Start/Stop Fonksiyonu ve Uygulanması
Between 2015 and 2021, every manufacturer must cut the fuel consumption of its fleet of new vehicles offered in Europe by an average of 27%.
Microhybrids (idling start/stop)

Soft hybrids (stop and go)

**Full hybrids** (power assist HEVs) Example of existing
- HEV battery systems: NiMH batteries
- Example of incoming HEV battery systems: Li-ion batteries

**Plug-in hybrids**
- Li ion batteries for PHEVs

**Electric vehicles**
- Examples of recent EV battery systems: Li ion
- Examples of recent EV battery systems: lithium metal polymer
- Examples of recent EV battery systems: sodium/nickel chloride (ZEBRA)

**Fuel Cell Hybrid Vehicles**
## KAVRAMSAL OLARAK START-STOP SİSTEMİ

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>Electric Power</th>
<th>Electric Storage</th>
<th>Grid Connected</th>
<th>Electric Driving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mild HEV</td>
<td>Low</td>
<td>Low</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Full HEV</td>
<td>Med</td>
<td>Low</td>
<td>No</td>
<td>Very limited</td>
</tr>
<tr>
<td>Blended PHEV</td>
<td>Med</td>
<td>Med</td>
<td>Yes</td>
<td>Limited</td>
</tr>
<tr>
<td>Intermediate PHEV</td>
<td>Med+</td>
<td>Med</td>
<td>Yes</td>
<td>UDDS cycle</td>
</tr>
<tr>
<td>E-REV PHEV</td>
<td>High</td>
<td>High</td>
<td>Yes</td>
<td>Full Performance</td>
</tr>
<tr>
<td>BEV</td>
<td>High</td>
<td>High</td>
<td>Yes</td>
<td>Full Performance</td>
</tr>
</tbody>
</table>

**Plug-In Vehicles**
Electrification Level of EVs

- **Micro HEV**: BMW 1 and 3 series hybrid, Smart
- **Mild HEV**: Honda Insight, Chevy Malibu Hybrid
- **Strong HEV**: Toyota Prius, Ford Escape
- **PHEV**: Honda Accord Plug-in, Toyota Prius Plug-in
- **ER-EV**: Chevy Volt
- **BEV**: Nissan Leaf, Tesla Model S

<table>
<thead>
<tr>
<th>Feature</th>
<th>Micro HEV</th>
<th>Mild HEV</th>
<th>Full HEV</th>
<th>PHEV</th>
<th>ER-EV</th>
<th>BEV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start-stop</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power assist</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regen Braking</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BEV driving</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plug</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Voltage (V)</td>
<td>12</td>
<td>48+</td>
<td>200-300</td>
<td>300+</td>
<td>300+</td>
<td>300+</td>
</tr>
<tr>
<td>Power (kW)</td>
<td>2.5</td>
<td>10-20</td>
<td>50</td>
<td>60+</td>
<td>60+</td>
<td>60+</td>
</tr>
<tr>
<td>Efficiency improvement (%)</td>
<td>2-4</td>
<td>8-11</td>
<td>20-35</td>
<td>50-60</td>
<td>&gt;60</td>
<td>&gt;60</td>
</tr>
</tbody>
</table>
ÖN BİLGİ

Plug-in hibrid elektrikli araçlar çoğunlukla menzili arttırmış elektrikli araçlar (ReEV ya da EREVs) olarak isimlendirilir.

Harmanlanmış/Karışık plug-in hibrid elektrikli araçlar (Blended PHEV), hem azaltılmış sistem maliyetinden (da daha küçük elektrik motoru, daha küçük akü gru bu ve daha düşük akü gücü oranları) hem de farklı sürüş koşulları için optimize edilmiş yakıt ekonomisi esnekliğinden dolayı daha popüler olmuştur.

Menzili arttırmış elektrikli araçlar (ReEV ya da EREVs) ile kıyaslandığında harmanlanmış/karışık plug-in hibrid elektrikli araçlarda genellikle paralel ve kompleks konfigürasyon kullanılmaktadır. Bu konfigürasyonda hem motor hem de elektrik motoru doğrudan tekerlekleri tahrik edebilmektedir.
By 2017, about 90% of new vehicles will be equipped with start/stop systems in Europe. This means workshops can expect an increasing demand for the corresponding spare parts and services.

Benefit from extensive start/stop system expertise: Parts, Diagnostic and Services from Bosch
Microhybrids (Idling Start/Stop)

In these cars, the combustion engine is stopped as soon as the car stops. The starter–alternator is only used to start the engine. No regenerative energy is recovered on breaking, and a few hundred watt-hours of energy is required (with a power of 2.5–5 kW). Therefore 12 V SLI lead acid batteries of the largest size can supply the required power. The same battery provides the energy for onboard equipment and starting. The battery is usually maintained at full SOC, but much more frequently and more deeply discharged than the conventional SLI. Therefore, battery aging is the challenge, the projected lifetime being generally about 1–2 years less than SLI batteries in conventional cars. As a consequence, the battery cost has to be as low as possible, and the replacement cost should be compensated by increased fuel economy. This fuel consumption reduction is obviously very dependent on the driving mode; in true urban configuration, with many stops, fuel saving can be more than 15%.

The valve-regulated adsorbed glass mat (AGM) technology is the most appropriate and offers the best cost/performance ratio, because of an improved cycle life [15]. Flooded type batteries with improved cycle life are also being developed.
BAZI NOTLAR:
• An automotive **SLI battery** *(starting, lighting, ignition)* powers the starter motor, the lights, and the ignition system of a vehicle's engine.
• The "**flooded cell**" type, indicating liquid electrolyte, is typically inexpensive and long-lasting, but requires more maintenance and can spill or leak. Some flooded batteries have removable caps that allow for the electrolyte to be tested and maintained.

**ÖRNEK UYGULAMA: AGM Teknolojisi**


**FLA (FLOODED LEAD ACID): Bakımlı kursun asit akü**
AGM Teknolojisi

Güvenlik valfı
kapak ve merkezi
gaz tahliyesi

Pozitif plaka seti

Plaka bloğu
Negatif plaka seti
Negatif plaka
Negatif ızgara
Micro cam keçeli pozitif plaka
Pozitif plaka
Pozitif ızgara

http://tr.bosch-automotive.com/tr/parts/parts_and_accessories/service_parts_1/batteries_4/s6_agm_1/s6_agm_1
Another difference is that AGM batteries have a slightly different charging rate and voltage. AGM batteries recharge about 15% faster than a conventional battery (which is important for maintaining battery charge for reliable starting). A fully charged AGM battery will typically read 12.8 to 13 volts or higher (versus 12.65 volts for a conventional battery). A reading of 12.5 to 12.8 volts indicates a 75% charge. A reading of less than 12.5 volts means the battery is low and needs to be recharged and/or load tested.
Soft Hybrids (Stop and Go)

The main difference with the former concept is that some energy is saved by regenerative electric power produced on braking (50–60% braking energy is converted to electricity), and more electric energy is used on starting because the car starts in an electric mode, while the ICE is being started. Compared to “stop and start,” the gain in fuel consumption can be almost doubled in the same driving conditions (from 5 to 25%).

There is a strong impact on the energy storage system that must be able to sustain high charge peak power, and provide more power and energy during the starting phase. The average power required during car start and average regeneration power is ~6 kW. The lead acid battery provides the energy required during start, and all onboard electric energy needs. Because the battery provides more energy, the SOC will vary more than in the “stop and start,” and typical depth of cycling range is 20% DOD, between 100 and 80% SOC, for a battery of similar size to the “stop and start” hybrid. The conventional lead acid battery design with flat plates is not well suited for this working mode and lifetime is reduced. The solution would be to increase the battery size, but volume and weight would become a burden. A better technical solution is the advanced high-power lead acid technology of spirally wound design. Another solution considered today is an association of conventional SLI lead acid battery and supercapacitors. The role of the capacitors is to accommodate and store the high peaks of regenerative power and help on starting, while the battery provides energy.

High-power Li ion batteries possess both power and energy requirements and can be considered as a future longer life solution as soon as the cost becomes compatible.
Start-stop teknolojisi ihtiyaç duyulmadığı sürece içten yanmalı motorun (İYM) çalıştırılmaması prensibine dayanır. Böylece içten yanmalı motorun boşta çalıştığı süre minimuma indirilerek yakıt tasarrufu ve egzoz emisyonlarında azalma sağlanır.

Start-Stop yani dur-kalk sistem, trafiğin yoğun olduğu zamanlarda ya da trafik ışıklarında aracınız durduğu zaman kontağı otomatik olarak kapatıp, sürücü debriyaja bastığı anda ise tekrar çalıştırarak, enerji kaybını önleneye yardımcı bir sistemdir.
Start-Stop sistemi, aracınızı durakta, kırmızı ışıkta ya da trafik sebebiyle durdurduğunuzda motoru otomatik olarak durdurur ve böylece aracınız sadece çalışması gerektiğini zamanlarda çalışır.
START-STOP SİSTEMİ NASIL ÇALIŞIR?

Manuel şanzımanlı araçlarda araç durdurulup, ayak debriyajdan çekildiğiinde, Otomatik şanzımanlı araçlarda ise araç durur pozisyonuna getirildikten sonra sürücünün ayağı frene basıldığı süre boyunca sistem otomatik olarak motoru geçici olarak durdurur.

Bu sırada gösterge panelinde ise "Start Stop" yazısı belirir. Aracı tekrar hareket ettirmek için manuel araçlarda debriyaja basılır basılmaz, otomatik araçlarda ise ayak frenden çekilir çekilmez sistem, motoru otomatik olarak yeniden çalıştırır.

Start-stop sistemi opsiyonel olarak kontrol butonu yardımıyla devre dışı bırakılabilir.
UNDERSTANDING START-STOP SYSTEMS

Start-stop systems are on the verge of being integrated into all automobiles worldwide. Schaeffler’s comprehensive and ever-expanding product range offers numerous engine start-stop (ESS) solutions.

<table>
<thead>
<tr>
<th>System complexity</th>
<th>Hybrid driving</th>
<th>“Sailing” – Engine stops while rolling</th>
<th>Engine independent A/C</th>
<th>Change-of-Mind</th>
<th>Basic Start-Stop</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>eDrive up to 2 km</td>
<td>Electric Catch-up</td>
<td>Active / Passive Boost</td>
<td>High-rev start Comfort start</td>
<td>Cold start</td>
</tr>
</tbody>
</table>

From starter to hybrid element: Advanced start-stop systems are capable of more and more

Advanced start-stop systems require component expertise and system understanding. They are developing from simple starters to hybrid elements that are permanently integrated into the complex architecture of the vehicle.

Decoupling tensioner
The change from recuperation to boosting creates vibrations in the belt drive, which are damped by this innovation from Schaeffler.

Permanently engaged starter
Provides a tangible increase in comfort and ensures the shortest possible restarting times in “change of mind” situations.

Neutral gear detection sensor

Clutch position sensor

Wheel speed sensor

Latchung valve
Stores hydraulic pressure and provides automatic vehicles with energy for a faster start-up after the engine has been stopped.

Graphic: www.josekdesign.de

Starting operations

<table>
<thead>
<tr>
<th>Starting operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
</tr>
<tr>
<td>0</td>
</tr>
<tr>
<td>250.000</td>
</tr>
</tbody>
</table>

http://www.car-engineer.com/stop-and-start-system-for-automatic-transmissions/#prettyPhoto
The "STOP & START" System

As part of its research into controlling the greenhouse effect, the PSA Peugeot Citroën Group has developed "Stop & Start". Designed for mass-market use, this new system improves fuel economy. The basic principle: as soon as the car comes to a standstill (red lights, traffic jam, etc.), the engine cuts out.

1. **When the vehicle stops, the engine cuts out**
   - When the driver brakes to stop the car, the engine cuts out and a green "eco" indicator appears on the dashboard.
   - The engine remains in standby for as long as the driver keeps a foot on the brake pedal, even if the pressure is slight.

2. **The engine starts again automatically and instantaneously**
   - When the driver releases the brake pedal, the engine starts up again, automatically, instantaneously and in complete silence (in some 400 milliseconds compared with around one second for a conventional start-up).
   - The green 'eco' indicator is switched off.

**Advantages of Stop & Start**

- **Driving pleasure**: simple to use, no noise and vibration when the car stops moving, instant and silent start-up.
- **Environmental protection**: fuel consumption and CO₂ emissions reduced by 10% over an urban cycle (8% over a combined cycle).

The different control units (BSI, engine control (CMM), gearbox control (BVMP), Stop & Start reversible alternator control (AR2S), etc.) check that conditions for stopping the engine are satisfied: driver's foot on the brake pedal, vehicle speed of less than 6 km/h, battery sufficiently charged, etc.

The reversible alternator control unit (AR2S) orders the engine control unit to stop fuel injection, and the engine cuts out.

Stop & Start is making its debut on the Citroën C3 1.4 i petrol model, fitted with the SensoDrive gearbox.
1. Engine control unit with software option start/stop
2. DC / DC converter 12 volts
3. Deep-cycle resistant battery (EFB, AGM) and battery sensor
4. Start/stop starter
5. Neutral gear sensor
6. Wheel-speed sensor
7. Crankshaft sensor
8. Alternator

Benefit from extensive start/stop system expertise: Parts, Diagnostic and Services from Bosch
1. **Engine ECU**: Manages the Start & Stop system.
2. **Car Access System**
3. **Start-up motor**: It is responsible for starting the internal combustion engine.
4. **Instruments panel**: Informs the driver about the status of the Start & Stop system: activated/deactivated.
5. **MSA Centre console switching centre**
6. **Speed sensor**: Informs, normally through the ABS unit, of the vehicle’s speed.
7. **Battery sensor**: Informs the engine unit about the current entering and leaving the battery in order to estimate charge level.
8. **Bonnet switch**: Warns the engine unit of bonnet opening.
9. **Seat belt switch**: Indicates to the engine unit whether the seat belt is fastened or not.
10. **Clutch pedal position sensor**: Signals the pedal’s position. If the lever is slightly shifted (a hand is resting on it), the motor starts after pressing the pedal by 90%.

11. **Clutch pedal position sensor**: Signals the pedal’s position. If the gear lever is in neutral position, the motor starts after pressing the pedal by 10%.

12. **Brake servo vacuum sensor**: Located on the servo brake, sends a signal proportional to the brake’s vacuum.

13. **Neutral position sensor**: Located on the gear box, signals the gear lever position. Normally, after replacement, calibration needs to be carried out using diagnosis equipment.

14. **Automatic Heat and A/C integrated system (IHKA) / Heat and A/C integrated regulator (IHKR)**. **Climate control unit**: Requests start up of the engine when it needs thermal units (A/C compressor) or calories (heating radiator) to reach the temperature selected by the driver.
Coordination: Energy management (1 and 3)
The engine control unit with integrated start/stop coordinator and the battery sensor are the principal components of the energy management system. Additional items include a deep-cycle resistant battery with EFB or AGM technology and a DC/DC converter.

Direct current: DC/DC converters (2)
The voltage level in the vehicle electrical system drops briefly when operating the starter. This can impair the operation of electronic devices – in the form of interrupted radio reception or the loss of navigation function. The DC/DC converter prevents this from happening by stabilizing the electrical system when starting the engine.

Monitoring: Electronic battery sensor [EBS] (3)
The Electronic Battery Sensor EBS, located in the pole recess of the battery, accurately and dynamically records the operating values such as current, voltage and temperature. It uses the measured values to monitor the capability of the battery and determine the energy input and output capacity.
Constant voltage level: DC/DC converter
The DC/DC converter stabilizes the vehicle electronic system and prevents problems with, or the failure of electronic equipment, such as the radio or navigation system on starting.

Maintains the voltage level on starting: DC/DC converter

Accurate measurement results: Sensors
A network of different vehicle sensors provides the control unit with the latest status data to achieve optimum control of the start/stop function.

• The neutral gear sensor indicates whether a gear is engaged.
• The wheel speed sensor detects the direction of wheel rotation and whether the wheel is at a standstill.
• The intelligent crankshaft sensor signals the engine activity.
• The brake booster differential pressure sensor monitors the pressure in the brake booster during the stop phase in order to start the engine when the pressure drops. This protects the brake booster.
• The electronic battery sensor (EBS) monitors the battery power status.
Especially more powerful: Start/stop starters (4)

By strengthening of the bearings, using an improved planetary gear, strengthened pinion-engaging mechanics and optimization of the commutator for longer service life, the starter has been optimized for frequent startings.

Information managers: Sensors (5, 6 and 7)
The sensors provide the control system with up-to-date information to help optimize the starting process. Whilst the neutral position sensor indicates whether a gear is engaged, the wheel speed sensor measures whether the vehicle has actually come to a standstill. The crankshaft sensor accordingly signals the engine activity.

Reliable power source: Alternator (8)
Even in the low speed range and immediately after starting, the highly efficient alternators generate a surplus of energy to supply the vehicle electrical system. In conjunction with the powerful battery they increase the availability of the start/stop Function.

Benefit from extensive start/stop system expertise: Parts, Diagnostic and Services from Bosch, 2014.
Starters for Start/Stop Systems

The number of starting sequences that are carried out with the starter motor, i.e. its service life, has been considerably increased so that the starter motor is able to withstand the frequent starts made over the lifetime of the vehicle.

The following measures have thus been implemented:

1. *Strengthening of the bearings which come under severe strain*
2. *Further improvement of the planetary gear*
3. *Use of a stronger starter pinion drive.*
4. *Optimization of the commutator for longer service life*

Alternators for Start/Stop Systems

Alternators for start/stop systems create more electrical energy for the on-board diagnostics, even at low speeds and directly after the vehicle has been started. Together with the high-performance battery, they increase the availability of the start/stop function.

- *Improved electrical design and optimized materials*
- *Particularly efficient at low speeds*
- *High efficiency diode technology (HED)*
- *Greater efficiency of up to 77%*
- *Greater fuel savings of up to 2%*
- *Noise-optimized*
Filters for Start/Stop Systems

Vehicles with start/stop systems start approximately six times more often than conventional vehicles. Due to the increased number of engine starts, the fuel filter is exposed more often to strong pressure pulsations. A particularly sturdy fuel filter with stronger housing, gasket seals and cover should thus be used to prevent bursting.
While a conventional vehicle is designed for only about 36,000 starts, basic start-stop systems are designed to endure between 300,000 and 500,000 such cycles. The specifications for a vehicle with sailing function are based on an average 1.2 million starts. This means: During the 300,000 kilometers of the vehicle’s expected lifetime, the motor is switched off and on again every 250 meters. For comparison: Today’s hybrid vehicles arrive at approximately 600,000 start cycles (Figure 1).

However, a decrease in the total required start cycles is emerging in vehicles with sailing function. This is due to the limited number of starts due to the operating strategy (reduced sailing speed range, latency).

The following aspects also have to be taken into consideration:

• The crank and the valve train are subjected to prolonged periods without oil pressure and are therefore frequently operated under conditions of mixed friction.
• The systems for exhaust gas after-treatment go through a temporary, shortterm cooling phase much more often.
• The accessory units in the belt drive pass through the start process more frequently (resonances, rotational irregularities).
• The elements of the air intake system (throttle valve, fuel injection system, turbocharger) pass through the start process more frequently (mixed friction, thermal stresses, pressure fluctuations).
• The dual mass flywheel often passes through the resonant vibration range.
• Safety-critical auxiliary units (brake servo unit, power steering pump) must be supported using electric drives under certain circumstances.
The length of the delay depends largely on the technology used. With a conventional starter pinion, the time between the CoM ("Change of Mind") event and reaching idle speed once again lasts up to 1200 ms.

**Development of start-stop technologies and functions by 2020**

- **Limited electric driving**
  - 2014: EU
  - 2017: EU
  - 2020: EU, US, CN

- **Sailing**
  - 2014: EU, US
  - 2017: EU
  - 2020: EU

- **Independent air conditioning (A/C)**
  - 2014: EU, US
  - 2017: EU
  - 2020: EU

- **Improved comfort**
  - 2014: EU, US
  - 2017: EU
  - 2020: EU

- **Basic ESS**
  - 2014: EU, US, CN
  - 2017: EU
  - 2020: EU

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**In sailing mode**, when the car is off throttle or going down an incline, the engine can turn off and the electric motor can either provide occasional power or act as a generator.

The starter-generator can then drive the air conditioning compressor when the engine is switched off.

Two-speed starter with planetary gear
The starter can then translate the lower friction of the warm engine into higher starting speeds using the same power input. This not only reduces the start time, but also the noise and vibration levels.

First gear is used for cold starts only, so that the customer perceives a noticeable difference between cold start and restart. This gain in comfort compares favorably to the relatively low outlay required for the mechanical integration.
The existing belt drive remains unchanged. Instead of a rigidly connected or magnetically separable pulley, a planetary gear set is used for the air-conditioning compressor.
START-STOP STRATEJİSİ
<table>
<thead>
<tr>
<th></th>
<th>Max. power</th>
<th>Average power City bus without AC</th>
<th>Average power City bus with AC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Summer</td>
<td>Winter</td>
<td>Summer</td>
</tr>
<tr>
<td><strong>Chassis System</strong></td>
<td><strong>Total</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Body Mounted equipment</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exterior Lights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Position lights</td>
<td>50 W</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Marker lights</td>
<td>50 W</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Head lights</td>
<td>140 W</td>
<td>140</td>
<td>140</td>
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<tr>
<td>Fog lights front</td>
<td>140 W</td>
<td>35</td>
<td>70</td>
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<tr>
<td>Fog lights rear</td>
<td>42 W</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Brake lights</td>
<td>84 W</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Reversing lights</td>
<td>42 W</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Direction indicators</td>
<td>168 W</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Licence plate lights</td>
<td>10 W</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Windscreen wiper</td>
<td>200 W</td>
<td>100</td>
<td>150</td>
</tr>
<tr>
<td>Interior Lights</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Night lights</td>
<td>60 W</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>Day lights</td>
<td>300 W</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>Step lights</td>
<td>60 W</td>
<td>60</td>
<td>60</td>
</tr>
<tr>
<td>Driver cabin lights</td>
<td>40 W</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>Heating</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Demister</td>
<td>340 W</td>
<td>170</td>
<td>340</td>
</tr>
<tr>
<td>Extra interior heaters</td>
<td>75/150 W</td>
<td>0</td>
<td>150</td>
</tr>
<tr>
<td>Auxiliary heater</td>
<td>350 W</td>
<td>35</td>
<td>350</td>
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<tr>
<td>Heated wind screen</td>
<td>1000 W</td>
<td>0</td>
<td>0</td>
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<tr>
<td>A.C.</td>
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<td></td>
<td></td>
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<tr>
<td>Normal or Ventilation</td>
<td>1700 W</td>
<td>400</td>
<td>100</td>
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<tr>
<td>Tropical</td>
<td>2800 W</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>With heaters</td>
<td>1800 W</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Audio &amp; Video</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radio</td>
<td>100 W</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Camera (reversing)</td>
<td>50 W</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total Power</strong></td>
<td></td>
<td>2397 W</td>
<td>2932 W</td>
</tr>
</tbody>
</table>
Start-stop dönüşümü için gerekli olan parametreler

**Engine and Auxiliary Systems**

- Electric aux
- Starter motor
- Hydraulic pumps
  - Power steering
  - Cooling fan
  - Exhaust after treatment
  - Turbo
  - Oil pump
  - AC compressor
- ICE
  - Power electronics
  - GEN
  - Low temp cooling
- 24V battery
- 24V alternators
- Water pump
- Air compressor
- Air tanks
- Air treatment
- Doors
- Service brakes
- Parking brake
- Suspension

Robin Rockström, An engine start/stop strategy for a hybrid city bus, Master of Science Thesis Stockholm, Sweden 2009
### Table: Minimum stop time, calculation inputs and results. s/s performed by means of the conventional starter motor.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle fuel consumption [g/s]</td>
<td>0,77</td>
</tr>
<tr>
<td>Engine off power consumption [kW]</td>
<td>4,0</td>
</tr>
<tr>
<td>Engine off power consumption, equivalent fuel consumption [g/s]</td>
<td>0,50</td>
</tr>
<tr>
<td>Start fuel consumption [g]</td>
<td>0,7</td>
</tr>
<tr>
<td>Start battery energy consumption [Wh]</td>
<td>2,1</td>
</tr>
<tr>
<td>Start battery energy consumption, equivalent fuel [g]</td>
<td>0,94</td>
</tr>
<tr>
<td>Fuel saved at stop [g/s]</td>
<td>0,27</td>
</tr>
<tr>
<td>Total fuel needed for start [g]</td>
<td>1,64</td>
</tr>
<tr>
<td>Minimal stop time to break even [s]</td>
<td>6,1</td>
</tr>
</tbody>
</table>