CLAIMS

1. A method for decarbonizing engines, comprising:

determining an initial set of decarbonization process parameters for a first engine;

performing a first engine decarbonization process upon the first engine, the first engine decarbonization process comprising:

introducing dry hydrogen into the first engine while the first engine is running by releasing dry hydrogen from a dry hydrogen source into the first engine rather than introducing oxyhydrogen into the first engine, in accordance with the initial set of first engine decarbonization process parameters;

automatically measuring first engine exhaust gas components while dry hydrogen is introduced into the first engine;

automatically determining a set of lambda values based upon the measured exhaust gas components while dry hydrogen is introduced into the first engine, each lambda value corresponding to an air-to-fuel ratio for the first engine;

automatically determining an updated set of first engine decarbonization process parameters based upon at least some of the determined lambda values; and

automatically continuing the first engine decarbonization process by introducing dry hydrogen into the first engine in accordance with the updated set of first engine decarbonization process parameters.

2. The method of claim 1, wherein the initial set of engine decarbonization process parameters includes a dry hydrogen flow rate, pressure, or volume.

3. The method of claim 1, wherein the initial set of engine decarbonization process parameters includes a first time period based upon at least some of first engine type, first engine capacity, and first engine odometer reading.

4. The method of claim 1, further comprising adjusting a flow rate of dry hydrogen sourced from the dry hydrogen source to establish an initial dry hydrogen flow rate or pressure in accordance with the initial set of first engine decarbonization parameters.

5. The method of claim 4, further comprising:

determining a temperature of the dry hydrogen source from which the dry hydrogen is introduced into the first engine; and

automatically adjusting the temperature of the dry hydrogen source before and/or during the first engine decarbonization process to establish or maintain a dry hydrogen flow rate or pressure in accordance with the initial set of first engine decarbonization process parameters.

6. The method of claim 1, wherein continuing the first engine decarbonization process in accordance with the updated set of first engine decarbonization parameters shifts first engine combustion conditions such that further determined lambda values are at least approaching a target lambda value range, or remain within the target lambda value range.

7. The method of claim 1, wherein the updated set of first engine decarbonization process parameters includes an updated dry hydrogen flow rate or pressure.

8. The method of claim 1, wherein the updated set of first engine decarbonization process parameters includes a second time period based upon first engine type, first engine capacity, first engine odometer reading, and/or one or more determined lambda values determined during introduction of dry hydrogen into the first engine in accordance with the initial set of first engine decarbonization process parameters.

9. The method of claim 1, wherein determining the initial set of first engine decarbonization process parameters for the first engine decarbonization process comprises:

receiving at a remote engine decarbonization management system first engine information including at least one of first engine type, first engine capacity, and first engine odometer reading;

automatically determining the initial set of first engine decarbonization process parameters by the remote engine decarbonization management system in accordance with the first engine information; and

automatically communicating the initial set of first engine decarbonization process parameters from the remote engine decarbonization management system to a first local engine decarbonization unit configured for (a) introducing dry hydrogen into the first engine in accordance with the initial set of first engine decarbonization process parameters and (b) measuring first engine exhaust gas components.

10. The method of claim 9, wherein determining the initial set of first engine decarbonization process parameters further comprises:

determining a set of preliminary lambda values for the first engine while the first engine is running prior to the introduction of dry hydrogen into the first engine; and

communicating the set of preliminary lambda values to the remote engine decarbonization management system as part of the first engine information.

11. The method of claim 9, further comprising:

performing a second engine decarbonization process upon a second engine, the second engine decarbonization process comprising:

determining an initial set of second engine decarbonization process parameters;

introducing dry hydrogen into the second engine while the second engine is running by releasing dry hydrogen from another dry hydrogen source into the second engine rather than introducing oxyhydrogen into the second engine, in accordance with the initial set of second engine decarbonization process parameters;

measuring second engine exhaust gas components while dry hydrogen is introduced into the second engine;

automatically determining a set of lambda values based upon the measured exhaust gas components while dry hydrogen is introduced into the second engine, each lambda value corresponding to an air-to-fuel ratio for the second engine

automatically determining an updated set of second engine decarbonization process parameters based upon at least some of the determined lambda values; and

automatically continuing the second engine decarbonization process by introducing dry hydrogen into the second engine in accordance with the updated set of second engine decarbonization process parameters.

12. The method of claim 11, wherein the second engine decarbonization process is performed by way of a second local engine decarbonization unit distinct from the first local engine decarbonization unit.

13. The method of claim 12, wherein portions of the first and second engine decarbonization processes are performed simultaneously.

14. The method of claim 12, wherein the first local engine decarbonization unit stores a first authorization code and the second local engine decarbonization unit stores a second authorization code, and wherein each of the first and second authorization codes is communicable to the remote decarbonization management system for automatic verification of the first local engine decarbonization unit and the second local engine decarbonization unit, respectively, by the remote decarbonization management system.

15. The method of claim 12, further comprising storing in a database associated with the remote engine decarbonization management system historical engine decarbonization information.

16. The method of claim 15, further comprising providing an Internet based vehicle manufacturing interface by which a vehicle manufacturer can access decarbonization process histories corresponding to vehicles they have manufactured, and/or categorical types of vehicles they and/or other manufacturers have manufactured.

17. A system for decarbonizing engines, comprising:

a set of engine decarbonization units, each engine decarbonization unit comprising:

a hydrogen flow regulation unit couplable to a source of dry hydrogen;

a hydrogen delivery line coupled to the hydrogen flow regulator and configured for introducing dry hydrogen into an engine rather than introducing oxyhydrogen into the engine during a decarbonization process;

an engine exhaust gas analyzer configured for measuring engine exhaust gas components and determining a set of corresponding lambda values, each lambda value corresponding to an air-to-fuel ratio of the engine; and

a control unit configured for controlling the decarbonziation process by way of controllably (a) introducing dry hydrogen into the engine while the engine is running in accordance with an initial set of engine decarbonization process parameters, wherein the initial set of engine decarbonization process parameters in based upon at least some of engine type, engine capacity, engine odometer reading, and a set of preliminary lambda values corresponding to the engine, wherein the preliminary lambda values were obtained prior to the introduction of dry hydrogen into the engine; and (b) automatically adjusting a dry hydrogen flow rate into the engine during the decarbonization process in order to shift engine combustion conditions such that determined lambda values are at least approaching a target lambda value range, or remain within the target lambda value range.

18. The system of claim 17, wherein each engine decarbonization unit further comprises a set of temperature sensors and a temperature regulation device for controlling a temperature of the source of dry hydrogen.

19. The system of claim 17, wherein the set of engine decarbonization units comprises a plurality of engine decarbonization units, and wherein the system further comprises a remote engine decarbonization management system configured for network communication with each engine decarbonization unit, the network communication comprising:

communicating from each engine decarbonization unit to the remote engine decarbonization management system a set of lambda values corresponding to an engine associated with the engine decarbonization unit, including lambda values

determined while dry hydrogen is introduced into the engine as part of the decarbonization process; and

communicating from the remote engine decarbonization management system to each engine decarbonization unit a set of updated engine decarbonization process parameters specifying a dry hydrogen flow rate for shifting combustion conditions of the engine associated with the engine decarbonization unit such that determined lambda values for the engine are at least approaching a target lambda value range, or remain within the target lambda value range.

20. The system of claim 19 wherein the network communication further comprises:

communicating engine information to the remote engine decarbonization management system, the engine information including at least some of engine type, engine capacity, engine odometer reading, and the set of preliminary lambda values corresponding to the engine associated with the engine decarbonization unit; and

communicating from the remote engine decarbonization management system to each engine decarbonization unit a set of initial engine decarbonization process parameters based upon the engine information.

21. The system of claim 19, wherein the remote engine decarbonization management system is configured for verifying an authorization code corresponding to each engine decarbonization unit.

22. The system of claim 19, further comprising a database coupled to the remote engine decarbonization management system, and wherein the remote engine decarbonization management system is configured to store engine decarbonization histories corresponding to different types of engines in the database.

23. The system of claim 22, wherein the remote engine decarbonization management system provides an Internet based vehicle manufacturing interface by which a vehicle manufacturer can access decarbonization process histories corresponding to vehicles they

have manufactured, and/or categorical types of vehicles they and/or other manufacturers have manufactured.

24. The system of claim 17, wherein each engine decarbonization unit further comprises a set of temperature sensors and a temperature regulation device for controlling a temperature of the source of dry hydrogen.

25. The system of claim 17, wherein the source of dry hydrogen for each engine decarbonization unit comprises a set of solid state hydrogen gas canisters, cartridges, or cassettes, and wherein each engine decarbonization unit further comprises a housing configured for removably receiving the set of solid state hydrogen gas canisters, cartridges, or cassettes and coupling the set of solid state hydrogen gas canisters, cartridges, or cassettes to the hydrogen flow regulation unit.

26. The system of claim 17, wherein each engine decarbonization unit further comprises a display device.

27. The system of claim 17, wherein each engine decarbonization unit further comprises a digital code reader.

28. The system of claim 27, wherein the digital code reader comprises a QR code reader.

29. The system of claim 27, wherein the system further comprises a decarbonization facility computer system having a digital code generation unit.

30. The system of claim 29, wherein the digital code generation unit comprises a QR code generation unit.

31. The system of claim 17, wherein the set of engine decarbonization units comprises a plurality of engine decarbonization units, and wherein the system further comprises a

remote engine decarbonization management system coupled to each engine decarbonization unit by way of a computer network.

32. The system of claim 31, wherein the set of engine decarbonization units comprises a first set of engine decarbonization units located at a first decarbonization facility, and a second set of engine decarbonization units located at a second decarbonization facility that is geographically distinct from the first engine decarbonization facility.

33. The system of claim 32, wherein the system further comprises:

a first network gateway corresponding to the first decarbonization facility and configured for communication with the first set of engine decarbonization units and the remote engine decarbonization management system; and

a second network gateway corresponding to the second decarbonization facility and configured for communication with the second set of engine decarbonization units and the remote engine decarbonization management system.

34. The system of claim 32, wherein the system further comprises a database coupled to the remote engine decarbonization management system, the database storing engine decarbonization history information associated with each of the first set of engine decarbonization units and the second set of engine decarbonization units.