': one tree
 - ii. n: a group of n trees
6. **Species** – A tree's "i-Tree species code" (e.g., 'ACSA2' for sugar maple). Use the 'getSpecies' API for a list of species and their corresponding species code.
7. **DBHCentimeter** – Measurement of tree trunk diameter at breast height (DBH, 4.5 feet up from ground). Enter value in centimeters. For co-dominate trees, if the split is below DBH level, then enter a separate "tree" for each trunk of it measured at DBH.
8. **TreeHeightMeter** – Measurement of the tree height, in meters.
 - i. Input '-1' if the value is not provided; when '-1', a calculated tree height made on the server.
9. **TreeCrownHeightMeter** – Measurement of the tree crown height, in meters.
 - i. Input '-1' if the value is not provided, and the API will use a calculated tree crown height.
10. **TreeCrownWidthMeter** – Measurement of the tree crown width, in meters.
 - i. Input '-1' if the value is not provided, the API will use a calculated tree crown width.
11. **Condition** – Condition classification status that best describes the health of the tree. Available choices are:
 - i. 'Excellent'
 - ii. 'Good'
 - iii. 'Fair'
 - iv. 'Poor'
 - v. 'Critical'
 - vi. 'Dying'
 - vii. 'Dead'
12. **CLE** – Numerical classification that best describes the tree's crown light exposure (CLE). Available choices are:
 - i. '0': Crown is fully shaded (Ex: small tree completely shaded under others).
 - ii. '1': One side of the crown is exposed to light (Ex: center of forest stand).
 - iii. '2': Two sides of the crown are exposed to light (Ex: forest edge).
 - iv. '3': Three sides of the crown are exposed to light (Ex: planted direct next to multiple trees).
 - v. '4': Four sides of the crown are exposed to light (Ex: planted directly next to one tree).
 - vi. '5': Crown is fully exposed to light (Ex: street trees are commonly completely exposed).
13. **EnergyOnly**: (optional but does not allow '-1') Use for repeat requests of the same tree when it impacts multiple buildings because only one building can be sent per request.
 - i. '0': calculate all result categories.
 - ii. '1': only calculate energy benefits.
14. **HouseVintage** – Category of vintage that best describes the materials of the target building.
 - i. 'pre-1950' - House was built before 1950 (Ex: uninsulated, drafty).
 - ii. '1950-1980' - House was built between 1950 – 1980 (Ex: economic expansion era).
 - iii. 'post-1980' - House was built after 1980 (Ex: somewhat modern construction or renovation).
15. **DirectionDegree** – Direction, in degrees, of planting site location in relation to the building.

- i. If the planting site is located directly north of a building, then 'DirectionDegree' is '0' degrees.
 - ii. If the tree is directly east of a building, then 'DirectionDegree' is '90' degrees.
 - iii. In the example at right, the tree (green blob) is 45 degrees NW of building (blue rectangle), and Building is 225 degrees SW of tree. 'DirectionDegree' should be input as '45' degrees.
 - iv. Or '-1' for no building.
16. **DistanceMeter** – Measurement of the distance from the building edge to tree trunk, in meters.
- i. **n**: distance in meters.
 - ii. **'-1'**: no building.
17. **Heated** – Determines if target building has heating utilities.
- i. **'1'**: building has heating utilities.
 - ii. **'0'**: building does not have heating utilities.
 - iii. **'-1'**: no building.
18. **AirConditioned** – Determines if target building has air conditioning.
- i. **'1'**: building has air conditioning.
 - ii. **'0'**: building does not have air conditioning.
 - iii. **'-1'**: no building.



These are calculated if appropriate values are not provided above (meaning '-1' is input):

- 19. CalculatedHeightMeter
- 20. CalculatedCrownHeightMeter
- 21. CalculatedCrownWidthMeter

These are provided by the USFS through the API and are not adjustable at this time:

- 22. EmissionRateOfCO2kgPerMwh
- 23. EmissionRateOfCO2kgPerMMBtu

Outputs

- Output is only supported in XML format, as seen above under “API Response” section.
- Benefits are estimated out to the ProjectYear input above.
- If a known error occurs, it will be described within the <Error> tag with a normal return status code 200 OK. If an unhandlable error occurs, then the HTTP status code will be 500 Server Error or 502 Bad Gateway with a non-end-user-friendly, technical message. Otherwise, that tag will be empty.
- For location names that the API cannot match exactly in its database, the API will do its best to find something similar. If something close is found, the <Warning> tag will contain the closely matched location from the i-Tree database. The API will automatically use this location to calculate benefits.
- Latitude & Longitude should be submitted for locations (Ex: via geocoding from a 3rd party service, direct map point selection by user, or GPS).
- Output is broken up into two parts: entered input information, and benefit estimate response.
- Output information displays: Hydrology, Energy, Air Quality, and Carbon benefits as AMOUNTS and MONETARY VALUES.
- Note that some benefits do not have dollar values associated with them. Example: there is no dollar value assessed for rainfall that a tree intercepts, but there is a recognized value to avoided runoff.

Benefit amounts and units:

1. Year – benefit year. Year 1 is “current” year.
2. TreeAmount – number of trees.
3. Benefit – internal use for i-Tree at this time.

Hydrological benefits

4. RunoffAvoided – Cubic Meter
5. Interception – Cubic Meter
6. PotentialEvaporation – Cubic Meter
7. PotentialEvapotranspiration – Cubic Meter
8. Evaporation – Cubic Meter
9. Transpiration – Cubic Meter

Heating and Cooling benefits

10. MbtuHeatShade – MMBTU (million British Thermal Units)
11. MbtuHeatClimate - MMBTU
12. MbtuWindHeat – MMBTU
13. KwhElectricityHeatShade – kwh (Kilowatt Hours)
14. KwhElectricityHeatClimate – kwh
15. KwhElectricityHeatWind – kwh
16. KwhElectricityCoolShade – kwh
17. KwhElectricityCoolClimate – kwh

Pollution removed by trees

18. CO - kilograms
19. NO₂ - kg
20. SO₂ – kg
21. O₃ – kg
22. PM₂₅ – kg

Powerplant emissions avoided due to energy benefits

23. CO – kg
24. NO₂ – kg
25. SO₂ – kg
26. PM₂₅ – kg
27. VOC – kg

Carbon benefits

28. CO₂ (sequestered in a given year) – kg
29. CO₂ (avoided at powerplant) – kg
30. CarbonStorage (total carbon stored to date) – kg
31. CarbonDioxideStorage (carbon dioxide equivalent of carbon stored) – kg
32. DryWeight – kg

Benefit monetary valuations in US Dollars (\$)

Hydrological benefits

1. RunoffAvoidedValue

Heating and Cooling benefits

2. MbtuHeatShadeValue
3. MbtuHeatClimateValue
4. MbtuWindHeatValue
5. KwhElectricityHeatShadeValue
6. KwhElectricityHeatClimateValue
7. KwhElectricityHeatWindValue
8. KwhElectricityCoolShadeValue

9. KwhElectricityCoolClimateValue

These are regional energy prices used by the API:

- a. KWhPrice
- b. ThermPrice

Pollution removed by trees

- 10. COValue
- 11. NO2Value
- 12. SO2Value
- 13. O3Value
- 14. PM25Value

Powerplant emissions avoided due to energy benefits

- 15. COValue
- 16. NO2Value
- 17. SO2Value
- 18. PM25Value
- 19. VOCValue

Carbon benefits

- 20. CO2Value (sequestered in a given year)
- 21. CO2Value (avoided at powerplant)
- 22. CarbonDioxideStorageValue (carbon dioxide equivalent of carbon stored)

Using recognizable species with the i-Tree API

The Davey Tree Benefits Engine API requires species codes that are compatible with i-Tree. An additional API that allows users to retrieve the current list of species and their corresponding species codes is available. **These species and their codes come from the United States Forest Service – i-Tree cannot alter them.**

Calling the API

API Name: **getSpecies**

Description: Gets a list of species names and their codes, taxonomy rank, and scientific name.

- Base URL:
<https://dtbe-api.daveyinstitute.com/v2/getSpecies/>
 - After the first parameter, add parameters using the ‘&’ symbol
- Example URL:
<https://dtbe-api.daveyinstitute.com/v2/getSpecies/?key=xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx&output=XML>

API Response

XML

```
1 <Result>
2
3
4   <Species>
5     <SpeciesCode>MACCLASS</SpeciesCode>
6     <SpeciesType>Class</SpeciesType>
7     <ScientificName>Magnoliopsida</ScientificName>
8     <CommonName>Hardwood</CommonName>
9   </Species>
10
11   <Species>
12     <SpeciesCode>PICCLASS</SpeciesCode>
13     <SpeciesType>Class</SpeciesType>
14     <ScientificName>Pinopsida</ScientificName>
15     <CommonName>Softwood</CommonName>
16 </Species>
17
18 ..
19
20753   <Species>
20754     <SpeciesCode>LEAX</SpeciesCode>
20755     <SpeciesType>Species</SpeciesType>
20756     <ScientificName>Leucothoe axillaris</ScientificName>
20757     <CommonName>Coastal doghobble</CommonName>
20758 </Species>
20759
20760 </Result>
```

General Technical Details

Inputs

The authorization Key is required, and the Output format is optional:

1. **Key** – Key string given for access. Unique key identifier that allows use of the API. To use the key, enter the key as a parameter. Be aware that minute and day rate limits are enforced to help keep the server stable for i-Tree web-site users. Those may be relaxed or tightened as performance changes in the future.
2. **Output** – Specify the output format of the species list. The default output format is ‘XML’ when not specified. The format ‘JSON’ is given for convenience and is simply tags as keys and content as values. Accepted ‘Output’ options:
 1. XML
 2. JSON

Outputs

1. **SpeciesCode:** A code that corresponds to a specific species. This code should be used to identify the species in other i-Tree API endpoints.
2. **SpeciesType:** The taxonomic rank of the plant species based on a taxonomic hierarchy. Only the following species types are included within the species list:
 - i. Class
 - ii. Genus
 - iii. Species
3. **ScientificName:** The scientific name of a species.
4. **CommonName:** A name that is commonly used for a species.

{DEPRECATED} Using recognizable location names with the i-Tree API

We have deprecated name-based location lookup in favor of submitting latitude/longitude parameters. The latter is more precise and avoids complications with similar names, or locations whose names have changed over time. i-Tree maintains a US Census-based database of location-related information critical in calculating tree benefit estimates. Accordingly, i-Tree must know the proper location of a tree being sent to the API. Users can test the location requirements of the current API as follows. **NOTE:** i-Tree is working on a simpler, latitude/longitude lookup to replace this aspect of the API.

Calling the API

API Name: getGeneralLocationInformation

Description: Returns location inputs if they can be found in the i-Tree location database.

- Base URL:
<https://dtbe-api.daveyinstitute.com/v2/getGeneralLocationInformation/>
 - After the first parameter, add parameters using the ‘&’ symbol
- Example URL:
<https://dtbe-api.daveyinstitute.com/v2/getGeneralLocationInformation/?NorthHemisphere=1&CityName=Kent&CountyName=Portage&StateAbbr=OH&NationFullName=United%20States%20of%20America&key=xxxxxxxx-xxxx-xxxx-xxxx-xxxxxxxxxxxx&output=XML>

API Response

XML

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <Result>
3   <Error></Error>
4   <ApiVersion>2</ApiVersion>
5   <DBVersion>11.1.16</DBVersion>
6   <EngineVersion>1.0.0-beta</EngineVersion>
7   <InputInformation>
8     <Location>
9       <NorthHemisphere>1</NorthHemisphere>
10      <ZipCode>None</ZipCode>
11      <FullNationName>United States of America</FullNationName>
12      <StateAbbr>OH</StateAbbr>
13      <CountyName>Portage</CountyName>
14      <CityName>Kent</CityName>
15    </Location>
16  </InputInformation>
17  <OutputInformation>
18    <FrostFreeDays>150</FrostFreeDays>
19  </OutputInformation>
20 </Result>
21
```

General Technical Details

Inputs

The authorization Key is required, and the Output format is optional:

1. **Key** – Key string given for access. Unique key identifier that allows use of the API. To use the key, enter the key as a parameter. Be aware that minute and day rate limits are enforced to help keep the server stable for i-Tree web-site users. Those may be relaxed or tightened as performance changes in the future.
2. **Output** – Specify the output format of the species list. The default output format is ‘XML’ when not specified. Accepted ‘Output’ options:
 2. XML
 3. JSON

Outputs

1. NorthernHemisphere: North or south of the equator.
2. ZipCode: Not in use at this time.
3. FullNationName: the country name used by i-Tree.
4. StateAbbr: abbreviations used by i-Tree.
5. CountyName: Secondary partition level names used by i-Tree.
6. CityName: Tertiary partition level names used by i-Tree.
7. FrostFreeDays: value used for frost free days at that location.

Visit <https://dtbe-api.daveyinstitute.com> to learn about gaining access to the API. Quarterly usage charges will apply to users based on the number of their successful API requests at a rate of \$0.02 per tree.

API users must attribute i-Tree on any display of all tree benefits derived from the API and link to the i-Tree website.