COREMO


*ARPA-E GENSETS ANNUAL REVIEW*

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# 1. About AISIN

AISIN WORLD CORP. OF AMERICA

- *A member of **TOYOTA** group of companies*
- *Headquarters: **AISIN SEIKI CO., Ltd.** in Aichi, Japan*
- *An international corporation with 189 facilities worldwide including factories, research centers, and sales offices*
- *33 facilities in North America including factories and offices i.e. **Aisin World Corp. of America (AWA)***
- *Tier 1 automotive parts supplier, 5$^{th}$ in 2015*
- *Sustainable technology since 1986 (US since 2008)*
- *Energy System Department: Gas engine driven heat pumps, Micro CHP (ICE & SOFC), Peltier Modules, etc.*

# 2. About "COREMO"

AISIN WORLD CORP. OF AMERICA

- *1st production in 2009, currently 2013 model*
- *Since 2009, about 2,500 units installed in Northern Japan*
- *Most systems configured with combi boiler*
- *Some systemized with PV*

| **Model Year** | **2013** | | Model Number: | GECC15B1N | |
|---|---|---|---|---|---|
| Dimensions: | H 1157 x W 755 x D 420 | mm | Power Factor: | Over 0.95 | |
| Weight: | 143 | kg | Voltage: | 202 | V |
| Electric Supply: | Single-phase, 3-lines (101/202) | V | Frequency: | 50/60 | Hz |
| Noise Level: | | | Heat Output: | | |
| *Rated Operation* | 46 | db | *Rated Operation* | 1.4e - 3.4h | kW |
| *Night Mode Operation* | 45 | db | *Night Mode Operation* | 1.4e - 2.7h | kW |
| *Silent Mode Operation* | 43 | db | *Silent Mode Operation* | 1.4e - 2.1h | kW |
| Ambient Temperature: | -25 - 25 | ℃ | Rated Flow Rate: | 5 | L/min |
| Power Output Range: | | | *Electrical Efficiency* | 26 | % |
| *Rated Operation* | 0.5 - 1.5 | kW | *Heat Efficiency* | 64 | % |
| *Night Mode Operation* | 0.5 - 1.2 | kW | *Total* | 90 | % |
| *Silent Mode Operation* | 0.5 - 0.75 | kW | Engine: | 4 cycle-single cylinder - OHV | |
| Current: | | | *Displacement* | 245 | cc |
| *Rated Operation* | 2.5 - 7.5 | A | *Idling @* | 1300 | rpm |
| *Night Mode Operation* | 2.5 - 6.0 | A | *Rated Operation @* | 1750 | rpm |
| *Silent Mode Operation* | 2.5 - 3.75 | A | *Gas Consumption* | 5.8 (LHV) | kW |

# 3. Pilot Project – Indiana (Detached House)

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***Property Info***

- *System Installed:* *October 2015 (Outdoor)*
- *Floor Space:* *5,400 ft2*
- *Annual Average Temperature:* *High 63.6F / Low 42.2F (Nov-Mar: 45.6F / 26.4F)*
- *Average Annual Snowfall:* *8”*
- *Electricity:* *Grid power*
- *Gas:* *Propane*
- *Snowmelt Area:* *Garage entrance area (about 1,500ft2)*
- *Primary Space Heating:* *AISIN gas heat pump system*
- *CHP System Component:* *COREMO with black start system, tankless boiler*

***Application***

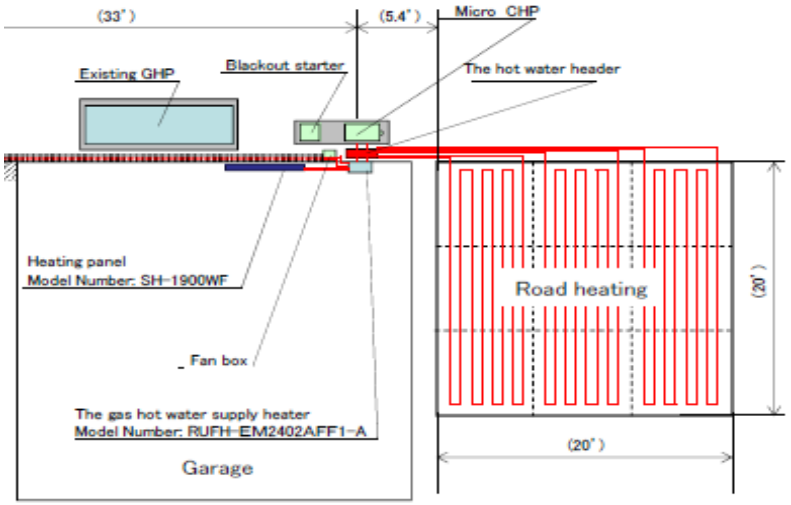
- *Generated power is fed back to the house, daily average use is around 600W/h.*
- *Generated heat is put into snowmelt system installed in garage front driveway.*
- *If snowmelt system requires more heat, tankless boiler (135,000BTU) will kick-in.*

***Challenges***

- *Automatic changeover during blackout.*
- *Heat utilization during low heat demand months.*
- *Power storage to offset high/low electricity use period.*
- *Installation cost reduction.*

***Next Step***

- *Sync with Home Energy Management System (HEMS).*
- *Domestic hot water connection.*



# 4. Pilot Project – Indiana (Semidetached)

AISIN WORLD CORP. OF AMERICA

***Property Info***

- *System Installed:* *October 2015 (Outdoor)*
- *Floor Space:* *1,300 ft2 per unit*
- *Annual Average Temperature:* *High 63.6F / Low 42.2F (Nov-Mar: 45.6F / 26.4F)*
- *Electricity:* *Grid connected*
- *Gas:* *Natural gas*
- *Primary Space Heating:* *Gas furnace*
- *Secondary Space Heating:* *Hydronic baseboard heater*
- *CHP System Component:* *COREMO with black start system, tankless combi boiler*

***Application***

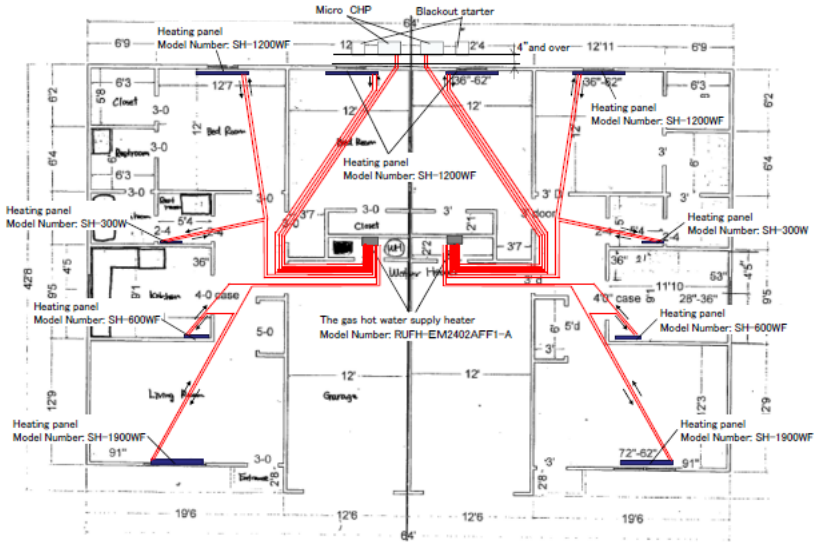
- *Generated power is fed back to the house, daily average use is around 300W/h.*
- *Generated heat is distributed through baseboard heater and pre-heats domestic hot water.*
- *If baseboard heater can not maintain set temperature, gas furnace will kick in.*
- *If higher temperature hot water is needed, tankless boiler will kick in.*

***Challenges***

- *Automatic changeover during blackout.*
- *Heat utilization during low heat demand months.*
- *Power storage to offset high/low electricity use period.*
- *Balancing heat supply per load.*

***Next Step***

- *Sync with Home Energy Management System (HEMS).*
- *Configure variable heat supply.*



# 5. Pilot Project – Michigan (Detached)

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***Property Info***

- *System Installed:* *October 2015 (Basement)*
- *Floor Space:* *5,600 ft2*
- *Annual Average Temperature:* *High 57.6F / Low 38F (Nov-Mar: 38F / 21.8F)*
- *Average Annual Snowfall:* *44”*
- *Electricity:* *Grid connected*
- *Gas:* *Natural gas*
- *Snowmelt Area:* *Garage entrance area (about 2,300ft2)*
- *Snowmelt System (Zone-1):* *200,000 Btu tankless boiler*
- *Snowmelt System (Zone-2):* *COREMO, tankless combi boiler*

***Application***

- *Generated power is fed back to the house, daily average use is around 500W/h.*
- *Generated heat is put into zone-2 snowmelt system installed in garage front driveway.*
- *If zone-2 calls for more heat, tankless combi boiler (69,000Btu) will kick-in.*

***Challenges***

- *Snowmelt system commissioning.*
- *Heat utilization during low heat demand months.*
- *Power storage to offset high/low electricity use period.*
- *Installation cost reduction.*
- *Dedicated air intake.*

***Next Step***

- *Sync with Home Energy Management System (HEMS).*
- *Domestic hot water connection.*

# 6. Pilot Project – Alberta (Detached House)

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***Property Info***

- *System Installed:* *September 2016 (Outdoor)*
- *Floor Space:* *4,800 ft2*
- *Annual Average Temperature:* *High 49.1F / Low 27.0F (Nov-Mar: 29.0F / 8.5F)*
- *Average Annual Snowfall:* *3.5”*
- *Electricity:* *Off grid*
  - *- PV capacity* *9.0 kW*
  - *- Wind turbine capacity* *2.4 kW*
  - *- Battery bank capacity* *1200 amp/hour (48V)*
  - *- Dump capacity* *5.0 kW rated*
- *Gas:* *Natural gas*
- *Primary Space Heating:* *Gas furnace*
- *Secondary Space Heating:* *Radiant floor heating*

***Application***

- *Generated power is fed back to the house, daily average use is around 400W/h.*
- *Generated heat is put into radiant floor heating system.*
- *5.0kW dump to prevent overcharging the battery system.*

***Challenges***

- *Snowmelt system commissioning.*
- *Heat utilization during low heat demand months.*
- *Power storage to offset high/low electricity use period.*

***Next Step***

- *Sync with Home Energy Management System (HEMS).*

| センサ入力 | |
|---|---|
| 制御電源電圧(V) | 11.9 |
| エンジン入口冷却水温度(℃) | 46 |
| 自立バッテリー温度(予約) | 0 |
| 排熱交出口温度(℃) | 60 |
| 自立昇圧電圧(予約) | 0 |
| 暖房温水戻り温度(℃) | 18 |
| 暖房温水行き温度(℃) | 30 |
| エンジン吸気温度(℃)<予備> | 0 |
| エンジン排気温度(℃)<予備> | 0 |
| 外気温度(℃)<予備> | -1 |
| エンジンルーム温度(℃) | 47 |
| エンジン排気触媒温度(℃) | 480 |
| イグナイタ電圧(V) | 15.2 |

| 状態データ | |
|---|---|
| エンジン冷却水ポンプ指示(%) | 63 |
| エンジン冷却水ポンプ回転数(mi… | 3860 |
| 暖房循環ポンプ指示回転数(%) | 66 |
| 暖房循環ポンプ実回転数(min-1) | 4156 |
| スロットル弁指示(step) | 236 |
| 燃料弁指示(step) | 249 |
| エンジン指示回転数(min-1) | 1750 |
| エンジン実回転数(min-1) | 1749 |
| 点火進角(° ) | 5.0 |
| 燃料弁ベースマップ開度(step) | 249 |
| スロットル弁上限補正値(step) | 0 |
| 燃料弁排気触媒温度低温補正… | 0 |
| エンジンルームファン回転数(min-1) | 5061 |

| インバータデータ | |
|---|---|
| 出力電力(W) | 1500 |
| 直流電圧(V) | 362.1 |
| R-S間交流電圧(V) | 205.4 |
| R-N相交流電圧(V) | 102.0 |
| S-N相交流電圧(V) | 103.3 |
| 自立発電電圧 | 0.0 |
| 出力電流(A) | 7.3 |
| 系統電力1(W) | -547 |
| 系統電力2(W) | -258 |
| インバータ温度(℃) | 14 |
| インバータヒータ温度(℃) | 0 |
| インバータ直流分(mA) | 9 |
| 発電リミット指示(W) | 1500 |

# 7. Design & Installation Challenges

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- *Who is to install?*
  - *Electrician? Plumber? HVAC?*
- *What is the adequate installation cost?*
  - *Quotes ranged from $2,000 to $8,000*
- *"As-built" or "pre-designed"?*
  - *Simple installation can be "as-built" to save cost*
- *Efficient heat utilization*
  - *How do you distribute heat efficiently?*
- *Systemize with other technology (PV, wind, battery bank, etc.)*
  - *How many inverters really needed?*
- *Balance-of-system*
  - *How can we create a best method?*

# 8. After Service Challenges

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- *Electrician, plumber, and HVAC contractor may get involved during MCHP installation.*
  - *Who will take care the after service?*
- *Typically, service calls are initiated by customers.*
  - *Utilize "IoT" for service network. Be proactive.*
    - *Remote monitoring, data collection, error/service notification, etc.*

| Manufacture | Service Contractor | End User |
|---|---|---|
| R&D | Service Efficiency | Reliability |
| Warranty | Operation Saving | Controllability |
| Service Quality | Customer Satisfaction | Energy Consciousness |
| Record Accuracy | | Satisfaction |
| Customer Satisfaction | | |

- *Standardized training program*
  - *Schools, institutes, associations, organizations, etc.*

# 9. Keys to MCHP Future

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- *Government & utility incentives*
  - *Carbon credits, tax credits, rebates, etc.*
- *Equipment lease & finance program*
  - *What are the obstacles?*
- *Emission regulations (Federal, States, districts)*
  - *What to expect after 2020.*
- *Smart energy integration*
  - *Can a MCHP be a part of it in electrical appliance turf?*
- *Public recognition*
  - *Mass or niche marketing?*
- *Sales channel*
  - *Distributor, dealer, direct, DIY, etc.*

# *Thank You*

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